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► To cite this version:

Michel Labour, Sylvie Leleu-Merviel. Tagging the interactive quality of Learning Objects in CALL: the role of metadata in assessing multimedia for educational purposes. SCI 2000, 4th World Multi-conference on Systemics, Cybernetics and Informatics, Jul 2000, Orlando, United States. pp.456-461. hal-03683713

HAL Id: hal-03683713

<https://hal.science/hal-03683713>

Submitted on 31 May 2022

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Tagging the interactive quality of Learning Objects in CALL : The role of metadata in assessing multimedia for educational purposes.

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Abstract

The efficiency of Computer Aided Language Learning (CALL) lies not only in its basic technical and pedagogical excellence but also in its ready accessibility to end-users. At present, however, many learners and teachers invariably find themselves overwhelmed by the complexities of multimedia products. What is needed is a system of tagging to help users choose appropriate learning material with a minimum of time and effort. Our paper attempts to do this by adopting an interdisciplinary approach in examining the role of metadata when it comes to classifying certain types of interpersonal and document-based interactivity in a computer-supported Tutoring System. This is done by proposing five broad categories of interactivity for which each is defined in terms of different sub-types.

Key words: multimedia, interactivity, CALL, metadata, tagging, document

1. Introduction

One of the stumbling blocks of the New Technologies of Information and Communication is their apparent over-complexity that dissuades learners and teachers from having a real say in what has been, and is being, developed for them. This arises from the premise that a Tutoring System should take into account different ways of learning and helping learners to choose the best way to attain their objectives. This premise rests on the assumption that users understand the system enough to make appropriate choices. However, if there is no appropriate conceptual and practical access to Learning Objects (LOs¹) it is nigh impossible for users to utilise and to offer constructive feedback of their needs and wants in optimising the Tutoring System.

As the number of (learning) objects continues to grow exponentially and especially as our needs for learning expand equally dramatically, the lack of information or metadata about objects has produced a critical and fundamental constraint on our ability to discover, manage and use (learning) objects (Learning Technology Standards Committee. *Learning Object Metadata. Working Draft Document 3, 1999-11-27*).

In this context, Littlejohn (1998, page 205) speaks of the necessity of closely examining pedagogic materials so that learners and teachers can see "inside" them to take more control of their design and use. Indeed, descriptions of digital LOs in language learning that do exist, invariably, tend to focus on the more "passive" elements of the product (how many hours of video, linguistic level, technical shortcomings, etc.). Little is said, for example, of the degree of interactivity that the product offers, and even less about the different types of interactivity available or how these features are made known to potential users.

Based on the work of an interdisciplinary team at the University of Valenciennes (France) we will attempt to clarify this issue by proposing a system of classification with five different types of interactivity in computer-supported Tutoring Systems. Without claiming that our classification is exhaustive, our aim is to propose a framework of analysis to facilitate dialogue between users and creators in Computer Assisted Language Learning (CALL). In so doing, this study falls into the ambit of work in progress of organisations such as the Instructional Management System project of EduCause and the Learning Technology Standards Committee (see References below).

In this paper, our classification limits itself to a descriptive analysis of different types of interactivity, rather than an examination of the impact of technology on learners. The main objective of our typology is to facilitate the identification of various interactive elements by using metadata in a way that learners can make more informed decisions about the learning content and the way to learn it.

To do this, we will propose five broad categories of interactivity. We will start by briefly looking at the issue of tagging, followed by an *interpersonal theory of learning* which underlies our system of classification. After this, a second category of classification is presented involving ways that learner output is evaluated as evidence of *cognitive interactivity*. Then follows a three-part analysis using a *scenistic* approach to classify interactive features provided by the scenario. To illustrate the practical use of this classification three examples of multimedia products will be given. Finally, some implications for designing and developing CALL are proposed.

