

THE SELF-DIRECTED LEARNING PARADIGM FOR INTELLIGENT EDUCATIONAL SYSTEMS

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Abstract

Computer-based educational systems can teach procedural expertise inexpensively yet effectively if a holistic, self-directed instructional paradigm is used. The educational system described here is an example. It teaches users who know at least the basics of a foreign language, to write effective business letters in that language. A case-based search engine proposed to these users passages extracted from correspondence which has been used with success in their business community, and lets them systematically "assemble" the letter needed for the circumstances at hand. Applying Case-Based Reasoning to a database of model letters, the system selects the passages according to the communicative intent which they user defines for each paragraph of the desired letter; the system also takes into account both the user's and the recipient's personality and culture. The most innovative aspect of the system is the underlying non-directive educational philosophy: "teach better by teaching less." It draws inspiration from such pedagogical currents as Constructivism and Self-Directed Learning. The system, in fact, does not offer the user a "best choice" from among the passages it proposes, but rather leaves defining what is "best" to the user/learner. The paper argues at length that by making learners responsible for formulating what they need to know, the system develops what is distinctively human in the process of coming to know: the volitional substratum.

1. Introduction

The enthusiasm brought about by the sophisticated resources offered by new multimedia hardware and by the possibility of developing highly adaptive learning-aid systems often induces developers to create omniscient computer-based educational systems: the system pretends to know what is to be learned, how this knowledge is to be subdivided into chunks and in which order the chunks are to be presented and assimilated. The result is a transposition, onto a PC screen, of traditional "lock-step

teaching” (imposed goals in a fixed order for everyone), albeit in an interactive, multimedia version (Boylan, 1995). But wasn’t adaptability to learners’ individual needs one of the advantages that Computer-Based Training (CBT) was supposed to offer? It is not enough to take into consideration, for example, that subjects have different learning styles (Caudill, 1998; Hong and Kinshuk, 2004; Sun *et al.*, 2005); it is even more fundamental to take into consideration that subjects have different learning goals.

The present CBT proposal is directed to those adults who, for their job, are required to write letters in a foreign language (usually in English), without, however, possessing the proficiency to judge the accuracy, suitability, or efficacy of what they write. An obvious example are the thousands of company secretaries who must write to foreign correspondents (often but not always in English) and who inevitably rely on cutting and pasting passages from standard letters, continuously searched and retrieved from old files and archives.

The final texts that they produce are not always satisfactory, not so much on the basis of universally-accepted principles of effective letter-writing (in English or any other language), but rather from the standpoint of what is most effective in the particular circumstances at hand. Indeed, there may be no recognized set of abstract principles. This holds true for writing letters in the variety of English that has become the lingua franca of the business community of South East Asia, as well as in the kind of English (dubbed “Eurospeak”) used by the E.U. bureaucracy in Brussels, or the Black vernacular English (“Ebonics”) used in much of the Afro-American music and video industry in the United States (Crystal, 1997). Indeed, the same lack of universal standards for effective letter writing holds true for any fragmented language community, such as the various Spanish-speaking or Arabic-speaking communities throughout the world.

What practical-minded letter writers in these various communities need, therefore, is an informal learning tool that permits them to cobble together correspondence that “works” on whomever their target interlocutors happen to be, no matter how “incorrect” or “inelegant” that correspondence may seem to be from the standpoint of a school teacher of “Oxford” British English (or Castilian Spanish or Classical Arabic or whatever). As Dewey reminds us, “true is as true does”: see Hickman, 1996, pp. 3-28.

The present proposal gives these users an educational tool based on the paradigms of self-directed learning and epistemological constructivism. It stimulates users to find the knowledge they need within themselves and within the system, through non-directive user/system interaction.

2. The Self-Directed Learning Paradigm

Most Intelligent Learning-Aid Systems - including Intelligent Tutoring Systems (ITS) - automatically presuppose that the knowledge required by a specific student may be predetermined and modelled as the “knowledge base” concerning a “domain” (field of knowledge). This knowledge is transmitted to the student through interactive exercises. The system’s intelligence lies in its ability to assess the amount of

information to be digested (represented by the "Domain Model") and in its optimization of the paths to be followed, in order to allow assimilation of this information, according to the students' progressive understanding, learning style, and interaction with the system (diagnosed by a tutorial model and represented by a knowledge base called "User Model" (Rich, 1983)).

Two modern schools of thought oppose this dogmatic and fundamentally authoritative vision of knowledge: the constructive vision of knowledge (Jonassen *et al.*, 1997; Willis, 2000; Willis and Wright, 2000; Akhras and Self, 2000) that takes its inspiration from Piaget (1923) and Vygotsky (1956) and the self-directed learning concept developed in Great Britain during the 1970s (Trimm, 1973 and 1976). A self-directed learner is something more than a simple "self-learner". In fact, usually by "self-learner" we mean an individual who follows a ready-made course for home study, including a self-correction exercise package and possibly a final traditional assessment (for example, university courses broadcast on television followed by multiple choice comprehension tests delivered by mail or on the web). Instead, self-directed learners establish their individual learning aims as well as the criteria to assess their learning. By using educational material (which they learn to choose judiciously or even to develop by themselves), they "construct" - or better, "reconstruct" - the knowledge required in their specific case. Thus, these learners adopt the learning style of their own individual preference and adapt their study goals to their progressive understanding of what "knowledge" is necessary for them.

Self-directed learning is by no means a utopian concept. A child will learn the names and playing styles of specific soccer team players by chatting with friends and watching matches on television, thus behaving, to all effects, as a self-directed learner; teenagers will learn to play an instrument by themselves by means of records and books and by observing the techniques of musician friends; university students may write their theses in order to answer a question they feel as important, to the extent that they seek out their tutors for an exchange of ideas, not to obtain directives.

This paper sets forth a description of a computer system, named BLITS (Business Letters Intelligent Training System), which facilitates learning in the constructivist and self-directed-learning perspectives just described. Without supplying rules or directives, it teaches users how to draft effective business letters. The letters may be written in any language, provided that:

- users have a passive knowledge of the language (reading ability of a foreign language even though they may have difficulty in speaking or writing in that target language).
- The system contains an extensive library of model letters, prepared in the target language with each paragraph labelled to indicate its original communicative intent.

