DigiStylus: A Socio-Technical Approach to Teaching and Research in Paleography

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Abstract

After a short overview of the results obtained by the use of information systems for teaching and research in paleography, the problem of the students' access to information on the web is discussed. The difficulty students have in finding the "right" documents, among the ones freely available in the site of the "Materials for Latin paleography", can be considered a particular branch of the broader problem of finding information in the web. As a result it is first analyzed the use of semantic web to solve students' problems, soon after the socio-technical approach in the planning and carrying out of a new information system for the management of teaching-learning materials is reported. The latter hypothesis, on the basis of the constructivist initial results, seems the best to meet the students' needs. To implement this solution a new online information system has been planned; in it students are involved both in the collection and the creation of information.

This approach transforms the search for information in the creation of new information to be included in a meta-structure for information retrieval; the main hypothesis is that it helps students in developing meta-cognitive skills while collaborating among themselves and working with professors and experts.

Keywords: constructivist learning environment, online information system, socio-technical approach, teaching paradigm, web technologies

Introduction

Since 2001 different web sites, to be used for research in paleography, have been planned and carried out. The online information systems underpinning the web sites were used to manage bibliographical data on medieval manuscripts and implemented the processes usually adopted from researchers for the collection of information.

The systems helped scholars in better analyzing the bibliographical information they collected and produced relevant effects on research. When analyzed by the DeLone and McLean model (2003) they would probably obtain good scores for the systems evaluation, but no assessment of their quality, efficacy, user satisfaction etc. was made.

No official motivation for the lack of the systems evaluation was given (i.e., they were made to answer to special needs), but those systems were used very soon to involve students in the management of bibliographical data and for teaching paleography. The reason for the above

choice was the conviction that web technologies could be used for actively involve students in learning, in a sort of reviewed application of the J. Dewey (1916) pedagogical method. To establish whether the conditions for the application of Dewey's ideas were present in the new environments and to have a snapshot of the students' engagement, a short description of the web sites is reported below.

Women and written culture in the Middle Ages (Cartelli, Miglio, & Palma, 2001) manages the data on the women who wrote manuscripts in the Middle Ages, together with the manuscripts they wrote; sometimes, they also let people see the women's handwriting styles by means of suitable images. The database can be accessed only by the authors and allowed people for the input of the bibliographical data; the information contained in the database on the contrary, can be queried by everyone.

The *Open Catalogue of Manuscripts of the Malatesiana Library* (Cartelli, D'Altri, Errani, Palma, & Zanfini, 2008; Cartelli & Palma, 2002, 2003) is the most complex system among the ones created until now (it derives from the more general idea of an Open Catalogue and has been made up by the staff in the Malatestiana Library). It is made of different sections (i.e., every library can activate one or more sections depending on its resources), and each section is an autonomous system managing different kinds of information: a) first, there are the documents on the library and its manuscripts (the history of the library, the people who worked at the construction of the collections of the manuscripts etc.), b) the second section reproduces the manuscripts (possibly all the folios in all the books), with a resolution high enough to let scholars and scientists obtain any visual information they could like, without being forced to physically go to the library and getting the manuscripts at hand, c) the bibliography of the texts, the journals and all printed materials on the manuscripts in the library is managed in the third section, d) special communication subsystems like forum, chat etc. to be used from people studying the manuscripts in the library follow; they all aim at creating communities of interest, study and practice and at helping people in these communities to share ideas and information, to propose suggestions etc.

BMB on line (Cartelli & Palma, 2004), is a pure bibliographical information system which manages the quotations of Beneventan manuscripts. People engaged with the collection of the quotations of those manuscripts are grouped into three categories:

1. contributors, who can access web forms by writing, modifying and deleting bibliographical data;
2. scientific administrators, who can manage all data and write, modify, and certify bibliographical materials; this last operation being done only once, because certified records cannot be reviewed (the same operation makes bibliographical records available to general users);
3. the system administrator, who is allowed to do all operations, including the modification or deletion of certified data.

General users can only access certified bibliographical materials in the site according to different query pages: a) by author's name, b) by manuscript, c) by contributor, d) by one or more words or part of them concerning title, location, or bibliographical abstract of a given publication.

It has to be noted that within the system are also implemented: 1) a closed communication subsystem made by an electronic blackboard, letting contributors and scientific administrators quickly exchange messages and texts, 2) special functions, available only to the system administrator, for the production of the printed versions of yearly collected data.