2. Tagging

The dilemma that tagging² LOs present is twofold. First, where does one draw the line regarding the level of detail that needs to be indicated regarding LOs *i.e.* a narrow, detailed or general, open-ended description? If the functional level of semantic content tagging is not appropriate, the degree of reusability of LOs could be severely limited. Second, should the vocabulary of these tags be fixed or

¹ *i.e.* "any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning." (*Learning Technology Standards Committee*)

² In this context, a "tag" consists of the name of domain (*e.g.* Year) and the particular value attached to the name/label (*e.g.* 1997).

essentially open-ended? On the one hand, a fixed vocabulary increases its interoperability. But on the other hand, too dense and rigid a vocabulary may limit its accessibility in terms of the different needs of authors, designers and users.

In attempting to answer these questions, we will look at tagging for “educational³” use, notably that which concerns and not limit itself to the flow of data between the user and LOs. It also includes the flow of data between the user and people-resources *via* the Tutoring System. In so doing, we hope to demonstrate the necessity of having a fixed vocabulary in that it offers a common reference point to facilitate dialogue between users and experts.

3. An interpersonal theory of learning

Based on his experimental work, Vygotsky (1934/1962, pages 101-104,116) showed that learner interaction with active external pedagogic agents, like teachers, can directly shape and transform the mental development of learners. For Vygotsky (1934/1962, page 8) effective learning necessarily involves mediators like teachers and various socially constructed (conceptual and mechanical) tools. In this sense the role of teachers and mentors is to provide a guiding hand at certain “critical” moments in the learning process (cf. the “zone of proximal development⁴”). One of the key elements in this process is the way language, as a pivotal conceptual tool, is learnt by the individual through interpersonal experiences (Vygotsky 1934/1962, page 137). This exchange implies some form of interactivity in such a way that learners need to adapt to the teaching/learning resources, just as these resources (teacher, a pedagogic tool) need to take into account the individual’s learning process, notably the person’s “zone of proximal development”. In this way both learners and learning sources (real or virtual) act on each other. While the classical vygotskian approach tends to emphasise more “vertical collaboration” between mentor and learner, a more recent approach includes “horizontal collaboration” in language learning via peer learning/teaching (Legutke and Thomas 1991, pages 276-279) without negating the place of the designated mentor.

This theory of learning, notably the need for learner accompaniment, implies different types of interchange and collaboration to facilitate the learning process. These various interchanges are not mutually exclusive and can be complementary facets of the pedagogic environment.

Type 0: No help is given to the user (presumably because the target user is not expected to “need” it)

Type 1: Built-in help - The designer anticipates the user’s questions and integrates the solutions within the product itself based on interactions between the user and the machine. This help mode represents contact with a tutor *in absentia*. It can take the form of pre-established glossaries and a dictionary. In this way, the learner is limited to the product designer’s choice of questions and solutions. Normally, it is up to users to find out how and when to best use these “help” features. In her book on CALL, Demazière (1986, pages 503-507) provides practical guidelines in how to optimise this function.

Type 2: Peer contact - This can facilitate learning by (horizontal) collaborative and co-operative activities in which the externalising of ideas and feelings helps learners to discover alternative ways of satisfying their learning needs. For instance learning a language *via* email partnerships where learners with different native languages: exchange information, suggest corrections to each other’s target language and ask for clarification about various elements of the target culture (Labour 1999). One advantage of this system is the possibility of self-management, especially among more autonomous learners.

Type 3: Reactive contact - It is up to the learner to take the initiative to contact the tutor (learner-led vertical collaboration). Access to the tutor can be on-line, by email, in a chat room, or off-line. The learner must not only be aware of having a question to ask, but must also want to make the effort to find a solution with the help of someone with greater expertise. However, from a language learning point of view, a certain level of tolerance of ambiguity and incompleteness of knowledge is sometimes needed (Naiman *et al* 1978). This implies that learners need to know when a question is conducive to achieving their objectives and when it is not. Not to do this, may lead learners either not to ask any questions or to ask so many questions that they become side tracked from their initial learning objectives.

