

Technological Intelligent Agents [TIA]: A Stimulus for (e)Didactics?

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Abstract

Information & Communication Technologies [ICT] have become a powerful force which are transforming and will continue to transform all aspects of education. While eLearning has obvious advantages related to time-space distanctiation, we feel that didactical eLearning issues are problematic. We therefore emphasize taxonomies concerning learning objectives as useful and necessary references for eLearning. Based on a distinction of three main areas of current research into eLearning, distance learning, multimedia supported learning and smart agent supported learning, we finally attempt to illustrate that eLearning qua distance learning has nothing to add to traditional learning other than the benefits of space-time distanctiation, but eLearning could revolutionize certain aspects of Learning through the development and implementation of smart learning software. It is the methodological benefit of the preliminary preparation of a certain content area for technological implementation which draws our attention.

1. Introduction: Understanding the concept of eLearning

We posit that an overly optimistic view of eLearning [offering exciting opportunities for University education, without the recognition that its use is not unproblematic or without boundaries] might be more prevalent than expected and needs to be

addressed by researchers and educators. Our opinion is supported by some who similarly recognize that eLearning is a popular movement not without limitations, and that greater consideration and reflection upon pedagogical issues is necessary [see for example: Thompson & Randall 2001; Fox, & MacKeogh 2003; Mwanza & Engeström 2005; Concannon, Flynn & Campbell 2005; Alonso, et al 2005; Selinger 2004; McConnell 2005].

We agree with other academics [see for example Guri-Rosenblit 2005] in recognizing that Distance-Learning \neq eLearning. In lack of a widely accepted definition of eLearning, we feel it important to emphasize a clear distinction between distance learning [based on time-space distanctiation, cf. Giddens 1990], multimedia supported learning, and technological intelligent agents [TIA]. From our perspective, distance learning implies eLearning, potentially uses multimedia technologies, although this is not necessary [but both eLearning and traditional classroom based learning will surely come to always include it in the near future], and could possibly be revolutionized by TIA. However, eLearning can be used in conjunction with more traditional classroom based learning and therefore we suggest that eLearning should not be seen as the exclusive domain of distance learning – increasingly both distance learning *and* non-distance learning will include forms of eLearning.

We also consider the distinction between traditional classroom-based learning as synchronous, and distance learning as asynchronous to be oversimplified. This is because the former assumes that the only learning that takes place is in the classroom. This is an inaccurate assumption. If we accept that learners learn outside of the classroom, then their learning can also include asynchronous forms, whether this is self-directed or initiated by teachers. Significantly, it is likely that learners within traditional classroom based learning contexts will increasingly use multimedia technologies and smart agents on their own accord. Similarly, distance learning can also include synchronous learning, if the teacher gives an online lecture or arranges an online discussion or activities where students are required to participate or be present at a specific time.

We therefore argue that researchers and educators should realize that the distinctions between different types of learning will increasingly be blurred. It might be useful to discard previously used terminology and mindsets altogether, and instead state whether learning includes: non electronic forms [non-E] and/or electronic forms [multimedia, TIA], and whether or not the learning includes a distance dimension. Based on this classification, distance learning therefore differs from other learning only in terms of its 'distance' dimension, which can be understood in terms of time-space distanciation. Time-space distanciation can be understood by contrasting traditional society as linking time and space through place, with our current society [often through the use of IT], where time and space are no longer linked through place.

In summary, we argue that educators and academics should recognize subtle differences between different forms of learning. This is essential if we are to improve our understanding of exactly how

differences in learning are implicated in pedagogical issues. To illustrate this, the next section emphasizes the importance of *learning taxonomies* and proposes that a sustained and systematic evaluation of how different types of learning can support different learning objectives would be invaluable.