The effects the online information systems had on the students were more complex and articulated than expected and hypothesized at the beginning and, when compared with the results of

North American researchers who worked on the use of ICT for the carrying out of constructivist learning environments, produced the following remarks (Cartelli, 2007b):

1. the information systems contributed in the creation of constructivist learning environments and helped students to develop cognitive apprenticeship strategies (Jonassen, 1994), very useful for the improvement of students' learning and performances,
2. the features of communities of learners (CoLs) and fostered communities of learners (FCL) were detected in the classes involved in the use of the described systems (Brown & Campione, 1996); otherwise stated, the online information systems, while supporting and extending traditional learning strategies, induced the creation of special communities, never detected in traditional paleography courses,
3. new skills emerged in the students while working on the information systems described above (Scardamalia & Bereiter, 1996): a) talent in working in a group, b) easier facing of complex tasks (thanks to the help each student could have from colleagues) and c) raising of the individual's peculiarities within the community,
4. new transversal competences were detected: a) better computing skills with respect to those of students attending traditional computing literacy courses, b) development of meta-cognitive strategies.

At last the generalization of the above systems led to the hypothesis of a new pedagogical paradigm: "the implementation of practices with the ICT". Its features look similar to the ideas reported by other researchers to explain the transfer of knowledge and expertise in people working with information systems (Rickard, 2007), but are mostly based on human and social factors with respect to the others.

In what follows the above ideas are applied to the solution of the problems the students show when they have to face great amount of data; furthermore these ideas are compared with the use of the semantic web.

Students' Problems, Semantic Web and New Teaching Paradigms

If the online information systems described above have been planned for research and used also for teaching, the static web site "Teaching Materials for Latin Paleography" was made up only to support teaching. Its main aims are in fact: a) to make available to the students the materials for the understanding of the ancient writing styles, b) to let them better face the final examination in Latin paleography (Cartelli & Palma, 2005).

The site is made of three sections continuously evolving and enriching for the addition of new documents:

a. plates, reproducing folios of ancient manuscripts (texts written in the different Medieval scripts); together with the images, the transcriptions are reported (i.e., digital full texts where symbols, special signs and abbreviations are clearly written). All the documents are organized on a tree structure, based on the writing style adopted in the plates,
b. texts, containing full or partial documents reproducing papers, presentations and articles in conferences, catalogues and books, on different discipline topics like book archaeology, scripts, cataloguing, history of paleography etc.
c. work in progress, hosting special documents; usually they are simple archives created with office automation programs (like MS Excel or MS Access), which are managed by

the professor and the students (work in progress to be operated collaboratively, to be downloaded from the site etc.).

The web site started the first time in 2001 and helped the students in the development of the competences for reading and understanding ancient handwriting styles, learning the history and the evolution of European national languages (especially Italian) and for approaching the processes, the strategies and the policies for the preservation of ancient manuscripts.

A relevant change in the way the students accessed the materials in the site was detected during last years by observing students' behaviors and collecting information at the end of the courses with simple questionnaires (it was very easy to collect the data on the students for the little numbers of them each time involved in a course; in the worst case they were in fact 19). The students were asked to say what pages and materials they visited in the site and how much time they spent in working on them.

The conclusions can be summarized as follows: the more the materials, the more the difficulties the students had in autonomously managing the study materials. The following two opposite behaviors emerged from students' answers:

a) at the beginning when the site was just made (i.e., when only a few documents were available), the students read all the texts and autonomously transcribed almost all the plates (then compared the texts they produced with the professor's solutions),

b) now, when more than 86 documents and 281 plates (with their transcriptions) are available in the site, the students mostly limit to the texts the professor suggests in his lectures and limit themselves to the analysis of the plates they discuss in the class.

When asked for the reasons of their behavior, the students mostly say that they hardly find the "right documents" to study or to analyze, when they autonomously browse the site. Very often, in fact, they are forced to read more than one document, before finding the right information or before understanding what document to search for and, sometimes, this time consuming job prevents them reaching the goal and bringing to an end the research.

It is beyond the aims of this paper a detailed discussion of the results obtained and their explanation. The issues listed below represent a first attempt of explanation for the changes in the behavior of the students:

a. the increase in the quantity of materials in the site *tout court*,
b. the overestimation of the students' knowledge and skills when they are requested to find a given information in a relevant amount of data,
c. the generational change inducing new and different features in the approach that younger students have with technology.