Type 4: Proactive contact - This type of interchange already exists in the traditional audio language laboratory where the teacher can take the initiative to intervene at the appropriate moment while the student is at work (tutor-led vertical collaboration). To do this, however, the tutor must first observe (“listen in” to) the learner at work and then step in at the right moment to encourage or to suggest corrections. While the approach may reassure some learners that they have not been left to their own devices, others may see this proactive intervention as tutor intrusion.

Having completed this first category of classification (see figure 3 below) it would now be useful to look at how one can assess the role of CALL from a more “cognitive” perspective.

4. Feedback on learner output

One of the aims of evaluating learner output is to assess the effectiveness of certain types of probable cognitive interactivity. In this sense, cognitive interactivity involves mental activity to do with data acquisition, storage, retrieval and use in a given context with which it interacts, as well as (reflexive) interactions with itself. In terms of learning, this implies that, on the one hand, learners can be encouraged to monitor the efficiency of their mental processes in achieving set goals (result-oriented metacognition). On the other hand, learners can be helped to be aware of their cognitive “tendencies” (*e.g.* use of memory, problem solving tactics) of processing new and

³ This is one of the items cited by the *Learning Technology Standards Committee* along with other tags such as: LifeCycle, MetaMetaData, Annotation, *etc.*

⁴ Vygotsky (1934/1962 pages 14,59,85,94,104) emphasises that pedagogic interaction is only effective if the learner is cognitively ready to accommodate new data. In terms of cognitive development, the “zone of proximal development” represents an area of possible growth in a given time span. When learners are in this zone, the tutor can, with careful accompaniment, help them overcome their difficulties. This accompaniment can include an approach that, for example, progressively up-scales (scaffolding) the learner’s role within a task until the person overcomes the obstacles unassisted. Once learners accomplish the task without the guidance of someone with greater expertise, it can then be concluded that significant learning has taken place.

old data (process-oriented metacognition). In light of this, a classification is proposed in evaluating output as a probable sign of significant cognitive interactivity.

Type 0: Read/listen - The learner receives the data but there is no associated activity to ensure that data have been successfully processed.

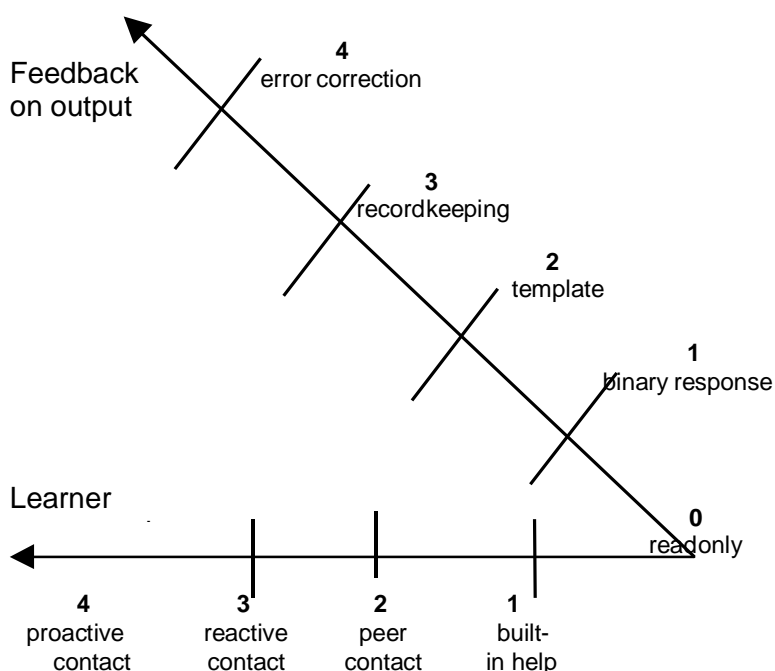
Type 1: Binary feedback - Each item of learner output (e.g. filling in blanks) is evaluated by a right or wrong response. No other comment or help is given to the learner.

Type 2: Template – This involves a more global process of comparing the learner’s answer with that of the tutor’s. For example learners can record their voices and compare it with a model (template). This can be done by voice recognition functions or oscillograms (to compare the learner’s voice with that of the model) for oral expression, or by making available model answers to written work. Different variations of the template can be proposed in terms of the learner’s needs.