2. Learning Taxonomies

Learning taxonomies enforce didactical elaboration – encouraging teachers [and students] to distinguish between different learning objectives. They therefore act as an essential pedagogical tool for educators. Bloom's learning taxonomy [Bloom 1956] was a seminal work, and has since been modified and adapted over a long period of time [see Simpson 1972, Harrow 1972, Krathwohl, Bloom & Bertram 1973, Simpson 1972, and Anderson & Krathwohl 2001, for a more recent revision]. The taxonomies consist of three distinct domains: cognitive, affective and psychomotor. For example, the cognitive taxonomy aims to hierarchically structure, and clearly delineate learning objectives, increasing in difficulty, with a higher learning objective necessitating the completion of a lower one. While it is not our intention to here to proceed further with an elaboration of each dimension, we do advise a permanent reflection on a detailed and subject related application of learning taxonomies for each different type of learning. Reflection upon learning taxonomies with regard to multimedia technologies, TIA and distance learning, will be beneficial in two ways. From a more practical perspective, for educators, they provide a useful reflective device upon which the increasing use of current and emerging technologies can be evaluated. In short, teachers can ask themselves how a specific technology assists learners to achieve a specific learning objective. From a more theoretical, or research based

standpoint, the taxonomies can be used to investigate how technologies are improving pedagogy [if at all]. Of course, progress will be made through the close interaction of practice and theory, which we intuitively feel will be essentially different in scope and limit as to each learning objective.

While we recognize that distance learning has great potential benefits related to time-space distanciation, we come to the conclusion that no genuine didactical potential lies in it. We argue instead that multimedia and especially smart agents could become central to didactical development. We choose to give some considerations regarding the latter.

3. Technological intelligent agents

Learning Management Systems [LMS] provide in large parts administrative support for distance learning, but as research into and use of TIA intensifies [see Peters 2004 for a historical discussion of learning machines], genuine didactical considerations become crucial. Since TIA are based on Artificial Intelligence, their use in eLearning opens up new philosophical [cf. Thagard 1993a, Moor & Bynum 2002] and technological [cf. Plekhanova 2003] challenges. We do not think that technological innovation *per se* can contribute substantially to university didactics, but we find it significant that the implementation of eLearning platforms and especially TIA enforces a beneficial methodological and conceptual clarification of teaching domains. It has to be emphasized that while software engineering stimulates design of TIA and defines its boundaries, preliminary theoretical preparations of domains must precede technological considerations. It is a stringent and detailed elaboration of teaching domains which characterizes TIA implementation from the viewpoint of didactics. Newly branded research fields such as “Knowledge Representation” [cf. Sowa 2000, Gordon

2004, more specifically Gaines/Saw 2000 for scholarly purposes, Boland 2001 from a management perspective] respond well to this demand and find a clearly defined research goal in computational implementation.

Nwana [1996] elaborated classification criteria for intelligent agents with smart agents showing the highest degree of competence. Generally, TIA are designed for less or more complicated tasks (such as more fundamentally information retrieval software but also concrete tutorial support, e.g. the comprehension and application of a physical law) and can be integrated as multiagents [see Lin 2005 for a throughout discussion]. Although the future could show some exciting possibilities of human like self-learning smart agents, the main research focus at the current stage concerns lower TIA types [for a discussion of agent classification see Nwana 1996, 6-9].

Software design issues may indeed lead to entirely new avenues in education and also corporate training. For example, Aldrich [2004] departs from computer games as sophisticated simulation environments and makes them a role model for what he calls “cyclic” and “open-end” learning in opposition to traditional “linear” learning. Shaffer [2006] speaks of transferable “epistemic frames” a learner should incorporate by experiencing interactive learning environments. Conati and VanLehn [1999] explore computer-based support via technological tutors for the meta-cognitive skill of self-explanation (so-called SE-Tutors).

Although implementation of TIA involves a vast array of fundamental questions [cf. Linn, 2005, 36] we would like to especially highlight methodological and ontological issues [see Thagard 1993b for an instructive illustration of those aspects in terms of scientific theories and their change] related to a new agent driven eLearning didactics.