Thus conceived, the system constitutes a tool not only for learning business correspondence autonomously but also for learning to compose in a foreign language. For the system encourages the user to link authentic and culturally dense foreign language passages to precise communicative intents directed to specific addressees - and the association of form and intent is the basis of effective foreign-language training

(Micarelli and Boylan, 1997). Thus, the system helps the user convert his/her own passive language knowledge into active knowledge.

The system was initially conceived for application in the business environment – as mentioned, by secretaries corresponding with foreign firms. This environment was chosen because it is self-motivating: the ability to quickly write effective letters is usually rewarded and, in any event, saves time and stress. In addition, the environment is linked to the real world: anyone writing letters on behalf of a company usually has the possibility of verifying the efficacy of his/her judgements as to style and lay out.

Operationally, through an interface (called the “Tutor”), the system encourages users to define what response they would like from the recipients of the planned letter. Subsequently, paragraph by paragraph, the Tutor offers users a range of possible moves from which they must choose. For each move the system then supplies a number of passages from actual business letters, to be evaluated by the user as to suitability in terms of obtaining a given effect. The actual content is usually inappropriate and not to be taken into consideration: if the user has indicated that s/he wants an “apology move” for a “delayed shipment” to a “trusted partner”, the system will furnish all the passages it has in its knowledge base of that kind, independently of what was to be shipped. Since the user indicates, at the beginning of the session, the characteristics of sender and addressee, the system will also make its choices on the basis of these parameters. Although the system lists the passages according to probable appropriateness to the present situation, it makes no indication of this and lets the user scroll through the passages at will.

When a passage is chosen, it is cut and pasted into a composition window and retouched as to content. The user then moves on to define the next “move” in his argumentation. When a complete letter is built up, the system invites the user to inspect the linking of paragraphs and the use of pronouns or synonyms to avoid repetition of the key words.

The system is said to have performed as an “intelligent tutor” if it supplies the user with passages that fit the new case as closely as possible - in other words, if it chooses, from its knowledge base, those passages that the users themselves would have selected had they had the time to review the entire archive. It does so by using the labels associated with each passage, which indicate the move it accomplishes and its stylistic register. The system is in fact furnished with a generic database of labelled letters, to which a company (client) can add its own (successful) correspondence which must, however, be labelled by a consultant as part of the cost of the system.

In any event, users are free to ignore the labels, the order of presentation of the selected passages, and the Help option (Note 1.). A busy secretary can cut and paste passages on the basis of her own criteria, whether conscious or unconscious. Users are free to choose which paragraph to use and how to link them because they are, in any event, responsible for the impact of their final product in the real world (a smile or lifted eyebrow of one’s superior, the comments of the company foreign staff, the suggestions of the in-house translator, etc.). In other words, each user is responsible for developing the knowledge s/he deems necessary. Although the system does not provide

judgements, in order to encourage users to verify the effect of their letters in the real world, it presents on start up, at regular intervals, a questionnaire asking for feedback on the letters composed most recently. On the basis of this input, the system adjusts the weights assigned to the various passages.

The "objective quality" of the letters, as measured by the norms taught in schools, will vary greatly. If users (and their respective companies) consider all correspondence as an essential feature of the company image, secretaries will use the system to draft letters that are linguistically norm-abiding, pragmatically efficient and culturally authentic. On the other hand, users (and their respective companies) may be satisfied with much less or with a different conception of norms and authenticity - for example, in a former British colony now seeking independence from what is seen as the linguistic imperialism of British English norms (Quirk, 1983). Letters that do not follow schoolbook norms may be entirely satisfactory to parties which deem face-to-face meetings and contacts more important than written correspondence. In a completely different direction, a company manager (or a given client) may prefer letters that are "better than good", i.e. that contain "excessively articulate" reasoning strategies (Ulijn and Strother, 1995): these users consider such style as prestigious or as a sign of respect.

Non-directive learning respects each user's learning priorities by making each user responsible for what s/he knows: if a letter produces a negative effect, it is "wrong" because of that effect, not because it has violated some schoolbook principle ("true is as true does"). By respecting individual choices of expression, non-directive learning allows each party to define the "rules of the game" of their own environment; it acknowledges that communication is not only a simple encoding/decoding process following universal, predetermined norms, but that it concerns the relationship between different "ways of being" and a continuous research for rules that define such relationships.

3. The Case-Based Reasoning Paradigm

Artificial Intelligence plays a key role in the system since the choice of passages is made using the Case-Based Reasoning (CBR) paradigm (Kolodner, 1993; Aamodt and Plaza, 1994). This paradigm is particularly well-suited to the epistemological-didactic choices explained above: constructivism and self-directed learning. In fact, CBR, which proceeds from case types, recognizes the priority of induction over deduction when developing empirical knowledge and thereby furnishes the user with material that gets her/him to reason in a similar way.

According to CBR theorists (Schank and Birnbaum, 1995), teaching should be aimed at strengthening a subject's capacity to grasp "real world truths", largely inductive. Coherently with this vision, the present system does not teach "rules for writing properly"; users must infer the principles to apply and how to apply them by perusing the sample passages furnished. By working out "constructively" her/his

own inferences, the user constructs a personal rule system of effective letter writing (customized in accordance with the user's national culture, company culture and idiosyncratic preferences).

Examples abound of the efficacy of the inductive process in resolving real problems. For example, if we are required to speak in a delicate situation and do not know what to say, we can find inspiration by putting aside all logical reasoning and relaxing a moment, allowing our mind to wander and make free associations. The cases that come to mind may only have a very distant relationship with the words we finally utter: it is by exploiting the vague relationships that we build new cases, made with "bits and pieces" of old ones. Each case constructed will represent a strategy with a varying probability of success in a given situation. According to actual results, we assign positive or negative weights to the different "parts" we selected and assembled - weights that, in the future, will facilitate our recollection of those particular words/passages (and the rhetorical strategies associated to them).

