Intelligent Agents and the Teaching of E-Government

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1. Introduction

Over the last years, the public sector in Europe has proved to be extremely active in the implementation of information and communication technologies both in its internal activities and in its relationships with its interlocutors. Several pilot initiatives and projects have been started and the legislator has provided an effective support, especially as regards the regulation of electronic signatures and documents, electronic procurement, electronic protocol, and so on. Therefore, a need is strongly felt in order to enable civil servants and decision-makers – as well as the citizens and the industry - to reach a common level of awareness and knowledge in relation to the new technologies, their applications in the Electronic Government and the legal consequences they imply. However, this should not only take into account consolidated tools, but also innovative ones, such as, for example, intelligent agents. The relationship between the teaching of E-Government and agents can basically be seen as twofold: on the one side, agents can be the subject of teaching; on the other side, they can be used as a sophisticated teaching tool. A particular area of interest on which teaching should be focussed is that of electronic public procurement, that is the on line purchase of goods and services by public administrations.

2. What is an agent?

Before analysing the role of intelligent agents in the teaching of E-Government, it is opportune to provide a short technical framing of the concept, which should not be given for granted.
In general, agents can be described as computational entities able to interact with the environment in which they are placed, through the performance of three basic functions: the perception of their environment, the processing of the information coming from it and the consequent performance of actions aimed at modifying its status.\(^1\)

They possess special characteristics, some of which are deemed necessary for their very qualification as agents, such as autonomy, the ability to interact with their own environment and persistence, that is the ability to last over time. Other features, like intelligence, mobility and sociality are instead possessed only by some particular types of agents.

The concept of autonomy seems especially innovative: within the scope of activity assigned by the user or by another programme on whose behalf agents are acting, they are able to autonomously decide what actions they deem most adequate to be performed, without needing to be directly controlled. Some noteworthy features which agents may possess and which differentiate them are connected with their ability to cooperate with other agents and to learn from experience.

Following a function-based method, grounded on what agents can do, we can distinguish between information agents, which carry out searches and data-mining; cooperation agents, which are able to negotiate with other entities - whether agent or human - and transaction agents, which manage activities connected with transactions.

3. Agents as teaching tools

As a preliminary consideration, it can be observed that the teaching of subjects connected with the Electronic Government does not necessarily imply technology-based methodologies. The choice on how to teach depends upon the type of learner, its age, its cultural level, as well as on the specific issues to be taught and the available time. In some cases, more traditional, direct methods can be preferred, while in others on line courses and modules can be offered, either by themselves or integrated with the traditional ones.

Some experiences show how agents can be used in teaching, precisely within the so-said intelligent learning environments. In this context, agents can take up the role of

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2 The concept of autonomy has been variously described. According to Wooldridge M., Lecture 1, Proceedings of ACAI-01 Summer School, Prague, 2001, it is the “capability to act not under the immediate control of a human”, while for Russel S.J. and Norvig P., Artificial Intelligence, A Modern Approach, Prentice Hall, Englewood Cliffs, New Jersey, p. 31, a system is “autonomous […] to the extent that its behaviour is determined by its own experience”, and not merely by the built-in knowledge used in developing it.


“coaches”, which have the task of providing support to students. Agents enable the students to find optimal solutions to complex problems, by helping them identify information and data in connection with known keywords in text questions. Whenever a student provides a sub-optimal solution, the agent leads it towards the optimal one. From another perspective, it has been demonstrated that a learner is particularly motivated whenever it is required to teach a subject as a tutor to other tutees\(^5\); it is the concept of “learning by teaching”. This could be especially suitable in the teaching of E-Government whenever the addressees of the courses are persons of a certain age or professional rank, who find it hard to play again the role of simple students. In this case, with the help of a simulation environment, “teachable agents” can be used. These can be described as “social” agents; this means that they totally depend upon the instructions of their teacher in order to perform a given task and are not in the position of actively and autonomously learning through algorithms. This contributes to enhancing motivation and thus better results for the students who are engaged in teaching: whenever an agent is properly taught, it will be able to solve problems that require the knowledge of specific disciplines, while in the opposite case, it will need to be taught again\(^6\).