4. Agent Interaction

Figure 1 [see appendix] interprets educational interaction between intelligent agents (HA or TA) as a permanent process of supervised problem solving with the objective of developing a certain problem solving competence. Problem solving itself can be seen as the effort to create a specific intellectual artifact and is as such a response to a symbolic input, e. g. a word as a simple answer to a question, a complex diagram as a summary and interpretation of a data collection, an extensive critical essay as the evaluation of a political measure but also non-verbal creations like a musical improvisations on a certain melody. The evaluation of such artifacts has been traditionally provided by teachers individually - during the learning process - but also standardized as a final assessment of a specific competence through tests. If and to what extent a technological agent (or multiagent) possibly could replace a human mind in such a process has become a challenging and revolutionizing eLearning issue. Some authors emphasize collaborative learning in communities of practice in order to overcome the traditional teacher/learner interaction pattern [Payr 2005] or oppose learning *qua* knowledge transmission with the concept of socio-cognitive learning [Laferriere et al 2006]. Such a modification and expansion of the traditional view on learning would not contradict Figure 1, whose generality and functionality is principally open to different interactive learning constellations [cf. Section 5]. Predominantly, it is the crucial relationship between human intentionality and automatic computation [cf. Self 1999 for a discussion of this genuine AI issue in terms of eLearning, Pollock 1995 for a technical philosophical outline, Block 1995 for a principal philosophical discussion] that theoretically leads the debate and factually determines TIA implementation. The most

obvious exemplification of the aforementioned issue is the question if and how syntactically driven computation possibly can reconstruct (imprecise) human semantics [cf. Sheth et al. 2005].

5. Interactive TA– HA constellations

We interpret the different positions for intelligent agents in Figure 2 (P_1 , P_2 and P_3) as variables which can be occupied by the values “HA” or “TA”. Although this is a rather simplified view, since these positions could appear differentiated within themselves (e. g. as multiagents or HA-TA sub-cooperation), eight distinct constellations appear possible in an interpretation of this model [Figure 3].

For example, the “HA/HA/HA” pattern could be seen as the traditional learning form, if P_1 and P_3 are executed by a human teacher while a human learner is in the role of P_2 . The occupation of all three positions by one and the same agent results in a self-learning process (which is especially interesting if we refer to TAs, for example as to self-learning robots). A “TA/HA/TA” pattern is exemplified by the aforementioned game oriented simulative learning software for human learners. Speech recognition software, where humans train computers, lends an example for the constellation “HA/TA/HA”.

6. Didactical consequences of TIA

While TIA represent the most striking eLearning challenges in terms of preliminary subject preparation, more basic features of genuine eLearning platforms such as structured conversation tools [Siegel et al. 2004] or threads, templates and modules [Chacon 2005] require essentially similar pre-considerations. Thus, eLearning issues sharpen the insight into an integration of the following areas: Knowledge Representation and (analytical) Symbolic Theory [cf.

Goodman 1976 as a whole theory, more specifically Sun 2003 for the acknowledgment of Semiotics in eLearning) offer differentiated formal theories of knowledge structures and symbolic systems while Psychology contributes sensitivity regarding ontogenetical and cultural characteristics of and differences among learners. Cognitive learning theory and Meta-cognition can be seen as mediators between logico-semiotical and psychological tasks. We additionally have to underline the importance of the methodology and ontology of *specific* subject fields as *the* determining force for possible instructional approaches – an aspect often overlooked in more general eLearning discussions. But above all, we advise a permanent reflection on a detailed and subject related application of learning taxonomies as main source for an evaluation of eLearning contributions. Indeed, if TIA (and other eLearning devices) can originally help to reach higher levels of learning objectives – those which require more philosophical and critical thinking – remains questionable.

7. Conclusion

In order to give a full account of the opportunities and challenges that eLearning presents, significant research needs to be conducted to analyse exactly how each of the component parts of eLearning [time-space distantiation, multimedia technologies, and TIA] impacts upon each individual learning objectives within learning taxonomies. This is an essential investigation to ensure that eLearning is not adopted without careful, systematic, and continuing reference to and reflection upon learning objectives. Methodological considerations when designing TIA may in fact provide useful information to educators in the sense that subsequent use of TIA will informate (cf. Zuboff 1988) the process of didactical enhancement. Ironically, the processes of

content preparation and informing should create pedagogical knowledge in general, applicable not only to the understanding of eLearning environments, but also to assist in traditional classroom based learning.