The present computer-based educational system leads users to follow a similar path. It automates the initial phase (the retrieval of suitable cases) and the final phase (assignment of weights to improve future searches). It purposely does not automate the intermediate phase and obliges users to find the relationship between the cases retrieved and the situation in which they currently find themselves. Of course, the Tutor indirectly helps users find analogies by supplying cases that, in theory, "speak for themselves". But the educational value of the system actually lies in encouraging users to exercise their own judgement based on a "will to know" developed in response to ad hoc necessities. This volitional-led formation of pragmatically efficacious knowledge is called, in everyday language, "good judgement". It is an inductive ability that can only develop through guided practice (Micarelli and Boylan, 1997a and 1997b; Micarelli and Humphris, 1991).

Indeed, the user's "good judgement" is necessary for:

1. assessing whether sample cases of successfully written correspondence are applicable in the current communicative situation or not;
2. fitting the communicative tactics exemplified by the various sample cases to the overall strategic aim (Communication Intent) of the letter to be drafted;
3. calculating which tactic, among those characterizing a given set of passages retrieved for a given move, has the highest probability of fulfilling the Communicative Intent in the current situation;
4. retouching the "move sequences" to fit one's personality, and to fit the culture and the individual character of the addressee.

The system works by developing CBR in its users as an empirical method of understanding and as a method of contingent problem-solving. In other words, the system is intelligent because it gets its users to act intelligently.

As previously mentioned, the CBR paradigm is also exploited internally by the system to retrieve the information useful for its own operation: in other words, the system also reasons on the basis of "cases". Cases do not consist of a "predetermined model

to be copied" or of a "combination of rules to be followed" but rather of a combination of chance events capable of serving as an example.

In the architecture of our system, a "case" is a Letter Instance composed of the following elements:

- a. a Recipient - represented by a set of attribute-value pairs describing psychological and cultural characteristics;
- b. a Sender - formalized in the same manner;
- c. Communicative Intents, primary and secondary. The former is the intent that the sender seeks to convey to the recipient by means of the letter and which may be called the letter label or genre (for example, "solicit payment"). The secondary Communicative Intents, also called "moves", are the labels for individual paragraphs; they express what a given paragraph does in advancing the argumentation toward achieving the primary intent ("declare debt", "threaten legal action", etc.). Each paragraph label also gives the history of that paragraph, i.e. the letter from which it came originally and where it has been used successively, the recent users, the recent recipients.

The overall letter can therefore be seen as a Move Sequence. Each move is a string of words (usually corresponding to a paragraph although, more rarely, individual sentences can also be moves) headed by a label or <alphanumerical string> defining the move and indicating the sociolinguistic register involved (what kind of person says it to what other kind of person and how). Using the indications of intent furnished by the user along with the definitions given initially of sender, receiver and style, the system retrieves a stereotype, i.e., a combination of Move Sequences that seem to fulfil a typical intent because: (a.) they offer analogies with one of the model letters located in a library, created off-line with the help of an communication expert; (b.) they recur, wholly or partially, in various letters in the database.

Thus, a "case" is not a letter stored in the knowledge base of the system as a fixed model, nor is it a series of rules for the construction of standard letters. A case is a network that links specific passages (paragraphs, occasionally sentences, that can be in different letters) to labels that describe the characteristics of specific users who have sent or received the passages and to other labels that indicate the mode of discourse. In other words, a case is a set of pointers that temporarily designate (and therefore connect) a certain number of alphanumeric strings located physically in different locations in the knowledge base of the system. Due to the reuse of the passages over a period of time, a specific passage may be associated with different attribute sets or "cases". For example, the short paragraph in English: "Would you kindly comply" may be linked to attributes such as "plea" (Move), "British" (Recipient), "direct" (User) - in this instance the passage will be included in a certain case - and at the same time may be linked to attributes such as "plea" (Move), "American" (Recipient), "polite" (User) and thus could also be included in a second case. Moreover the attributes that define a specific case may vary in time: as the cases contained in the system will change when the use that is made of them changes.

The concept of "case" - which formally corresponds to a transitory linkage of attributes - has some analogies with the modern theories on the functioning of the human brain. Neurobiological research has in fact demonstrated that the memory of a word or of an event is by no means constituted by a single chain of neurons located in a single section of the brain, rather by various chains of neurons located in different parts of one or more areas of the brain (Freeman, 1995). The "addresses" of the different chains are stored in the hippocampus, the area of the brain capable of activating them simultaneously and therefore of "gathering" them virtually as a memory (or, if the different chains are linked by mere proximity, as a fantasy or dream). Nevertheless, the "addresses" that constitute a specific word or event may, due to their use, be subject to changes (elimination, overlaps, etc.) that change the nature and availability of the memory, and consequently the constitution of the memory as a case.

As for the architecture of the system, it is composed of:

- a. a Knowledge Base containing the model letters labelled paragraph by paragraph;
- b. a module that incorporates the Stereotype Libraries, capable of dynamically building a Sender Model (which does not necessarily correspond to the user of the system, as in the case of a secretary writing a letter for her/his boss), a Recipient Model, and a primary Communicative Intent corresponding to a defining label and to a probable Move Sequence. The stereotype associated with each sender or recipient is updated by the system on the basis of the choices of letters made over time, or of the changes in the answers to the initial questionnaire presented at the beginning of each session (for example, the user may decide to switch to U.S. English instead of British English, or to switch from "polite" to "friendly" with respect to a specific recipient);
- c. an Expert Module that manages the interaction and retrieves the letter passages. Again, there is a significant difference between this Expert Module and those used in the learning systems which are commonly described in the literature. The present Module does not compute a learning path to be followed, nor does it assess the work performed by the users; it attempts to furnish users with the right tools at the right time (when users feel they need them) in order to gain better control over real-world situations (for example, in order to get a particular recipient to pay an outstanding bill); it supplies suggestions only indirectly (the labels), or upon request: the short tutorials which will be activated by means of the Help button in a future implementation (see Note 1 previously cited).

