1 Technology-enhanced language learning environments: A rhizomatic approach

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Abstract

Theoretical models for language learning based on postmodern thinking are currently under development. These models argue for the development of learning systems which identify the process of (language) learning as a process of personal/individual meaning-making. This chapter describes progress achieved so far in one such model. This in turn forms the intellectual framework for an experimental technology-based environment designed to enable language learners to develop their meaning-making mechanisms by providing opportunities to confront, contrast and contest their understandings with examples of the foreign language at work. It intends to achieve this objective, in part, through the provision of support and help systems based on an infrastructure consisting of potentially large remote networked databases of multimedia materials showing language at work in realistic settings. The databases are complemented by systems designed to defeat the learners' perceptual systems. A proof of concept system will be described as will example applications. The strength of the system lies not only in each of its parts but particularly in the high level of connectivity between its parts: essentially a rhizomatic approach. Navigating through the system will enable learners to generate internal representations of the phenomena of the language which is being observed leading to more effective understandings of language at work.

Introduction

This chapter describes the development of a technology-enhanced foreign/second language learning framework and some aspects of its implementation. The chapter consists of three mutually referential parts which correspond to the three requirements necessary for any teaching/learning environment or structure: a guiding intellectual framework; an operational space (either physical or conceptual); and support structures and associated conceptual and physical tools.

Intellectual framework

While it is recognised that the focus of contributions in this book is necessarily on interesting *applications* of technology, the importance of the over-arching intellectual framework cannot be under-estimated.

The intellectual framework which informs this work finds its origins in the works of Petar Guberina (Guberina, 1976, 1972; Renard, 1978), a Croatian psycholinguistic and postmodern scholar *avant la lettre* who had been working on problems of perception with hearing-impaired people as well as people with normal hearing. His work in the area is based on what he called the verbo-tonal theory of perception. This theory which has tended to be overlooked or misunderstood in Anglo-American literature of applied linguistics provides us with interesting ways of thinking about perception and learning in general. Of particular interest in our context is Guberina's notion that deafness can be thought of not so much as a deficit caused by a physical defect but as ways of organising the world which are *different* from those which have been learnt by those who are not deaf. Keeping this principle in mind will enable the reader better to understand the development of the characteristics of the intellectual framework to be summarised below.

Guberina's work, while offering a crucial starting point for reflection in this and other papers (e.g. Lian & Lian, 1997) has subsequently been augmented, refined and reframed through application of the thinking of Pierre Bourdieu (1991; 1995), Jacques Derrida (1982), Anne Freadman (1994), Craig Calhoun (2000) and Ania Lian, et al. (2004).

Theoretical framework

Major characteristics of the framework used here have been established following an intellectual journey back to the basic principles not only of (language) learning, but of action in the world. Guiding the development of this process was the desire to arrive at a set of high-level coherent solutions for (language) teaching and learning, not merely a set of techniques.

In order to respond to that requirement, a question was formulated to help provide the starting-point for investigation. That question is: "How do we make sense of the world?" This is not a philosophical question such as "Why have we been put on this planet?" It is a much more concrete question with impact on every moment of our lives and it can be reformulated variously into: "What did this person say?" (for what we might call language – this will be recognised as an obvious example of attempted meaning-making) or into something common-sensically less obvious such as: "How do I not bump into other people as I walk down the street in Paris?" (sense has to be made of the situation in order to be able to go from point A to point B. If what is happening on the street is not understood and adjusted to, then moving forward will be impossible – not with safety at any rate and certainly with little popularity with passers-by). As we go about our daily activities, we are constantly engaging with complex multi-sensorial information which we relate to our internal systems. In other words, we all constantly need to generate understandings in order to be able to act at all during each and every moment and every context of our daily lives. This is part of the human condition. The act of learning is no different. In order to learn, we have to make sense of what is happening: we generate meanings. We are essentially sense-making creatures.

Other aspects of the framework

Space does not allow detailed development of the consequences of the above, but they can be summarised in the points below.

(a) Meaning is never found but constructed internally by each individual according to personal representational and logical systems which are the product of the individual's past. Ultimately, the act of understanding is always individual but shaped by the practices of society in interaction with us. It is constructed internally through a process of convergence from multi-channel experience and feedback: "A thing or idea seems meaningful only when we have several different ways to represent it - different perspectives and different associations. […] In other words, we can 'think' about it. […] So something has a "meaning" only when it has a few; if we understood something just one way, we would not understand it at all. That is why the seekers of the "real" meanings never find them." (Minsky, 1981).