Type 3: Record keeping - A global score is given for work done. This allows learners to have an idea of their rate of progress. This function can also include record keeping of work done, and that which needs to be done, i.e. an (automatic or semi-automatic) electronic logbook.

Type 4: Error correction - This involves giving learners a personalised and relatively detailed response to their errors. Each error has a different type of response to make the learner aware of why the mistake was probably made. This type of feedback tends to encourage process-oriented metareflection (see Demaizière 1986, pages 478-503).

Figure 1 below presents interactivity linked to learner accompaniment and feedback on output.



We have seen how the concepts of interpersonal and significant cognitive interactivity can be operationalised, the challenge, however, is not simply in making these resources available in a haphazard way, but as part of a coherent whole, that is to say *when a learning resource is most likely to be useful to the learner*. It may be that different activities are of high technical excellence but lack the necessary overall interconnections to facilitate appropriate learning. Knowing that a learning tool has different pedagogic features, like voice recognition or a wave form oscillogram does not tell us how they are linked to other learning activities. Not to look at the overall coherence of the system, may lead to cognitive overload or to other forms of dysfunctions such as learners losing sight of their priorities. One way that these learning resources can be co-ordinated to facilitate the learning process is by a carefully designed interactive scenario. In the discussion that follows, the role of the scenario will be examined in some detail.

Figure 1. Feedback on output and learner accompaniment

5. Role of the scenario

In an extensive study into designing effective multimedia texts, Leleu-Merviel (1996) proposes a “scenistic” analysis concerning the interactive quality of the scenario in determining what information is given to the user and the way this is done. In this context, a “scenario” is defined as a deliberately thought-out text that has: a story line, technical details, the author’s intention, a target audience, and a message. From this point of view, the concept of “interactivity” implies a scenario which anticipates the various responses of the user that are oriented in a particular direction by a “scenational schema”, or a series of pre-planned events/states linked together by different paths for the user to take. In this way with each interactive session the user can follow a different path. Thus when evaluating the “interactive” quality of CALL it is important to closely examine the choices the Tutoring System gives to the learner. In this context, Laubin, Durand and Leleu-Merviel (1999) propose a classification based along three axes:

- the interactive nature of the scenario,
- the generative nature of the data,
- the evolvibility of information units.

Before examining these categories more closely, it is important to underline that a product is never situated purely on one level. It may have different predominant features, but depending on the needs of the learning context other features may exist that can be classified into different categories. This, as we shall see below, is the case of three language learning cd-roms chosen for evaluation.

6. The interactive nature of the scenario

Type 0: Linear non-interruptible / audio-vision (*e.g.* cinema) - The system works independently of the reactions of the user (sit back and enjoy). While there is no direct interactivity with the user, there may be concomitant cognitive, emotional or social interaction.

Type 1: Linear interruptible / reading (*e.g.* video recorder, book) - Users can stop the text, skip sections and carry on as they please, or sometimes go back to reread the text. Essentially, however, the text remains linear and users have limited control in the way the content is presented.

Type 2: Menu-based navigation (*e.g.* arborescent database) - The navigation is done by a series of limited choices offered by a predetermined menu. The arborescent structure of the navigation offers little possibility for undoing the choice (unidirectional navigation), except if a previous choice has been “copied and pasted” (“cloned”) in a successive phase.

Type 3: Multiple-criteria exploration (*e.g.* train time table) - Multi-criteria requests can be made, as at each step the choice is multidimensional. Users enter different criteria and then select what corresponds to their needs. In reality, it can be difficult to establish if a product is mainly type 2 or 3 as it may take too long (40-60 hours) to look at everything in the product. So one has to assess a sample of features.

Type 4: Free exploration (*e.g.* networks like the *World Wide Web*) - The exploration is less predictable. The user is not limited to predetermined paths. From a given entry point, networks of interconnected links allow the learner to create individualised paths that may not have been foreseen by the creator of the system. One can go back and forth on different paths that include segments of other greater routes. One can therefore jump in and out of different categories (help page, index page, news pages, etc.) unlike a strict arborescent route (type 2).