4. Why Teaching Less Favors Learning More

Often learners are seen as "inert silicon chips" to be "programmed" by a skilled human/machine tutor so that, for a given input, a specified output is regularly obtained (Boylan *et al.*, 1999). This philosophy has such ancient roots that it has withstood many years of research clearly demonstrating the fundamental creativity, and consequently the uncontrollability, of the learning process. Indeed, teachers or trainers waste their

time if they expound information about a given "subject" in the hope that their students internalize it: textbooks or multimedia systems can do that job just as well if not better. What teachers or trainers can usefully do, however, is what in fact they do not always do: develop, in their students, a "will to know" – in other words, an inquiring mind, a curiosity for the domain being studied, and a certain number of "subject" skills seen as heuristics for getting a hold on that domain. To clarify the terminology just used by means of an example, a division algorithm may be considered one of the heuristics which, taken all together, define the "subject" mathematics; the "subject" math may, in turn, be considered a formalization — based on concepts such as number, set, and calculus — of our curiosity about the domains of quantity, space and relation.

This task — the assignment of purpose to the activity of inquiry, or the "teleological function" of teaching — is, indeed, one that only human tutors can do well. The first premise of this paper, therefore, is that learners are experimenters who want (or who can be led to want) to investigate a domain and who, in forging tools for this purpose, end up (re-)creating a "subject".

This view of learning radically changes the role of the tutor (human or electronic) who, from "depository of knowledge", becomes the agent responsible for creating a stimulating environment in which the learner can come to grips with a given domain by conducting successful experiments on it. In the classroom, this means abandoning the use of a single textbook — containing received "knowledge" of the "subject" — and working instead with resource materials, case studies, lab instruments, and a variety of textbooks, all stored in a class library. In a computer-based educational system, this means a) abandoning the instructional paradigm of "empty vase"/"inert chip" ("To transmit knowledge X to Learner Y, we need only to know the properties of X and the characteristics of Y"). It also means adopting instead a "learning-by-example" paradigm. An example of the latter is a system embodying the CBR paradigm: the system retrieves Instances of a given domain (I1, I2, I3, ... In), so chosen as to allow Learner Y to elaborate situation-specific knowledge K', i.e. knowledge of the type K that satisfies current needs and goals. This learner-centered view of education has immediate consequences for the design of educational systems. If learning is "creative experimentation", then educational systems ought to offer learners simulations whenever feasible and only when not - as happens, especially in the soft sciences - tutorials, demonstrations, drills, games, problem-solving tasks, all based on the pre-established-answer paradigm (Micarelli and Boylan 1997b). Schank (1990) has amply described the suitability of the CBR paradigm in creating simulations on the basis of "learning-by-example" for educational applications.

BLITS implements this paradigm by formalizing the learning process such that: a) given a knowledge domain that is only partially formalized (the Case Library in which "cases" evolve dynamically from session to session) and b) given individual learning goals (defined by real-world circumstances) and style (defined by the learner, through interaction with the Help tutorials), the program provides a suitable self-directed training environment for a well-defined target population.

If the learner is not a native speaker of English, the CBT system counts as both

“learning business communication” and “improving one’s knowledge of the English language”. Repeated practice in acquiring situation-specific knowledge should lead the learner to acquire an overall decisional expertise in the domain: in this case, “How to write effective business letters in... (English...)”. This expertise is the kind of practical knowledge which Aristotle calls *phronesis* (Ethics, VI, 1140b, 4). It is something more than just know-how, for it is grounded in reasoned (analytically explainable) assessment; at the same time, it is something more essential than theoretical speculation, for it involves intuitively choosing what elements to focus on in making a decision.

The system, too, becomes “wise” with experience, since it retrieves Instances (I1, I2, I3, ... In) partly on the basis of the successful retrievals it has performed with previous users whose needs and goals are similar to those of the current user. As “wise” as the system becomes, however, it never constitutes a formalization of the ideal learning process for any given user. This is because, according to the view of learning defended here, there is no single established way in which a given domain must be studied in order to be learned, nor a single way in which way a given user will decidedly learn best. Still more fundamentally, there is no single way of looking at and defining a phenomenon to be studied, nor of determining which phenomena deserve study by a given individual.

What the system described here attempts to do pedagogically, is to create a favourable environment for learning, putting the (hopefully) right resources at the disposition of the learner: the rest is up to her. In the same spirit, the system does not pretend to contain a formalization of what it means to “know” a given domain. The system elaborates pointers to (hopefully) pertinent data stored in its Case Library and asks the user (hopefully) stimulating questions to get her to think about what these data mean in the case at hand. But it is up to the learner to define what “knowing the domain” means, both in the case at hand (to achieve the goals she has currently set) and in general.

At the heart of this philosophy is the following conviction, which constitutes the second premise of this paper: knowledge springs from a partially arbitrary volitional act of the individual (we decide what to inquire about and how much we want to know) and is therefore fundamentally non-logical (Gadamer, 1960). Clearly, the kind of pedagogy described here presupposes highly motivated students. Moreover, it puts the entire burden of learning squarely on their shoulders: while our system tries to adapt to individual needs as much as possible, the actual process of getting a hold on the knowledge domain (inferring what is essential from the cases presented) remains entirely the job of the student. Such a view of learning, as previously said, contrasts with spoon-feeding or with the highly directive approach of classical educational practices, as embodied in typical courses based on tutorials, drills, demonstrations, games, and problem-solving tasks, all of which pre-suppose what there is to know. These approaches see knowledge as a product, while the CBT described here sees knowledge as a process of coming to grips with a domain which defines itself in the very process of studying it. The discrete conceptual formulation found in books ($e=mc^2$, Goethe wrote Faust) are here considered to be simply the external manifestations of

knowledge, not knowledge itself. They are notions transmittable from depository X to recipient Y while any real knowledge must be re-created by learners on their own, in terms relevant to their experience of the world and as the response to questions they feel the need to answer.

One might object at this point that, if the present criticism of standard educational practices is valid (and it extends, as has been suggested, beyond Computer Based Training to mainstream classroom instruction as well), how is it that students manage to learn anything at all in school or in front of a computer? The fact of the matter is, of course, that the students who learn — and many do not — manage to do so in spite of the way things are taught. In other words, the students who get ahead in school do so by practising on their own just the kind of “creative experimentation” we are proposing here for everyone (Chi *et al.*, 1989). At school these students conduct mental experiments, “sifting” what the teacher says through their experience of reality in search of analogous or contradictory cases, while at home they check things out by testing their parents’ reactions to their teacher’s affirmations, by consulting an encyclopaedia, or by conducting informal experiments in the kitchen or in the garden. The less “intrinsically motivated” students, on the other hand, acquire only the kind of rote learning that standard educational practices are designed to give them. These students become the uneducated diploma holders that critics like Bloom (1987) lament.