(b) We perceive the world and make sense of it essentially through the filter of our personal logical and representational systems, i.e. through the "filter" of our past (Bourdieu, 1995, p. 60). Paradoxically, these systems both help us to make sense of the world and limit our range of understandings. We never perceive the world directly (be it the perception of an individual sound or that of a complex human interaction). All we can ever access are perceptions and inferred meanings and, at a profound level, each individual's perceptions and meanings will be different from everyone else's though shaped by society as it interacts with us.

(c) To learn implies an act of comprehension which challenges the learner's personal representational and logical systems i.e. which challenges their past. Learning is an act which brings into the learner's logical and representational systems that which had previously been excluded (unconsciously) by them. In a sense, it is an act of violence (in the sense of violating the regularities inferred by the individual on the basis of the past).

(d) The act of comprehension can be thought of as an act requiring individuals to confront, contrast and contest their understandings and beliefs against the complexity of events unfolding around them, be they linguistic or non-linguistic events (Lian, 2000).

(e) It is arguable that all of life is systematic and that all systems, however seemingly remote from one another, appear to be intertwined and mutually reinforcing. In our context, this applies particularly, but not exclusively, to semiotic systems. The thing to which we commonly refer in a common sense way as "language" is just one of the many intertwined systems that we need to manage and there is no doubt of its intertwining with others. An interesting example is the case of grammar and intonation. When grammar breaks down, the brain actually generates its own intonation patterns in order to compensate for the deficit (Herrmann, 2003).

(f) A corollary to the above is that even if "language" were to be the primary focus, then the learning of "language" cannot be *only* about the learning of "language". It necessarily involves other systems which must be made to work in synchrony with "language": "we would say that any language developed by human society can be learned by the members of another human society, and that this learning is possible both because of the redundancy, which provides for a whole range of individual differences in sensory modalities, memory and intelligence, and because language has been conceptualised the world over as a part of culture that can be learned by members of different cultures" (Mead cited in Birdwhistell, 1970, p. 108). If systems do not work in synchrony, then there is a risk that they

will act antagonistically in the learning process. From a learning perspective, two conclusions can be drawn from this.

a. Non "language" systems can act as good entry points to the learning of "language".
b. The learning experience needs to be complexified rather than simplified. This means that natural language in action should not be presented, in the first instance, stripped from its links with other systems. Learning needs to begin with authentic language in authentic contexts and then be subjected to a process of investigation by the learner through the use of appropriate tools and feedback mechanisms. Some of these processes may include but will not be limited to simplification or explanation or supported observation of language acts in different contexts. All of these will help to enhance the potential by learners to make sense of what they are observing. These remarks argue strongly for the use of authentic materials in language learning at every stage of the process provided an appropriate environment and support structures are set in place.

(g) Following the above arguments, it becomes clear that what language-teachers are teaching and what language learners believe are learning is not (only) the thing that linguists call "language". There are many other things that are learned and taught in high proficiency language learning but not always categorized or understood. Learners often need to know, and often work with, the unknown, the invisible, the uncategorized, the unpredicted and the unpredictable. Learning systems need to be constructed in such a way that these unknowns can be taken account of and incorporated in the learning process albeit they remain unknown/invisible.
(h) Humans are physiological beings with limits imposed on them by their bodies though great plasticity also exists.

To summarise the main points so far: "Our objective is to create facilities which make it possible for different perspectives to collide and for the participants to explore forms of legitimation in terms of which they construct and enact reality". (Lian, A. B., 2003). To be consistent with this statement, (language) learning systems need to create opportunities for collisions between individuals' internal systems of understanding and rich language activities. Consequence of this are:

(a) Learners' needs, predicted, unpredicted (and unpredictable) will be made visible. These needs result from the attempts of individuals (and their individual histories) to cope with the tasks at hand.
(b) Because needs are unpredicted, unpredictable, involving infinite combinations of mutually reinforcing modalities and thus very likely to be different from one learner to the other, it is not logically possible to offer a sequenced (or externally scaffolded) intervention strategy capable of simultaneously meeting the needs of all. Entry points to solving individual problems are likely to be different from person to person.