Type 5: Virtual visit (*e.g.* virtual/3-dimensional reality) - Users are fully immersed in a near continuous interactive universe, and choices are made by trial and error as users work their way through the system. The whole system depends on the continued action of users who act as if they are part of the same space as that of the electronic universe. In this type of 3-D space there is direct manipulation of objects without having to learn external metaphors. The quality is judged not by the richness of the “scenario” (different messages that can be sent and received) but by the quality of the “events” (data flow).

7. The generative nature of the data

The preparation of a “document” (*i.e.* an organised structure of content) involves the judicious choice of data and organising them in a given structure. It is the type of data and the way they have been organised that determines the different “scenational” modes.

Type 0: Fixed data - Choices and solutions are rigidly predetermined. There is no possibility of modifying data other than the way they were initially presented. Every time the application is used the user is exposed to the same content in exactly the same way.

Type 1: Basic automatic start-up generativity - There is an automatic, machine-generated selection of parameters *at the start* of the work session, independent of the action of the user. This feature adds a factor of initial unpredictability to the learning task. There is no way for the user to know on what basis the selection of the new data is done as the controlling variables are ensclosed in the programming codes.

Type 2: Basic user-driven start up generativity - Users decide at the start of the work session which features and parameters they wish to activate (*e.g.* level of difficulty). One has access to some of the variables used, this makes evaluation of the learners’ performance clearer than *Type 1*.

Type 3: Basic automatic dynamic generativity *during* use - The system automatically modifies the variables at the start and during the work session without the user being able to directly control the process. This can add an element of unpredictability (and realism) to the learning activities. That said, it also makes evaluation of progress more complex as it becomes much more difficult to quantify the interaction of the user with the tool.

Type 4: Basic user-driven dynamic generativity *during* use - The user can modify the parameters at the start and during the work session. The modification depends directly on the user’s choice. The interaction is easier to measure than that of type 3.

8. The evolvibility of information units

It is often the case that data do not have meaning in themselves, but depend on their semantic links with other data. It can sometimes be necessary to unclip and reclip (regroup) different data together to achieve a given objective.

Type 0: Totally integrated fusion - Information units are completely integrated/indivisible both to its context and to the fact that they are one whole, with no sub-component parts, for example a traditional-format photograph.

Type 1: Indivisible & context-bound - Information units can be organised in various ways as long as they remains in their initial-state and context. One can reassemble the information units (*e.g.* displacing the different parts of a face in a specially formatted photograph) but one *cannot break them* down any further to create new (smaller, bigger, different) information units.

Type 2: Divisible & context-bound - Information units can be broken down into sub-component parts and reorganised in a different way but only within the initial context. For example, the different elements of a web page can be selected and copied onto another web page.

Type 3: Indivisible & transportable - Information units cannot be broken down any further but can be exported to other contexts that are different to the initial one, for example from a web page to a word processor page.

Type 4: Divisible & transportable - Information units can be broken down into their component parts and transported from their original context to a different context.

The role of the scenario in encouraging interaction between the user and the learning content can be represented on a graph in the following way (figure 2).