Why does the “sifting” process make the better students more intelligent? As Schank (1995) suggests, intelligence is intimately connected with the web of associations that link our experiences. While the average student “learns” (i.e., stores in memory, together with immediate context) the affirmations made by the teacher and can produce them at test time if the context is the same, the better student manages to put more “handles” on each and every affirmation. She “tags” them (what Schank calls indexing) by linking them to the entire range of her experiences; she may even create new experiences ad hoc, to “situate herself” differently with respect to them. Her tagging is also an “affective recoding”, as Stevick (1976) acutely notes. Thus the affirmations become readily available for future use; they rally to the call of a volitional state in the most unpredictable situations. Our system “learns” to deal with particular users and communicative situations in a similar way. The activity of our system is not, however, triggered by changes in its affective or volitional states — in fact, our system has none. Unlike the wilful supercomputers in science-fiction — for example HAL in the Stanley Kubrick film *2001: A Space Odyssey* — our system is not “affectively coded” and cannot WANT. Thus, no matter how much it “learns”, it can never be said to have human-like autonomous intelligence. Human beings, on the other hand, do appear to possess fully-autonomous, wilful intelligence: they decide by an act of the will what they want to learn and therefore what counts as knowledge (which varies from culture to culture and from epoch to epoch). In fact, we maintain that this is precisely what distinguishes humans from artificially intelligent computers. The obvious conclusion, therefore, is that instruction aimed at humans should try primarily to develop their “will to know”.

Alas, such is not the case. As we have pointed out, most classroom instruction and

computer-based courses focus on rote learning and algorithmically-definable knowledge, treating students as though they had the merely artificial intelligence of computers and no more.

Clearly there must be a reason for all this. After all, traditional educational practices must serve some useful purpose or else they would not be so widespread and persistent. It is therefore necessary, before criticizing them, to ask what that purpose is.

Standard educational practices are clearly useful in at least three circumstances. First, a certain number of training activities (for example, learning touch-typing) do not require “creative experimentation”; in these cases, conceptualized explanations, tutorials, drills and discrete-point testing generally get satisfactory results more quickly. Unfortunately, educators often classify any apparently routine task in this category – from learning to speak a foreign language to learning to write business letters or establish project specifications – and create classroom materials or computer-based systems accordingly. Therefore, when criticizing standard educational practices, it is important to point out that we are not referring to them in general, but only to their (mis)use in domains which instead require the development of the particular kind of wilful intelligence that humans seem to possess.

Secondly, most high-level activities (such as, for example, the three just mentioned) involve acquiring a certain number of sub-skills and for this purpose many of the standard educational practices are perfectly adequate. The problem here is that, in actual practice, educators spend most of their time on preparing classroom lessons or designing systems to teach the low-level, discrete-point sub-skills and seldom get around to creating materials to help learners practice the high level, holistic activities that develop fully-autonomous intelligence. A case in point are the twenty or so ITS for foreign-language learning described in the authoritative volume edited by Swartz *et al.* (1992): three-quarters teach low level skills using standard educational practices (or variations of them). ITS researchers justify themselves by arguing that, given the limits of present-day computer technology, it is simply too difficult to create a system able to control and correct very high level activities. But if this is the case, why don't we simply abandon for now the Faustian aspiration of creating a system able to control and correct everything? Why don't we get the students to take control of their learning and let teachers correct everything the computer and learners cannot? Computer-based education purists might object that developing a hybrid system (one-third computer, two-thirds human) would not advance computer science very much. They forget that the workstation triumphed over the mainframe in large organizations precisely because it did not try to do everything: it delegated responsibility and integrated expertise locally.

Thirdly, standard educational practices often seem to be the only way to handle unmotivated students (ones who have no desire to “learn creatively” a discipline they feel forced upon them), especially when their teachers, poorly paid, are unmotivated, too. The question is, however: should we satisfy this demand? If our society had somehow conserved the ancient tradition of whipping schoolchildren to get them to learn — Maria Montessori once asked — would we in educational research consider it our duty to work on the development of more advanced whips? Or would we not choose

instead to investigate why our society still practices whipping and attempt to attack the problem at its roots? It may often seem that we have no alternative. Swann (1992), for example, reports that he finally chose to implement conventional grammar exercises in his ITS because otherwise the system would not have been used in the Italian classrooms he had targeted, where teachers and students, although motivated, held very traditional ideas. But even in such cases there may be ways to avoid the practice of developing "more advanced whips": the reader is referred to Boylan (1995) for a practical strategy to follow in a conservative school system.

In a word, the key lies in discovering why students are unmotivated in the first place. Many are so for personal, social and political reasons, of course; but others are simply rebelling — consciously or unconsciously — against teaching focused on the "subject" instead of the "domain". A joint rethinking with teachers, administrators, and students alike could lead to programs like Schank's (1990) celebrated ITS to teach animal biology: schoolchildren learn the function of various animal organs by inventing a new species with any combination of organs and testing its performance. Besides teaching the children the "basics" of animal biology, Schank's program gives them an intuitive understanding of evolutionary theory (now employed in microeconomics and other disciplines), something they would not get if the program simply drilled them in naming the functions of the various animal organs.

5. Session Example

This paragraph describes a typical session with the system, illustrating the most relevant stages. Attention is mainly focused on the implementation of a user-friendly graphic interface, featuring a tutor named Murphy, and on the structure of the letter-composition process. Intelligibility and clarity give in fact added value to any teaching/learning process.

5.1 *Login*

Figure 1 describes the login dialogue-box that appears when the system is started. The user is asked to enter a user ID and a password, under Murphy's watchful guidance. Other information requested includes the network configuration of the client and server unless, as in most cases, they are default values.