None of the above reasons contradicts the hypothesis by which we are facing a special situation, probably to be included in a more general problem, concerned with the search in the web.

Probably the solution of the students' problems can benefit from the right answers to the following questions: What difficulty do people have while searching materials in the web? Do they succeed in finding the right data on the web? Can the semantic web help students search the information they need and build new and meaningful knowledge?

The last question doesn't completely include all the other questions but it is the most comprehensive one, and we'll concentrate on it, in what follows. On this regard some features of the semantic web and of the information systems will be analyzed.

Semantic Web and Education

The basic idea of the semantic web, as stated from Tim Berners-Lee, is relatively straightforward: to create a layer on the existing web, enabling advanced automatic processing of the web content, so that data can be shared and processed both by humans and software.

This declared result is obtained through the use of Resource Description Framework (RDF)-related technologies, but there are also many other technologies for the creation of semantics. Some among them are reported below (Koper, 2004):

1. Unified Modeling Language (UML), providing a collection of models and graphs for the description of the structural and behavioral semantics of complex information systems,
2. XML and XML Schemes, to structure data and documents according to personal or community defined vocabularies (within which semantics can be implemented),
3. RDF and RDF-Scheme, the metadata approach from the W3C, defining semantic meaning for data on the web (i.e., multiple semantic perspectives of the same data are possible),
4. Topic Maps, defining arbitrarily complex semantic knowledge structures and allowing the exchange of information for collaboratively building and maintaining indexes of knowledge,
5. OWL – Ontology Web Language, implementing the semantic description of a domain by means of the specification of its concepts and relationships,
6. Latent Semantic Analysis, based on the use of programs for the understanding of natural language,
7. Software Agents, rather ill-defined, but commonly identified as pieces of software acting proactively (they are adaptive and (semi-) autonomous and can communicate with other agents and human creators).

While looking at the use of the above instruments in teaching and learning activities R. Koper (2004) stated that the introduction of the above instruments in education aimed at: (a) increasing the effectiveness of education, (b) increasing the flexibility and accessibility of education, (c) increasing the attractiveness of education and (d) decreasing the workload for educational staff (or, more in general: decreasing the institutional costs). On these bases Koper proposed an educational semantic web (i.e., a strategy representing a course in a formal, semantic way so that it could be interpreted and manipulated by computers as well as humans).

If everything sounds good in Koper's ideas and suggestions, the positivistic and deterministic ideas underpinning his hypotheses are often at odds with the results coming from the application of good management strategies in the school curricula and from the suitable control of teaching-learning processes (i.e., from good practices). It is well known by every teacher, in fact, that the best teaching strategies not always guarantee an efficient and meaningful learning or help students in overcoming their difficulties.

The above statement means that LOs (learning objects) and UOLs (Units of Learning) do not automatically guarantee the students' acquisition of the right knowledge, skills and competences. That happens also when special and well defined LOs are made under the consideration of the right dependencies from other topics (which can be other LOs or more complex structures like the ones in the semantic Web) and when they are included in the processes of knowledge construction performed by one or more UOLs.

To obtain the best results from new technologies it could be very important to consider the results from traditional teaching and especially:

a. the introduction of feed-back and recovery actions in teaching processes (self managed by the students or governed by the teacher),
b. the use of strategies helping students to overcome the difficulties they meet in the study of scientific disciplines and in the acquisition of meaningful learning.

Many studies have been made on these topics to investigate the dependencies of students' performances from their learning styles, the interactions they have with real or virtual learning environments etc. More generally, online action research strategies have been suggested for the systematic monitoring of the students' behaviors and the collection of the corresponding data with the ICT.

In figure 1 the comparison between traditional teaching-learning processes and e-learning is reported with a special attention to the following elements: content (topics in scientific disciplines), process (teaching management) and student (individuals' features and results/performances after having attended teaching-learning experiences).

In the last box the lack of any adequate and systematic instruments and strategies in e-learning contexts is evident (Cartelli, 2007a).