At a lower - albeit not less relevant - level, agents can be implemented in other specific tasks connected with teaching, such as the designing of tests for the evaluation or self-evaluation of the knowledge achieved by the students, the creation and maintenance of databases on E-Government connected subjects for education purposes, etc.

### 4. Agents as the subject of teaching

One may ask itself why agent technology should be taught in connection to E-Government. It is actually a tool that up until now has mostly found its natural environment in the performance of actions connected with the carrying out of commercial activities, in particular e-commerce ones. However, it can prove to play a

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relevant role also for public administrations and thus deserve attention in teaching programmes connected with the Electronic Government.

First of all, it should be remembered that - on the one side - the public sector itself is in certain cases involved in commercial activities, for example as the purchaser of goods or services or the provider of services to third parties, such as citizens, companies or other public administrations. Very often, said services are offered on line through open networks, such as the Internet; in these cases, public administrations may avail themselves both of information agents for data searches and negotiation agents to carry out on line transactions.

On the other side, if we only think of information agents, they can be used to perform on line searches for data that can be potentially relevant in relation to any function - having or not commercial purposes - to be performed on behalf of the public administration. This may affect, for example, legislative offices which have to be constantly updated on new rules and regulations, or local administrations needing to monitor national and foreign E-Government-connected pilot initiatives or calls for tenders, etc.

A further possibility of utilisation of intelligent agents for the public administrations can be envisaged in the personalisation of services to citizens and to the industry. These latter could be guided through services with the aid of intelligent agents and not simply receive a standardised set of services based on simple automatic procedures.

In so doing, it is important that the public administration on whose behalf agents are acting makes sure that the delivery of the service is correct, law abiding and compliant with its policies.

5. Some notes on the legal implications of agents

When dealing with agent technology in connection with teaching, as in all possible applications of sophisticated technologies, the public sector should be aware of the possible legal implications that derive from it.

In order to better introduce the legal perspective, a parallel can be drawn between agents and traditional software. It has to be clarified that agents can be regarded to as a software possessing particular characteristics, while not every software is also classifiable as an agent.

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In legal terms, software can be considered as a means to transmit the conditional will of its owner. Provided that it has been correctly developed and that it is reliable, it can be affirmed that its behaviour can be foreseen. Software is developed in such a manner as to exactly perform particular tasks and subsequently stop; it is totally dependent upon a higher entity. However, it is not possible to be completely sure of the results of its actions, except in theory, as it may not have been adequately verified and may contain errors.

Unlike with software, not even the exact behaviour of the agent in different circumstances and conditions is to be totally foreseeable. This makes it difficult to affirm that agents are in fact an instrument for the transmission of their owner’s will, not even where conditional. It cannot be given for granted, in fact, that - given a particular context and specific instructions - the agent will always act in the same manner. It may be inferred, therefore, that a part of the agent owner’s will, as concerns both its development and its subsequent manifestations, can be technically attributed to the same agent.

At present, the legal research on agents appears quite scarce, while the European legislator has not yet explicitly addressed the issue. The U.S. legislator, instead, in the Uniform Computer Information Transactions Act (UCITA) proposed uniform law, has laid down some specific rules on the use of “electronic agents”.

Given the presently applicable legal framework, the agent cannot be considered an autonomous entity to whom rights and duties can be imputed; it does not possess a personality or a subjectivity in the legal sense. Therefore, it should be reflected upon the theoretical solutions necessary to legally impute to its owner that specific portion of will connected with the agent.

Some doctrinal contributions, albeit related to the unpredictability of software - a concept which may, in the opinion of the writer, not be totally sharable - have proposed some solutions in this sense. In particular, it has been affirmed that software possesses a potential will that cannot be totally foreseen by its owner and thus it is deemed acceptable the application by analogy of the principles of voluntary agency. However, it can be argued that this may be considered unfeasible, as software agents cannot in any case be considered “agents” also in legal terms, owing to the mentioned lack of

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9 See, in particular, UCITA, Section 107 (d).

subjectivity of technological tools\textsuperscript{11}. Others, in relation to artificial intelligence applications, have affirmed that the results of the processing must be imputed to the subject who avails itself of the programme, following the principle of reliance\textsuperscript{12}. The rights of those who have relied on the validity of a contract and on the correct manifestation of the will of their counterpart need to be protected.