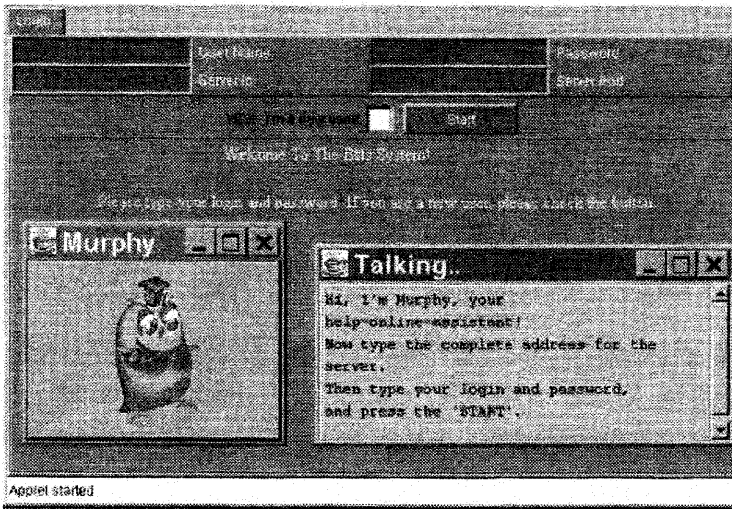


Figure 1, System Login.

5.2. Functions

The functions provided by the system are the followings:

- The Option Page
- The Letter-Characteristics Selection Page
- The Move-Sequence Decision Page
- The Letter Implementation Page

The Option Page is displayed after the user logs in to the system. It enables access to three functions, as shown in Figure 2:

- Composition of a new letter (Write a New One)
- Retrieval of previously written letters (Get Old Letters)
- Feedback to the system of the results obtained through these letters (Feedback)

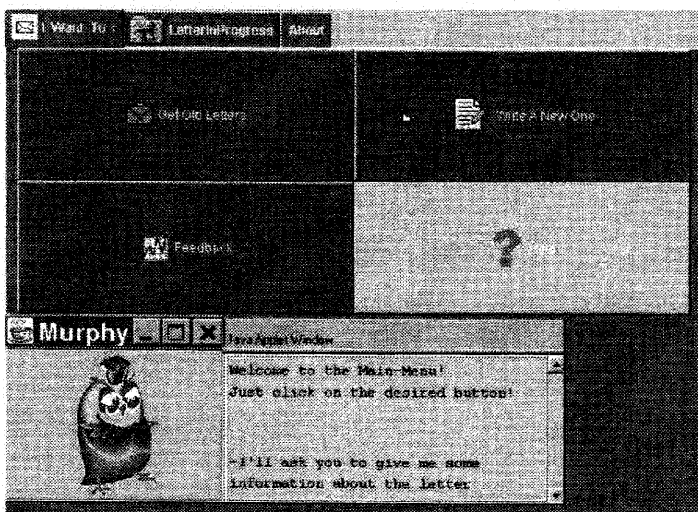


Figure 2, The Option Page.

What follows is the detailed description of the session “Write a New Letter”, in order to illustrate one of the most interesting functions offered by the system.

5.2.1 Write a New Letter

By selecting this item from the Option Page, users may gain access to the page where the following features for a new letter can be selected, as illustrated in Figure 3:

- Type, style and strategy of the letter to be drafted.
- Description of the personality of the sender.
- Description of the personality of the recipient.

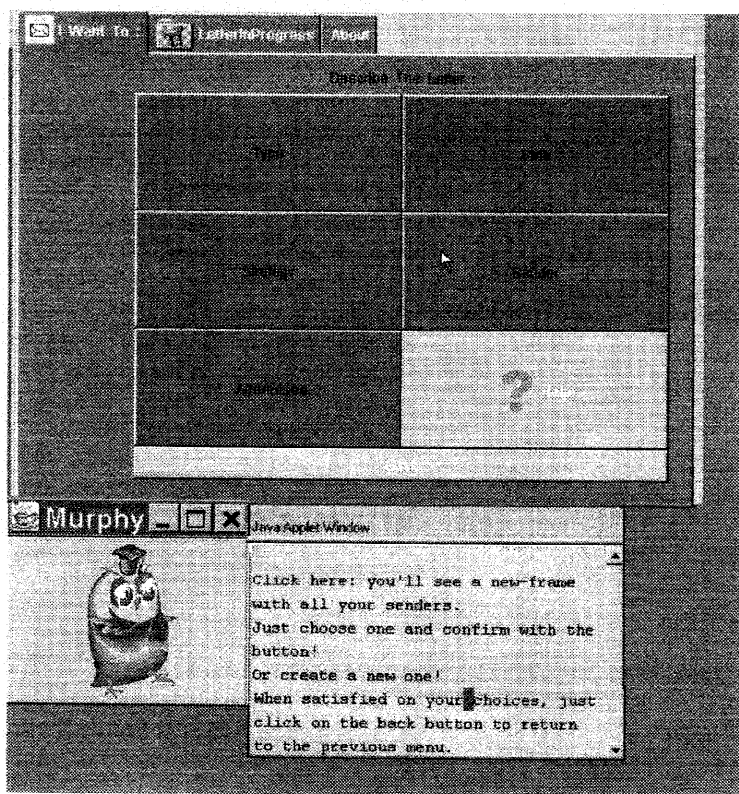


Figure 3, Write a New Letter.

When choosing the type of letter to be written, the system guides the user through the Type menu, illustrated in Figure 4. Notice there are several letter layout possibilities: the user can choose the type s/he wants with a simple click.

Next, the user can select the font style, as illustrated in Figure 5. Finally, Figure 6 illustrates the dialogue-box that allows selection of the Writing Strategy.