This means that the notion of a tree-like structure for determining a learner's path through a learning system is not optimal. A more interesting approach would be to try and create a learning system based on the notion of the

rhizome i.e. a set of conditions which allows for multiple, non-hierarchical entry and exit points in data representation and interpretation (Deleuze & Guattari, 1987, pp. 6-7). This is the very antithesis of a tree structure. A rhizomatic structure can be thought of as a structure which contains components where each and every component is connected to each and every other component of the (living and potentially infinite) structure. In a learning structure it means that learners are able to connect from any activity or information point to any other activity or information point according to perceived need. A rhizomatic structure should not be thought of as chaotic but rather as a self-regulating structure responsive to the learners' needs as determined by the mechanisms in place (human or otherwise) for determining such needs. The rhizome is a critical feature of the language learning system to be described.

The essentially postmodern views that underpin the statements made above cohere well with the following summary of the intellectual position adopted in this paper: "Postmodernist insights require a major shift in our conception of inquiry. No longer should we see ourselves as seeking to uncover a pre-existing reality; rather, we are involved in an interactive process of knowledge *creation*. We are developing a "working understanding of reality and life, one which suits our purposes" (Beck, 1993, Inquiry section, para 1).

Activity Space

The above discussion has identified the general characteristics of desirable language learning environments. The next section will sketch out some environments which have been developed within the above framework and which have shown success.
All the environments share the following characteristics:

(a) They create spaces for collisions to occur between learners' logical and representational systems by requiring them to engage in complex real-life (or at least realistic) tasks with genuine communicative stakes.
(b) These tasks necessarily require learners to access, understand and possibly reproduce or replicate, parody or otherwise demonstrate an understanding of observed language events. In so doing, they will be exposed to a broad range of problems which they will need to solve in order to make the necessary progress and complete the tasks.
(c) The nature of the environments is such that learners of most, if not all, proficiency levels are able to learn personally relevant information and processes and make appropriate contributions.
(d) All environments have support structures available to guide learners through individual problems and needs as required. At the most rudimentary level, this support will take the shape of an "all-knowing" teacher or adviser. In more developed systems, there will be contact with the relevant linguistic community as well as audiovisual and software support. The more developed the system the more problems can be solved simultaneously for the group as a whole and the more efficient and effective the system.

Experiments have been conducted in recent and not so recent times within this framework. All have shown good results but all have also suffered from a lack of sufficient resources for self-managed work. Two environments will be summarised below. Others can be found in Ania Lian et al. (2004).

The first environment to be described involved students of French at the University of Queensland, Brisbane, Australia, in a macrosimulation revolving around the creation of a French village (Mestre & Lian, 1985). This was a long-term simulation where participants were required literally to create a village in France, build houses and other buildings, generate local institutions and ways of life. They were required to select personae, to determine their characters and to act out their roles for a whole semester. After a while, they developed a sense of their own history in the simulation and their personal stakes changed: they were no longer just doing an exercise, their "self" was at risk. Their activities were videotaped and time was set aside for observations and analysis of their performances by teachers and other students. Support was available from the teachers in the program and a few native speakers. Available resources included a small selection of books, dictionaries, videocassettes and audiotapes. Resources available nowadays, some twenty years later, can significantly enrich the learning experience.

The second environment involved a group of Master and Doctoral level students in TESOL and foreign language teaching at the University of Canberra, Australia. Their task was to create a radio program for the local community radio station. In order to achieve this and to do so on schedule, they had to wrestle with the realities of a radio station, to understand how radio programs work on community radio, to learn the various discursive genres associated with the undertaking and to act out the roles which they had selected in ways which were acceptable to the local community. Feedback from the community indicated that they achieved significant success despite limited resources and difficulty in accessing them. Like the French students, though, they did develop a sense of their own history within their task.

These environments all provide spaces where collisions can occur between learners' logical and representational systems and the world. While standard textbook and exercise-driven teaching structures may be able to do some of that to a limited extent, they are unlikely to provide a level of complexity sufficient to enable learners to "confront, contrast and contest their understandings and beliefs against the complexity of events which are unfolding around them" . In other words, exercise-driven approaches are too "low-level" though they are useful in some of the focused activities which are required from time to time.

Software Tools

While the learning spaces referred to above were successful, they all suffered from a lack of resources capable of meeting the individual needs of learners as and when they were required. The tools now to be described represent an attempt to deal with that problem. While these tools all fit within the intellectual structure described earlier and are motivated by it, they can be incorporated into more traditional contexts and will continue to provide the benefits which they were designed to produce.