From another perspective, it could be resorted to the principle of objective liability. It is the situation in which a subject appears liable for a fact from which damages have arisen, although neither intentional wrongdoing nor fault from its part are to be envisaged. The foundation of objective liability lies in the very connection between the fact and the event which has caused damage. The author of the fact will be liable unless it proves that the event was unforeseeable or inevitable, thus dissolving the cause-effect relationship\textsuperscript{13}.

The use of agents might also be reconnected with and compared to the carrying out of dangerous activities, as of art. 2050 of the Italian civil code.

Where an activity can be considered dangerous owing to its nature or in relation to the nature of the means utilised in its performance, the damage caused through it shall be compensated, except in case the author of the fact provides evidence that it has adopted all measures suitable to avoid damage. If the technological state-of-the-art does not allow for adequate measures to be taken to prevent damage, the dangerous activity will be performed at its author’s risk, as the affirmation of the absence of prevention tools does not, in any case, exempt it from liability.

6. Agents in Electronic Public Procurement

A particularly relevant application for which agents can be implemented in the public sector is electronic public procurement, that is the on line purchase of goods and services by the public administrations.

From the legal standpoint, it has to be observed that the doctrine is still debating on the nature of public procurement; some affirm that it falls within the legal institute of public tenders, while others see it as a particular form of e-commerce. The consequences on its regulation would be quite different, especially in terms of the possibility to apply public law or private law rules.

\textsuperscript{11} See the Guide to the Enactment of the UNCITRAL Model Law on legal aspects of electronic data interchange (EDI) and related means of communication, 1996, 48.

\textsuperscript{12} In this sense, Finocchiaro G., I contratti informatici, cit., p. 65. Clarizia R., Informatica e conclusione del contratto, Giuffrè, Milan, 1985, p. 126 has also made reference to the theory of reliance, albeit in relation to the unpredictability of computers.

\textsuperscript{13} Galgano F., Istituzioni di diritto privato, CEDAM, Padua, 2000, p.321.
The Italian legislator, for example, has chosen not to modify the regulations on commerce to include electronic procurement; instead, this latter remains based on the traditional discipline on the choice of the counterpart and on the purchases performed by the public administrations\textsuperscript{14}.

Taking as a reference the Italian legal framework, the basic reference point is the Presidential Decree 4 April 2002, No. 101, a regulation which sets criteria and modalities for the performance by public administrations of telematic procedures for the purchase of goods and services. The Decree has made it possible to carry out the presentation and evaluation of offers for public procurement, as well as the final award, entirely on line.

Software agents are not explicitly foreseen by the Decree but can easily fall within the category of ICT tools that enable the cited telematic procedures. A very important application where they could be implemented, in particular, is the final award. The criteria for the award - in theory - always remain the same as in traditional procurement, that is the lowest price or the most advantageous economic offer; however, some authors\textsuperscript{15} have observed that, in practice, it is difficult to think that in a totally automatic procedure such as the one foreseen for the electronic procurement there can be space for the most advantageous economic offer. The reason lies in the very nature of the information systems used for the evaluation of the offers; they are programmed to perform some operations that cannot be compared with the ability of a human operator.

Different considerations would apply where intelligent agents were utilised. If adequately developed, these latter would be able to reproduce the evaluation procedure typical of a human agent and make it possible to perform an analysis that considers the whole of possible situations that characterise a tender with the evaluation of the most advantageous economic offer.

7. References


Biswas G., Katzlberger T., Bransford J., Schwartz D., & The Teachable Agent Group at Vanderbilt (TAG-V), \textit{Extending Intelligent Learning Environments with Teachable}


\textsuperscript{15} Sarzana di S. Ippolito F., \textit{L’e-procurement pubblico}, cit.