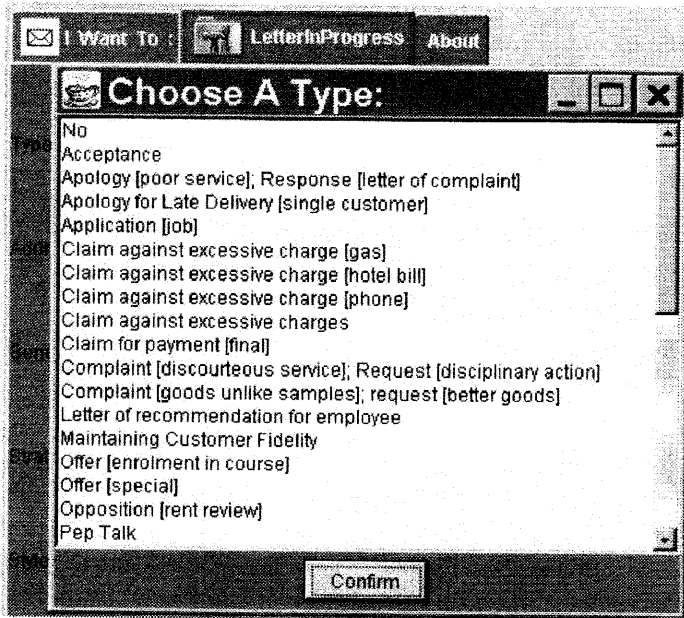


Figure 4, Type of Letter

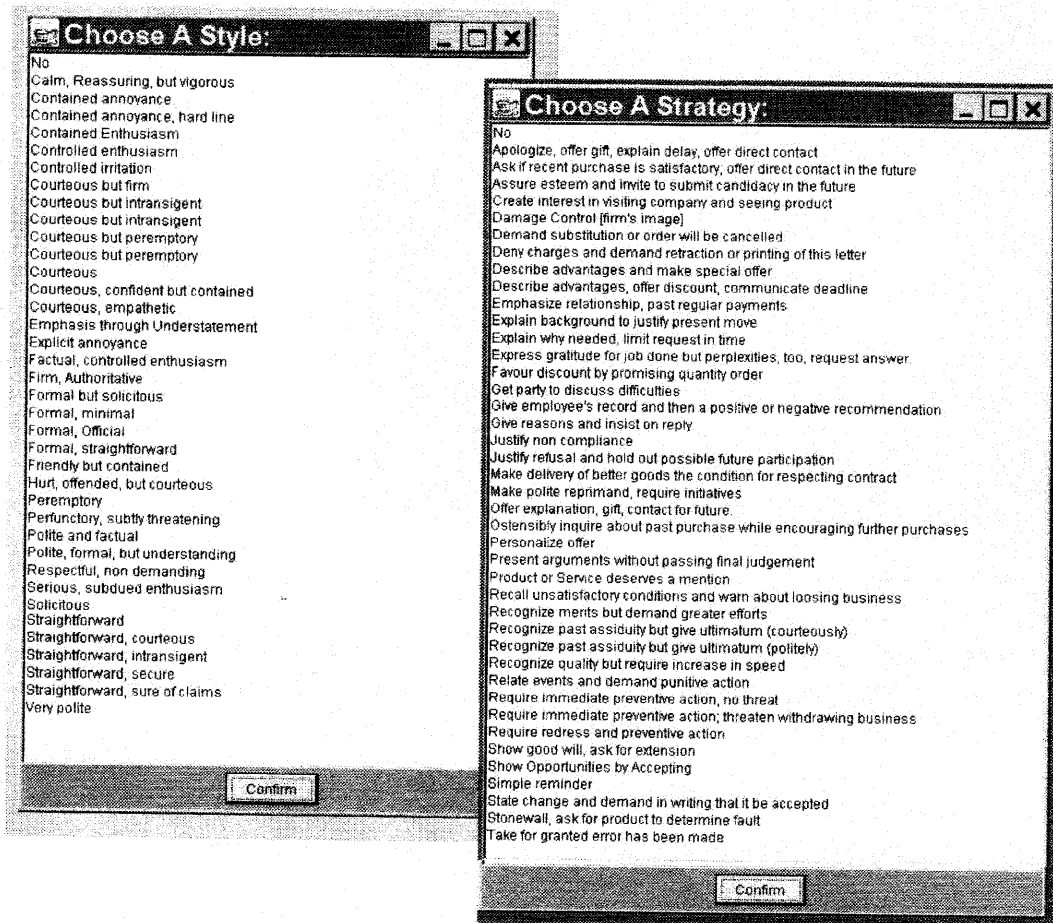


Figure 5 and Figure 6, Select the Font Style and the Writing strategy.

Next, the user can select the sender and recipient typology as illustrated in Figure 7.

Figure 7, Choose a Sender/Recipient.

The Moves-Choice Page, described in Figure 8, enables the user to construct a sequence of “moves” (or communicative intents that contribute to realizing the overall purpose of the letter). All possible moves are given in the upper-left area of the screen, while the move sequence that the user is developing is displayed in the upper-right section. The examples are shown in the lower part of the page.

Fig. 8: Choose the Moves-Choice.

Finally, the Write-Letter Page, shown in Figure 9, helps to implement the current communicative intent (move). On the left hand side there is a space in which to draft the new letter. An external browser window presents a list of paragraphs for each selected move sequence. By selecting them with the mouse, they automatically appear in the box reserved for writing the letter. The user may freely edit any section of the passages that the system has inserted in this area, until the final version of the letter is obtained.

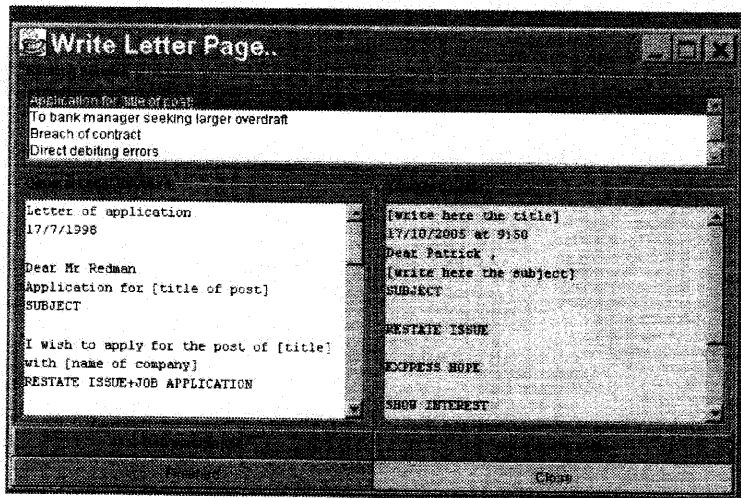


Figure 9, Paragraph re-editing environment.