General characteristics

The tools all share the following general features:

(a) From a technical perspective, they are all part of an open-ended set of local and distributed computer programs and other support systems. While the tools are modular for maximum flexibility, portability and individual use, they are all related to one another and can all connect to one another. Connectivity provides additional functionality as opposed to the stand-alone versions.
(b) They all have a strong focus on increasing understanding, awareness-raising and critical analytical thinking by giving learners the opportunity to test out their various hypotheses. All tools provide learners with opportunities to confront, contrast and contest their understandings against observed language phenomena through the feedback provided.
(c) They all provide on-demand access to information.
(d) They all provide a way of questioning the system and the data by making selections, by clicking on words/phrases or on a button. In some cases, the information requested may be tailored to respond to the learners' perceived needs. In other instances, the learners themselves can generate specific lessons on specific points of interest.
(e) They all place learners in control of their activities and encourage learner autonomy.
(f) They all incorporate the ability to allow learners not only to retrieve but to produce language in one form or another and to help them develop self-awareness.
(g) Where appropriate, many of the programs contain automatic feedback systems such as answer markup procedures (to identify incorrect parts of learners' written answers) and/or awareness and self-awareness tools such as visual displays of intonation and automatic low-pass filtering of students' answers to facilitate auditory comparisons between the "native-speaker" production and the learners' productions. They also incorporate enhanced standard language laboratory comparison functions.
(h) All programs incorporate load-reduction mechanisms to the extent that it is possible/desirable and, in some cases, *over*loading mechanisms to enable students to practice processing language under greater pressure than would otherwise be the case.
(i) Most importantly, they are all able to connect to Web-based database management systems. This provides a high level of "at-will" connectivity between the programs, teaching resources, communication and the general Internet if necessary. These databases are at the heart of the system and enables pointers to be set to appropriate resources, exercises, analysis and self-analysis tools and other systems. The databases enable the system to function rhizomatically. There are no fixed entry or exit points. Learners access the system according to the demands which they happen to be facing at any particular time. For instance, they may want to develop their listening skills. In that case, they may choose to access a listening comprehension program. On the other hand they may want some information about laws relating to the renting of an apartment in Paris. They could question the databases for information and would then be pointed to appropriate resources. Where they move onto next is totally open to conjecture and would depend on a number of unknown/unknowable factors.

By observing interactions, asking questions, generating custom-made exercises, obtaining automatic feedback, processing text under reduced or increased load conditions, developing self-awareness and linking across many sources of information all at a time and place of their choosing, means that the likelihood of learners' needs being met is higher than

would otherwise be the case. While this is true in today's mass market of language learning, it is also true in a 1-teacher:1-learner model (often intuitively touted as the ideal). The truth is that no single teacher can possibly know everything that there is to know nor could that teacher provide instantaneous access to the myriad of authentic multimedia documents required, let alone the load-lightening and feedback procedures available only through electronic means. Significantly too, these systems also necessarily promote autonomy as the learners go about their tasks, thus enhancing their research skills and their ability to learn how to learn.

The Database

Web-based databases of multimedia documents are at the centre of the learning environment. The taxonomy used to organise the data was developed some years ago by Lian, A. B. (1996) in the context of the *MMBase* database (Lian & Lian, 1994) and was subsequently augmented to reflect growing interest in relating gesture to speech. Examples of categories include functions, notions, grammar, contexts and power relationships between interlocutors. The categories also include intonation classifiers and gestural classifiers. Very importantly, the database provides links and pointers within each document to the micro and macro contexts of the language activity of interest. The system can also provide links to a multitude of other documents - which may reside at remote locations (perhaps in another part of the world).

Learners can interrogate the database directly or it can be accessed by other programs. This combination of features provides the infrastructure for a properly rhizomatic learning structure, offering a very large number of possible entry and exit points.