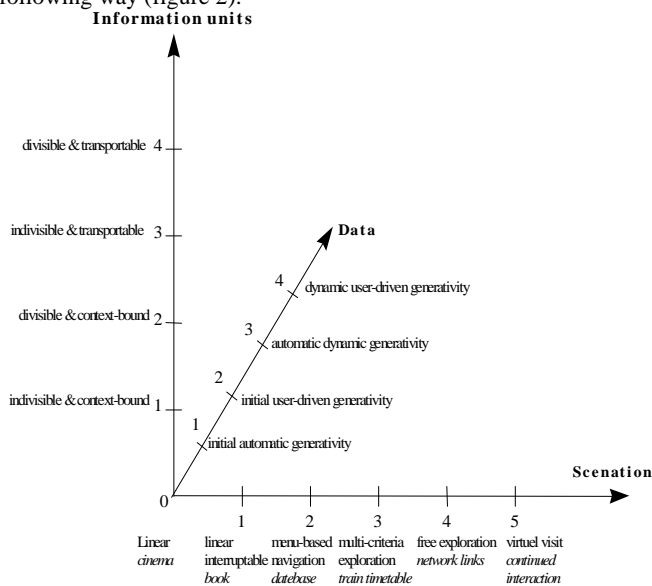


Figure 2. The degree of interactivity in a virtual environment's scenario

9. Some examples

In order to illustrate the use of this type of classification in CALL it would be useful to look at three language learning multimedia products currently used in learning English as a Foreign Language. The first cd-rom, *The Adventures of KC in London* revolves around the theft of the Crown Jewels from the Tower of London. Learning activities are based on a variety of grammar, vocabulary, comprehension, and listening skills games, with an Avatar, called KC, who tries to get the jewels back from the Alphabet Gang. The second cd-rom, *English Plus* (version 2.0) contains 9 sections: reading, writing, language, vocabulary, web links, exploration of the cd-rom, and a virtual reality "adventure" game. It is this last feature that we will be examining. Finally we will look at *Top Score* (International version) prepares students for the American *Test Of English for International Communication* (TOEIC) and one of its activities includes a 3-D Maze (vocabulary acquisition activity) which will be tagged according to our typology in Figure 3.

This type of description can be used to compare certain features of related multimedia products to help users decide which to use, or at least to be forewarned of their limits. By the same token, the description can serve as a common reference point when consulting users about this type of tutoring. Armed with these descriptors, the

researcher can also set about evaluating the impact and the efficiency of a given Tutoring System. This could be done by conducting experiments in varying the different types of "interactivity". For example, one could compare learning outcomes and learner satisfaction via a Tutoring System composed of *Scenation Type 5⁵ + Generative Data Type*

2⁶ + Information Units Type 3⁷ + Feedback on Output Type 3⁸ + Learner Accompaniment Type 1⁹ to those using a similar configuration but where one of the variables is changed, for example *Learner Accompaniment Type 3¹⁰* (rather than *Type 1*). These type of studies could help clarify key issues about what constitutes appropriate pedagogic accompaniment in terms of pedagogic content and presentation in CALL.