6. Lessons Learned

Presented in these terms, our system may resemble everything but an educational tool. A computer-science expert could view it as nothing more than an expert system conceived to query a knowledge base containing labelled letters. A Company secretary could see the system as a letter-writing program equipped with an extensive archive of passages to be assembled (boiler-plate) something similar to an Auto-composition system of standard letters already included in many text-composition programs.

On the contrary, we believe that BLITS should be considered as a fully effective *educational* tool. If it does not appear as such, this is simply because of the persistent belief that teaching means getting students to assimilate pre-defined chunks of “knowledge” — precisely what our system does not set out to do. In other words, it does not:

1. “explain concepts”;
2. then “assess the comprehension of what has been explained”.

This vision of teaching/training is valid when students already have a familiarity with a discipline: for this means that they have constructed the mental categories necessary for processing information in that discipline. Thus additional information, even of a more specialized nature, can be assimilated into the already-functioning associative network. But such a vision of learning is not valid when students have not yet mastered a subject domain and may even be unfamiliar with much of the content.

A constructivist approach, on the other hand, permits students to elaborate categories in which to store the new information. Even when students are familiar with a subject but have not yet attained expertise, a constructivist approach can often be the most useful (Spiro *et al.*, 1988). In fact, for constructivism the term “to teach” does not mean furnishing knowledge but rather removing obstacles to the development of the student’s intelligence and judgement, starting with what the student currently knows, such that he can adapt his knowledge to new situations, and deepen it. Instead, for upholders of imposed learning, there is only one body of knowledge (that which “the discipline”

has officialized and which can be represented in a computer system as a Domain Model). In this perspective, the student's environment cannot determine different kinds of knowledge to be acquired. Indeed, the student's mind is led to conform to the pre-determined Domain Model (see Section 2). BLITS, on the other hand, is based on four postulates, diametrically opposed, which have referred to in the course of this paper, and that can now be summarized as follows:

1. "Knowledge" is any mental representation that gives subjects a better hold on their environment. Thus, for our students, the micro-society in which they move - their colleagues, clients, etc. - constitutes the only source of what for them is "knowledge".
2. Since "knowledge" means grasping local reality sufficiently to achieve a locally established aim, effective educational software cannot determine in advance, for a given subject, what must be known and why; instead, it must allow users to develop their own answers to these two questions.
3. Following this view, a system (or a tutor) need not necessarily teach for students to learn. On the contrary, the less is "taught" (in the sense of "imposed on the students' minds), the more flexibility is given to students to actually learn.
4. Therefore, the new possibilities that educational technology has today to build Intelligent Learning-Aid Systems with a high degree of adaptability, must be used to give students a more refined control over the system, not to give the system a more refined control over the students.

Work on this project has shown the importance of holistic learning. It clarifies why so many people "just can't seem to learn to think creatively" in a domain which is taught to them by (apparently) well-conceived textbooks or well-designed ITS, based on standard educational practices. For knowledge is not a series of pre-determined concepts, fixed or linked at run-time, to be learned in a prearranged way - whether fixed or established at run-time by a pre-determined pedagogical heuristic.

Indeed, knowledge is not so much the result of an inquiry as the inquiry itself. Distinctively human knowledge originates from an act of the will to sort out the confusing bits and pieces of experience felt subjectively as relevant. To be meaningful, that order must therefore be created (or recreated) by learners on the basis of what they want to know and how they go about knowing. Put another way, human knowledge is nothing more than the willful ordering of phenomenological reality, to give it a meaning. At its very roots, it is a non-logical, largely culturally-determined, on-going attempt at making sense of things (thus, a process), constrained by reality and processed logically, but only after the initial non-logical choices have been made as to what is to be studied, how and why. This is precisely what the history of science teaches us.

Once classroom teachers and CBT system designers grasp the volitional nature of knowledge, they will see how closely real instruction depends on the learner's "will to make sense" of things. We are not simply saying that learners must be motivated - this is obvious - but that what remains in a learner's mind after a course of instruction is not human knowledge if it is not the product of an intent to give a meaning. Thus, if we define intelligence as the capacity to produce and manage knowledge (of any kind),

then it is clear that any course of instruction aiming at developing human-like autonomous intelligence, and not something resembling the Artificial Intelligence that machines are capable of, must activate in learners not only cognitive, but also affective and above all volitional faculties. This is exactly what our CBT system focuses on. By "teaching less", it aims at getting learners to do more, and to do it holistically.

On the negative side the Project has confirmed the well-known drawback of case-based systems: the staggering effort that goes into indexing data — in our case, into putting useful handles on the letter excerpts and mini-lesson slides. Indeed, any real intelligence that our system demonstrates will necessarily come from the potential of the data, expressed by the way those data are indexed and actualized through interaction with specific users. No matter how intelligently the user-profiles and case-retrieval mechanisms perform, if the handles put on the data are inappropriate or simply too generic, the computer will look dumb: it will furnish letter excerpts or mini-lessons that are inappropriate or too generic.

7. Conclusions

This paper has described an approach to the development of Intelligent Training Systems based on a combination of constructivism, self-directed learning and case-based reasoning, which aims less at acting intelligently and more at getting users to act intelligently. Implemented with client-server architecture, the system, called BLITS educates users to write effective business correspondence. It supports users by getting them to define the letter they need to write in terms of a sequence of moves, and then, for each move, provides them with sample passages from a Knowledge Base of letters of proven value in the target language. The Knowledge Base can even be customized to a given language community by tagging and inserting typical letters used in that community.

An initial evaluation of the system, performed in an experimental setting with a Knowledge Base of business letters in British English, showed that BLITS effectively gets non-native-speakers of English to structure business letters in English addressed to a British recipient following typical British discourse structure. The variety of letters in the Knowledge Base was too small for extensive testing; therefore it can only be surmised that users will, after months of usage, acquire a creative writing ability in English on their own, as a sign that "learning" has taken place.

The system is conceived for business letters but could be adapted to other genres as well, such as reports or summaries. Future work on this project will therefore consist in expanding the current Knowledge Base and studying the possibilities of reusing the architecture for other domains.

Notes

1. In future, the Tutor will be equipped with a help system, i.e., a Help button that offers, upon request, short explanations on specific topics, such as courtesy formulas or link words in the target foreign language.

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