As an example, let us imagine that a learner wishes to inquire about the workings of "yes-no" questions in French. The learner queries the system according to criteria he/she has selected (e.g. a yes-no question within the context of a greeting) and has a list of instances of yes-no questions returned. The learner examines instances of interest by viewing (and of course listening to) extracts from multimedia documents (perhaps a series of movies) which are relevant. They observe the contexts of language use and reflect on the ways these yes-no questions operate. They then identify and compare further instances of such questions drawn from the same movie as, for reasons best known to themselves, they have now decided to compare the ways in which a specific movie treats these questions. They then decide to expand their search beyond the context of greetings. Their curiosity triggered by what they have seen and heard, they decide to view the entire movie from which the questions are extracted. As they view the movie, they stop to check their comprehension of the particular events unfolding before them and, at the same time, sharpen their understandings of communication in French. After these enriching experiences, they return to their original point of departure and ask the computer system to generate a series of focused lessons for which they themselves have set the parameters. Finally, they return to whatever original task had triggered their interest in the first place.

The above example clearly illustrates the rhizomatic nature of the experience. An arbitrary (relevant to the learner) entry point was selected. It happened to be a grammatical structure but it could have been a function (e.g. a greeting) or a genre (e.g. an advertisement), a gesture or a facial expression (e.g. raised eyebrows). The learner then went on a serendipitous adventure which was supported at every step of the way by lessons and other forms of learning infrastructure capable of establishing a form of dialogic inquiry between

learner and text. The path selected was in no way predetermined and was made possible only because of the connectivity provided by the database system and, of course, the speed of retrieval.

At every step of the way, plentiful opportunity was provided for collisions to occur between what learners knew (their personal histories/perceptions/internal logical and representational systems) and what they were encountering as the support systems were constructed to facilitate such collisions (for some examples see below). In their data-surfing, learners would have encountered and dealt with not only what they expected to find or, indeed, what the support systems had identified as valuable, but also unpredicted and unpredictable instances of communicative phenomena at work which the very act of comparing across contexts would have brought to their attention and possibly clarified for them at a personal level.

The description of activities just provided is not fanciful. All programs referred to have already been developed in proof-of-concept mode over the space of several years and now need to be integrated. That integration has already begun as will be illustrated by brief overviews of three programs: *MMExplore*, *Dialgen* and *MMGen*.

MMExplore

MMExplore (Lian, Lian & Puakpong, 2003) is a refinement of its predecessor *MMBrowse* (Lian & Lian, 1995). It is a system designed to enable the exploration of authentic text in a variety of ways with special emphasis on the development of listening skills. It enables learners to discover, observe and reflect on the meanings of individual texts while varying the processing load.

In order to achieve this, the program offers learners a written transcript of the passage where each letter in every word has been replaced with an asterisk (*). The learners' task is to discover the words underneath the asterisks and recreate the text. In so doing, they will gain an understanding of the passage, come to grips with the features of the text and engage in many discoveries and develop self-awareness along the way.

Load-lightening is built into all aspects of the program's operation. For instance, learners have the ability to view or listen to any arbitrarily-selected portion of text in a variety of modes: full audiovisual, audio only or video only (with further modifications as indicated below). In support of their "raw" viewing/listening they are given further help through the "starred" transcript and other inferencing and guessing exercises, explanations and glosses. These explanations and glosses are available automatically in response to learners' interactions with the system but they can also be provided on demand. Learners click on words or chunks of language in a variety of ways and receive different forms of feedback either from the program itself or from a remote database.

Further load-lightening of "raw" multimedia information is provided through electronic low-pass digital filtering of speech to highlight intonation patterns, as well as forward and backward build-up of speech in order to bring out previously undetected features of the spoken language. Underloading and overloading is provided through the use of distortion-free electronically slowed-down, accelerated or "noisy" language. Built into the system is a sophisticated answer-evaluation system (based on Lian, 1984) which, by virtue of the nature of its feedback is able to help learners to modify their perceptions and develop new understandings of how communication works. It also enables learners to record their voice

and compare it immediately with that of the text being studied thus providing enhanced language laboratory functionality with the added advantage of being able to use any authentic text selected for inclusion in the system.

Additional functionality is to be provided through the inclusion of visual support through the display of intonation curves for both the native-speaker model and the learner's own productions. The ability to enhance learners' judgements in relation to their own pronunciation will be provided in due course through the addition of real-time low-pass filtering for learner productions.

Not all functions are made available at all times as the system adopts a problem-solving approach where learners need first to grapple with difficulties rather than be provided with the relief of "the correct answer". Finally, *MMExplore* lends itself to a multitude of activities, including the analysis of gesture. Crucially though, *MMExplore* is only one of the open-ended set of modules which can be linked to the database which, in turn, provides both the information displayed to learners and the ability to connect to other sources of information.