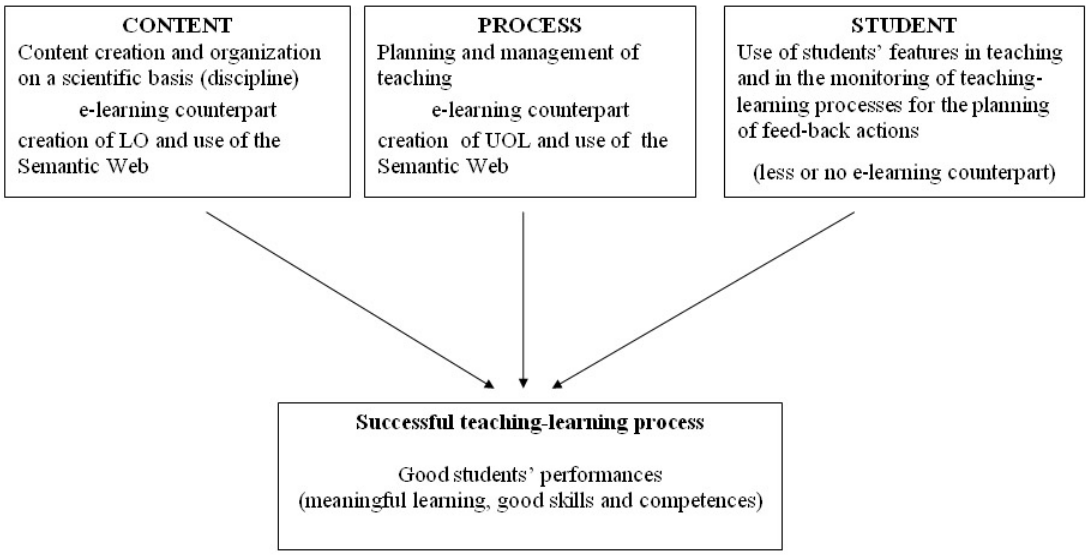

Figure 1 – Elements affecting teaching-learning process and their e-learning counterparts

The lack of contact points between traditional teaching and e-learning in the last box is neither synonymous of the ICT exclusion from the corresponding processes, nor means that there are no experiences or researches involving its use; it only points out the need for further studies and research.

Nowadays the educational potential of automated technologies has still to be deeply analyzed and it is probably too early to say what influence they will play in formal education and especially at school.

In next paragraph another pedagogical paradigm involving the use of ICT in a constructivist way will be discussed.

The Implementation of Practices by Means of ICT as a New Pedagogical Paradigm

The idea of the possible influence of online information systems on the creation of communities of learning and practices led to the hypothesis that new technologies changed, or at least introduced new approaches, in the construction of knowledge.

By following Ong's (2002) and Olson's (1991) ideas of a connection between technology, literacy and new orality (or *second orality*, as they like to say), new dimensions for human communication and knowledge construction could be induced by the ICT.

Without entering the debate on the influence that Knowledge Management instruments, processes and functions have in corporate, organizations and maybe single persons, it can be easily recognized that the problems showed by paleography students are knowledge management problems. The leading idea in this paragraph is that the use of socio-technical strategies, supported by special information systems, can help to find the right solutions to the above problems. Before doing that, some conclusions on ICT influence on knowledge construction are reported.

The following remarks synthetically describe the features of the different levels for the influence of the ICT (and the information systems) on knowledge construction, by looking at two different points of view: the personal development of knowledge and a more theoretical one. In detail:

- first, the subject's point of view is considered. By this perspective it can be stated that people build knowledge in at least three different ways: a) autonomously (mostly constructively, by interacting with phenomena, real or virtual they are) , b) by socially interacting with other individuals in a community, where mediation and support from peers have a relevant role (and ICT are important in helping subjects to create communities or induce communities), c) by being an active part of the society they are immersed in, where emulation of behaviors and codified and socially accepted rules can modify pre-existing learning strategies or determine new ones. As a conclusion, subjects' knowledge is made of three components: the individual, the community and the social ones, with their own contents, learning strategies and possible communication channels (Cartelli, 2006). Figure 2 gives a snapshot of the tri-partition of this viewpoint.