8. References

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Appendix

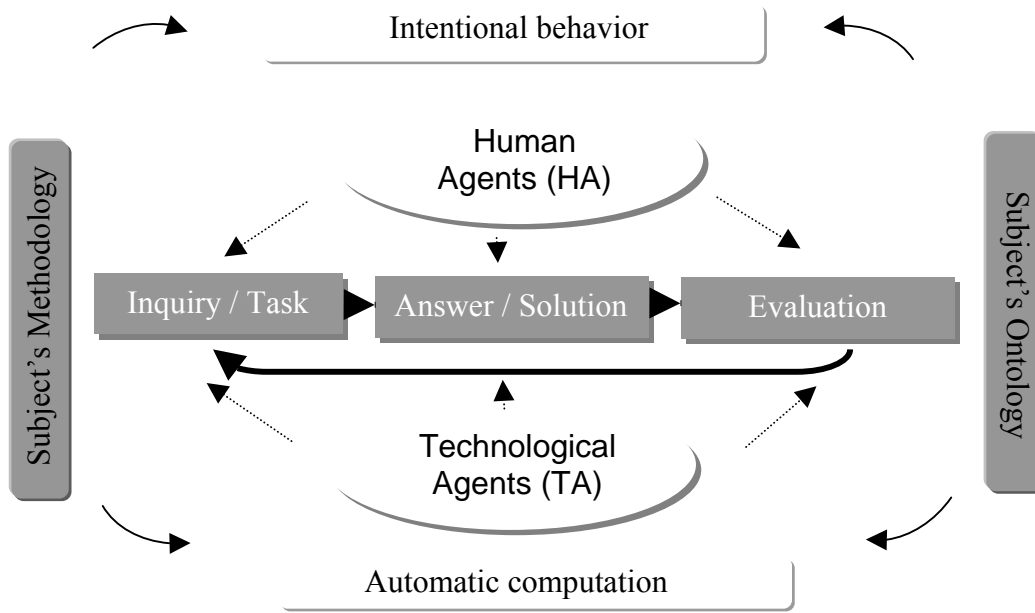


Figure 1

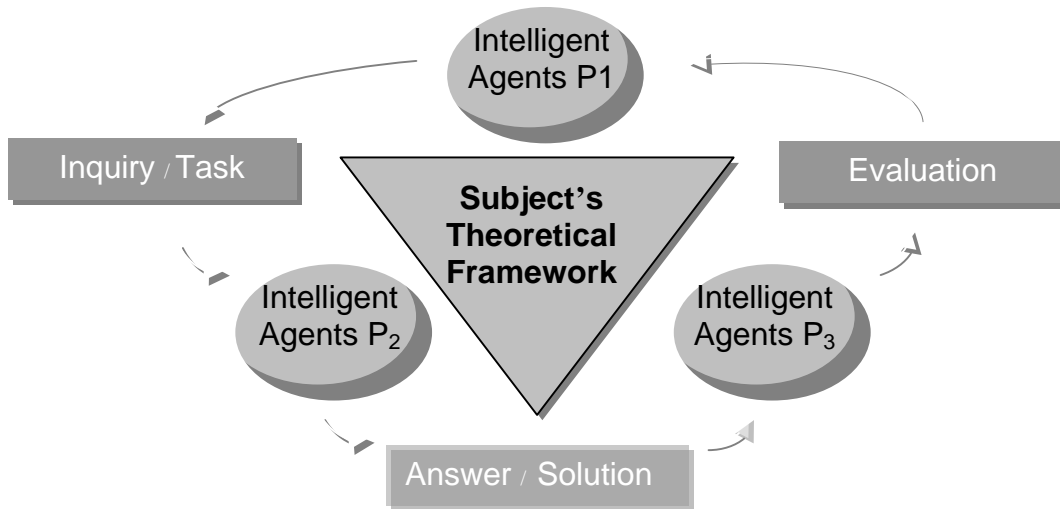


Figure 2

P₁	TA	HA	HA	HA	HA	TA	TA	TA
P₂	TA	HA	TA	TA	HA	TA	HA	HA
P₃	TA	HA	HA	TA	TA	HA	TA	HA

Figure 3