Together, these support structures will ultimately lead not only to an awareness of communication at work but also to the development of enhanced self-awareness. Further, users of this program are catering to their own needs, motivations or preferences in ways which would simply be impossible in a regimented/text-controlled lock-stepped environment.

It is worth remembering though that while the program is useful of itself, its value increases considerably because of its connectivity features.

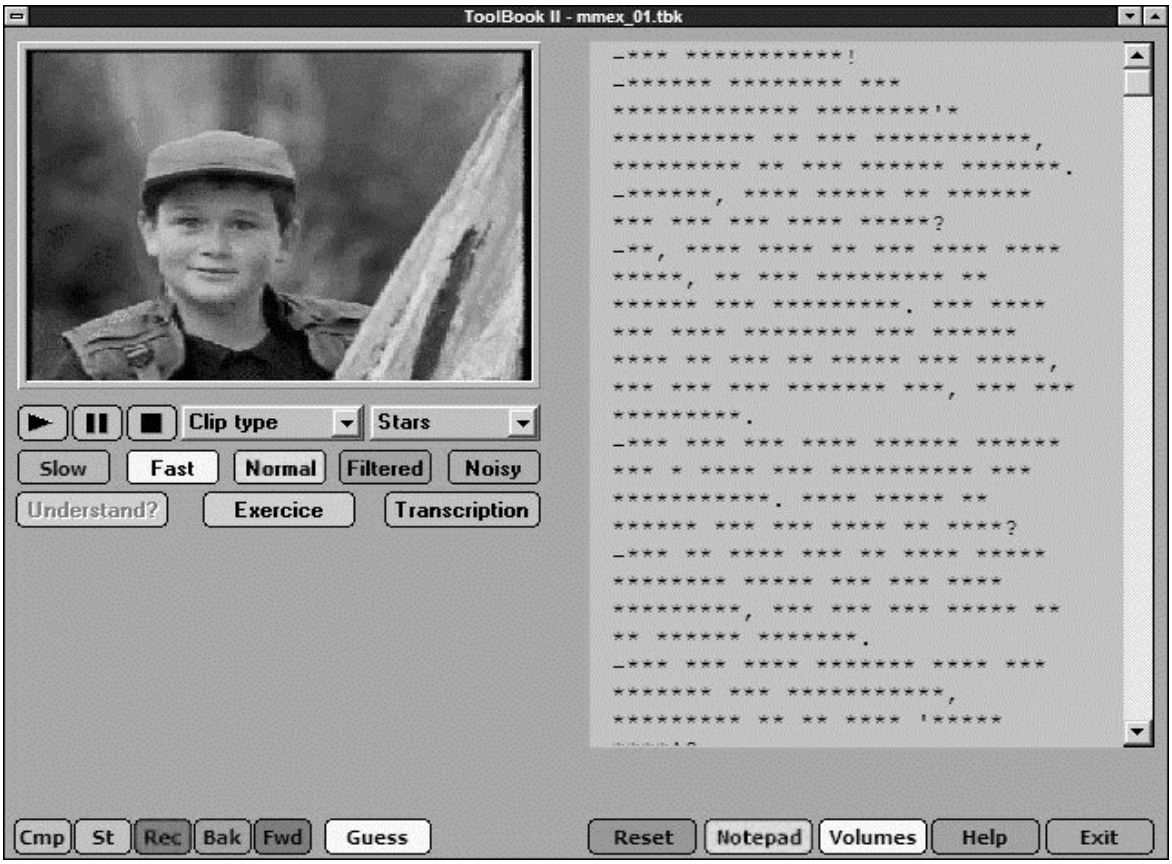

Figure 1 MMExplore screen layout

The descriptions of other programs which now follow are much briefer as they all contain more or less the same kinds of features described above. Descriptions will now focus on differences between programs. Further, the screen displays will be more or less self-explanatory if the general features described in this paper are kept in mind.