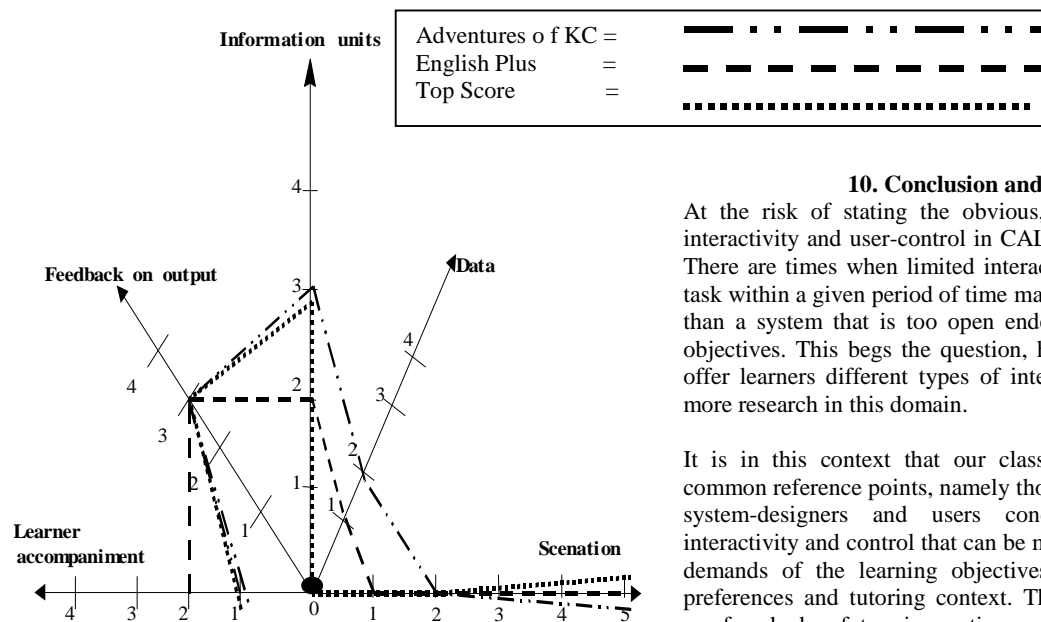


Figure 3. The interactive profile of three EFL cd-roms

10. Conclusion and implications

At the risk of stating the obvious, it must be made clear that interactivity and user-control in CALL are not ends in themselves. There are times when limited interactivity and control for a given task within a given period of time may be more useful to the learner than a system that is too open ended to satisfy specific learning objectives. This begs the question, however, of knowing when to offer learners different types of interactivity. Hence the need for more research in this domain.

It is in this context that our classification attempts to provide common reference points, namely though agreed metadata, between system-designers and users concerning different types of interactivity and control that can be made available according to the demands of the learning objectives, pedagogic content, learner preferences and tutoring context. This interchange of perspective can foreshadow future innovations.

⁵ virtual visit
⁶ initial-user driven data
⁷ indivisible and context-bound information units
⁸ record keeping feedback
⁹ built-in help
¹⁰ reactive tutor-learner accompaniment

With this in mind Tutoring Systems need to encourage learners to engage in motivating, exploratory activities that allow users to express their personality and in so doing develop more creative approaches to learning and using, in this case, English as a Foreign Language. This involves understanding the workings of the user's imagination and learning process via a scenational schema that creates semantic links between what the learner knows, wants to know, and what is not known. Ways of doing this include helping learners not only to acquire (declarative) knowledge but also how it can be used, managed and updated through a variety of tasks that encourage questioning, challenging, explaining, constructing, and tutoring.

From an educational perspective, CALL needs to more clearly define the limits of working by oneself and of interacting with others (peers, tutors) to accomplish a given task. The issue of the learning activity and context also includes practical factors like the resources available to learn, given that one of the characteristics of adult (language) learners is the need to learn "quickly and efficiently" (Labour 1998, page 155). This has direct implications in the way the Tutoring System helps learners choose appropriate pedagogic content and assesses their progress (e.g. *Evaluation of Output Type 3 or Type 4?*).

One of the challenges in designing a Tutoring System remains the judicious selection of appropriate elements in constructing the underlying model of how users interact with the system given that learners cannot be offered all they desire, if nothing else, for logistic reasons. The complexity of this task cannot be the exclusive province of any one academic discipline but that of interdisciplinary teams of researchers and designers. This is often easier said than done in that it demands a redefinition of the role of specialists from various related fields of research. For when it comes to modelling the user in a Tutoring System one faces the challenge of, for example, weighing up which of the different learners' needs and representations are to be included, or not, from the model. This raises complex issues, such as: How does one go about identifying the various needs and wants of learners in a virtual environment? Are certain needs and wants more of a hindrance than a help in achieving certain set objectives (see Labour 1998)? If so, how can one help the learner develop compensatory strategies? Is it to be done by the Tutoring System (*Generative Data Type 3*) or by learners themselves (*Generative Data Type 4*) through, for example, self-evaluating questionnaires?

Similarly, the concept of learner needs and goals are themselves problematic. Even when one has identified them, how can they be efficiently updated, given that learners' needs and objectives change with time. Does the system have an ongoing assessment of learners needs and goals linked to appropriate learning activities and tutoring styles? This implies looking more closely at factors that enhance pedagogic coherence of the teaching/learning experience, as well as at the density and timeliness of learning and tutoring activities.

In short, current research in the domain needs to broaden its scope of enquiry in examining how users can more easily identify, and consequently use, the interactive elements of CALL so to better control what they learn and how their learning is done. This control should include letting learners determine the degree of unpredictability, realism and complexity of the (virtual) language learning context. In this way, CALL can offer greater possibilities for learning and using a language in a way that makes the guided learning context more effective and authentic for learners and tutors alike.

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