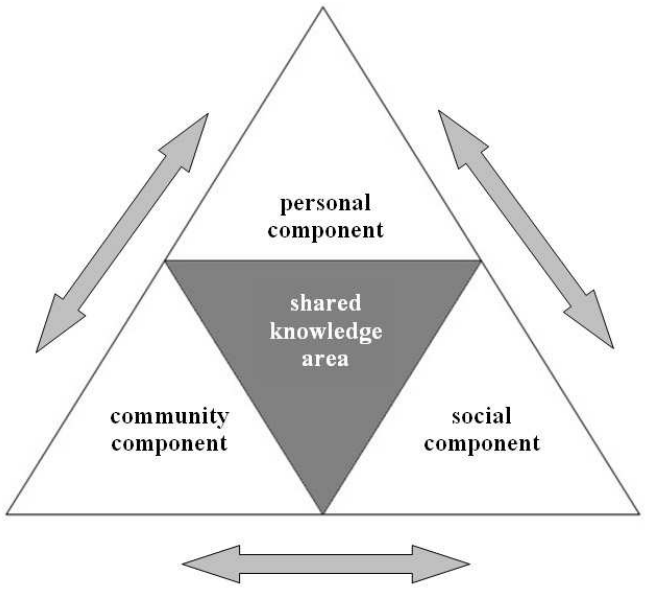

Figure 2 – Knowledge components and their interactions

- second, the other viewpoint is concerned with the analysis of knowledge by itself; that is knowledge as a theoretical construction, or an artifact of mankind. In this case, like the former one, at least three kinds of knowledge can be recognized:
    1. individual knowledge, built by subjects who construct their knowledge while interacting with the environment they are immersed in (natural or virtual, populated or not by other subjects etc.),
    2. community knowledge, belonging to communities as autonomous entities; or by using Wenger's words (2004), it is the knowledge letting communities identify themselves in an autonomous social environment, where people have common aims and motivations and share a repertoire of instruments, made of signs, symbols, processes and strategies,
    3. society knowledge (often called scientific knowledge), which is well codified, evaluated and approved by a relevant number of individuals and communities (it can probably be identified with the scientific knowledge or with its paradigms).

  Figure 2 well describes once again the situation.

The main results from what has been reported until now are:

a. knowledge construction is the result of the influence of the three different components,
b. the planning and carrying out of an information system for the management of information and its retrieval must consider all the components described until now,
c. the use of information systems for implementing the practices adopted by professionals and inducing or creating communities with didactical aims can be considered a new pedagogical paradigm. It displaces the problem of the "search for information" to that of "information creation".

Towards the Final Choice

Both the above instruments and strategies give a solution to the educational problem of helping students to better organize and find information and to construct new knowledge. How to choose the best one? The good results from constructivist and social-constructivist experiences in educational environments (i.e., the good practices experimented until now), suggested the adoption of the socio-technical approach to the introduction of information systems for helping paleography students in overcoming their difficulties. In the next paragraph this choice is discussed and applied to a special information system.

The Information System DigiStylus

The planning and carrying out of an information system helping students in the access to the plates and the documents available in the site of the "Teaching Materials for Latin Paleography" has been proposed as the winning strategy against the students' problem in the retrieving of those documents.

The main considerations which guided the creation of the information system have been:

1. students must be the creators of the information in the site (they must organize and input in the system all data concerned with the documents in the site),
2. the information in the database must to be available not only to students but to everyone in the web,

3. any information students put in the system must be validated by one or more scientific coordinators before being available in the web,
4. a closed forum (communication subsystem) within the information system, letting students communicate, discuss on their work and exchange documents, among themselves and with the professor, must be created,
5. the evaluation of the students' work and the final score they will obtain at the final examination must include:
   - the evaluation of the work he/she made up,
   - the evaluation of the support he/she gave to colleagues,
   - the evaluation of the accessibility and usability of the information retrieved by external readers (i.e., general users),
   - the evaluation for criticism and suggestions he/she gave to the system and its functions.

Before entering the details of students' involvement in the project it has to be noted that the meanings of the words 'usability' and 'accessibility' are here a bit different with respect to their ascertained use. Now external users must evaluate the access to the following elements: a) space (path) and time spent to reach the right and proper information (accessibility), b) easy transportation and inclusion in a wider document of the retrieved information (i.e., by a score in a Lickert scale, people will be requested to evaluate how easy was for them the use of the information obtained from the system).

It can be easily recognized that students are involved in the project at different levels:

- individually, by critically studying and meaningfully learning the basic topics of the discipline, by applying those ideas to the materials in the site and by writing the records in the database (this job is made easier by the presence of supporting materials and the use of communication subsystems letting them easily ask for suggestions and being helped by colleagues and professor),
- at a community level, by adopting different strategies: a) the legitimate peripheral participation (LPP) suggested by Lave and Wenger (1991), helping the management of the community while including the weakest subjects, b) the implementation of practices with the ICT, by letting the system implement the processes which manage the information acquisition, storing and validation (Cartelli, 2008), c) team competency learning, suggested by Jewels and Albon (2006), inducing the professor to act as a coach and assign to every student the best role with respect to his basic knowledge and skills,
- socially, by considering the effects of the information the students produce on the professor and the community they belong to, but especially on the people not necessarily expert in Latin paleography or in any other discipline concerning the study of ancient manuscripts.