Dialgen: A dialogue generator and dialogue practice system

Dialgen is a system designed to provide opportunities for speaking practice (Lian & Joy, 1983; Lian, 1994). It consists of a program which generates authentic-like dialogues which learners can then listen to in part or in whole. They can observe and question on a word-by-word, chunk-by-chunk or sentence-by-sentence basis. Perceptual support is provided by way of low-pass filtering as well as language-laboratory functionality. A self-awareness feature enables learners to record their voices and to listen to themselves as if they were one of the participants in the dialogue being studied. A simulation mode provides a timing constraint that learners need to adapt to. In this mode, learners "participate" in the conversation by adopting a role and by being given turns by the program during which they should speak. Each turn is timed and learners have to learn to comply with the rhythms of natural conversations. This is a way of letting the rhythms of speech write themselves on learners in a way which is psychologically safe but also enforces the demands of real life. While, in the first instance, this will almost certainly overload learners, it provides a worthwhile and interesting challenge and learners have been observed to adapt well to the procedure. Again, this program has links to a central database and can either act as a starting point in the rhizomatic sequence or as one of the many possible stops along the learning sequence.

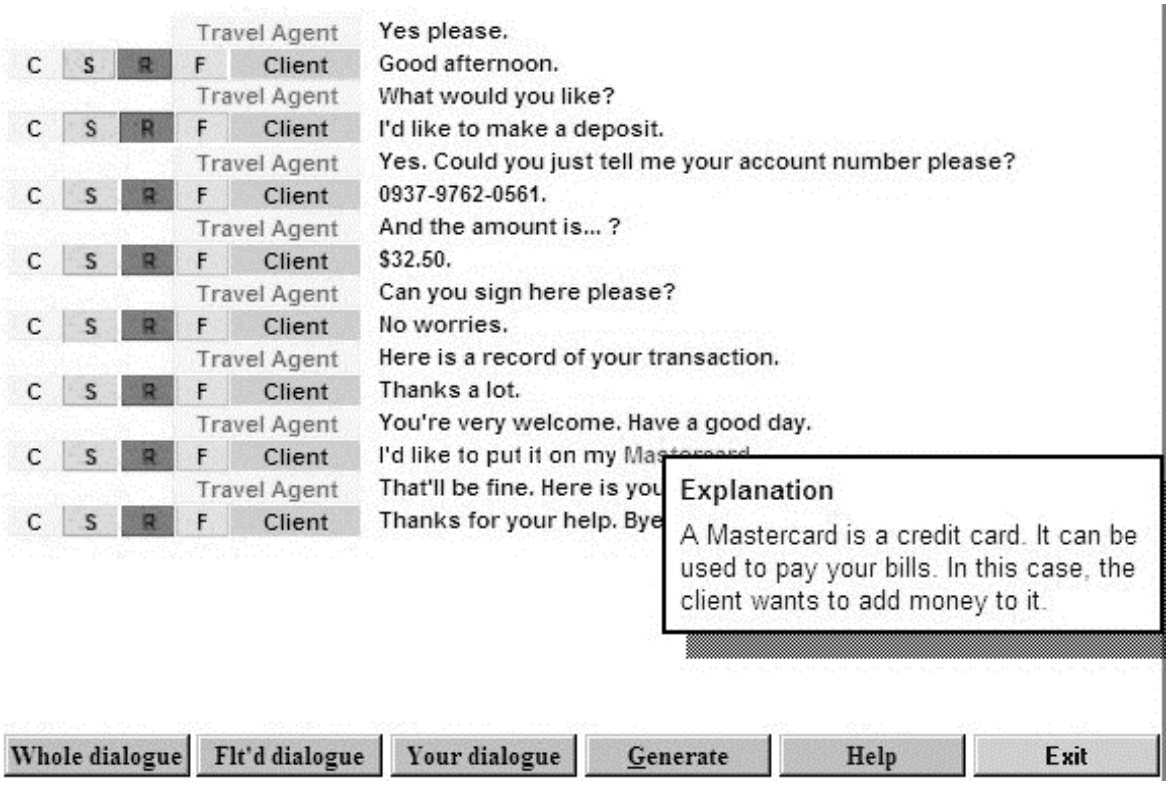

Figure 2 Dialgen screen layout

MMGen: A lesson generator

An interesting possibility which a database-managed approach offers is that of learners themselves generating their own lessons. This is what *MMGen* helps to achieve. In the example below, learners are investigating how questions work in French. The display shows questions extracted from a French television game show. Where this program differs from other programs described is that before reaching the stage of actually doing the exercises, learners go through a process of selection of the patterns that they wish to study by interrogating the intonation database, examining the descriptions and characteristics of each intonation pattern and then requesting the system to generate the lesson from a series of built-in templates. The result is shown below. The program maintains its connectivity to the database so as to provide additional information and navigation capabilities. Again, close examination of the screen display below will reveal some of the features of the program not discussed here in detail.

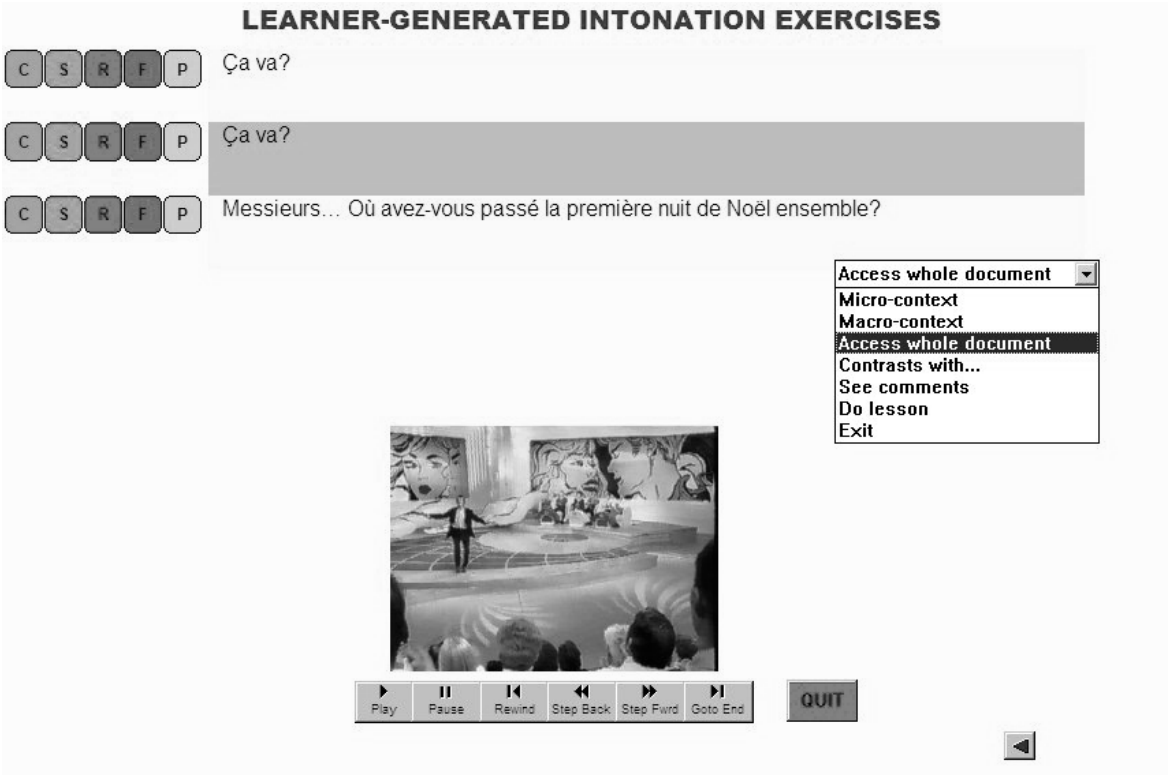

Figure 3 MMGen screen layout

The list of programs described above is by no means complete, nor can the list ever be closed off. Systems like these are fundamentally open-ended and limited only by the technology available at any particular time and, of course, our imagination. As connectivity increases as a result of better and faster networks, the ability to add extra modules with relatively little effort will enable the system to grow in functionality.

Conclusion

Systems like the one described in this paper provide a level of learner support which will become increasingly necessary in a rapidly globalising world where the future of language teaching and learning is in a mass market rather than an elite market. Language learning is likely to be the biggest educational business ever as all citizens will need to know a language other than their own. This is particularly important for the learning of English which is clearly sweeping the world. Many continue striving to achieve some level of communicative proficiency in English. In that context, the language teaching profession and the learning systems which it develops will need to be able to deal with the demands of these new conditions while still remaining true to the requirements of properly conceptualised and responsive teaching and learning approaches.

This chapter has sought to respond to some of the above concerns by introducing an intellectual framework for language teaching based on a postmodern view of the act of learning. This framework then provided the basis for a principled approach to the

development of learning environments. A description of such environments was then offered and suggestions were made as to how appropriate individualised technology-enhanced support could be provided.

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