The structure of the information system based on the ideas reported until now is drafted in Figure 3, where a snapshot of the data structure and their flow is drawn.

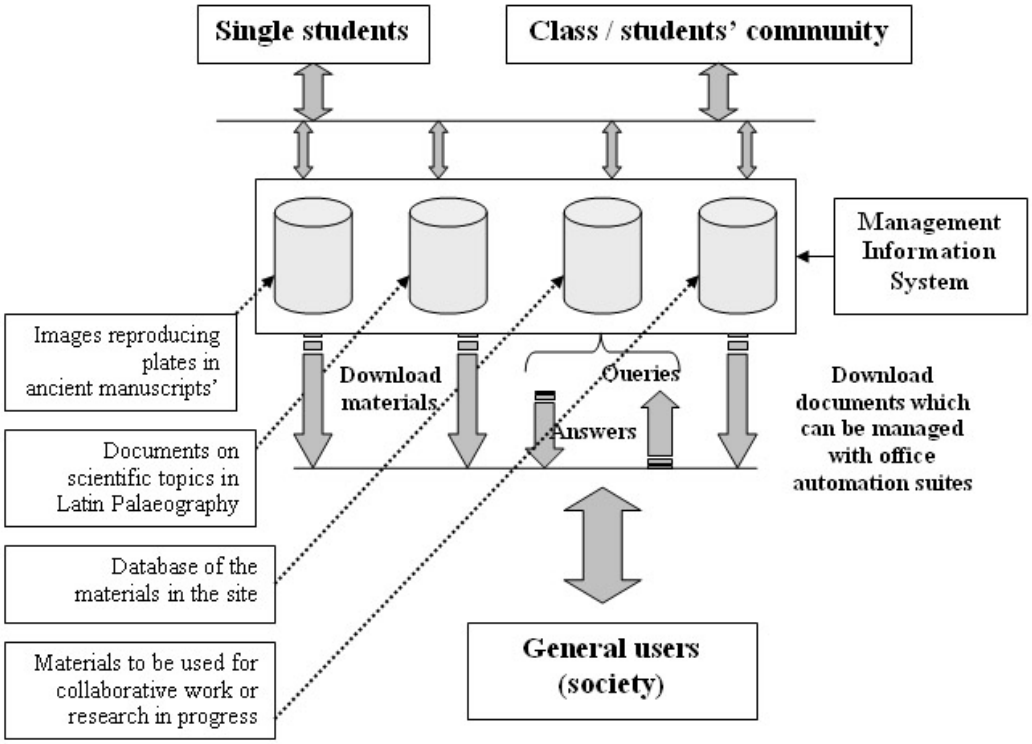

Figure 3 – The DigiStylus information system built around the site "Teaching Materials for Latin Paleography"

It can be easily deduced, from the above image, that the introduction of the DigiStylus information system leaves the former site unchanged (with all the documents and the plates within it), and people who like a direct approach to the materials in the site can access them in the old manner, by browsing it. It must be noted that the repositories for the documents and the plates, are web and/or ftp sites (in both cases http and ftp protocols can be used to access and/or download the documents).

The creation of the whole site lies on the adoption of Open Source software: Linux as the Operating System, Apache as the web server, PHP as the interface language, PostgreSQL and MySQL as RDBMS.

The DigiStylus information system is based on: a) one database, b) different allowed users who can access the database for different operations, c) a query system and d) a specific data flow. In what follows details on the above elements are given:

a. the database lies on five tables: 1) the first, *utente*, is used for contributors' data (students) and for the scientific administrator/s; 2) the second, *plate*, contains the shelfmark of the manuscript the plate belongs to, the bibliography of the book with the reproduction of the plate, the writing style and all other data (if available) to be used for a better description of the page; furthermore there are two fields respectively containing: the link to the web page with the plate, and the code of the contributor who is charged of the compilation of the record; 3) the *transcription* table contains the key words letting people query for the transcription of a given plate, other fields in the table are: the link to the web page with the text of the transcription and the code of the contributor who compiled it; 4) the fourth table, *bibtext*, contains the bibliographical records of the documents in the site, the link to the documents and the code of the contributor who wrote the record; 5) the last table, *bacheca*, is an electronic

blackboard and makes easier for the people involved in the collection of bibliographical materials and the writing of the records of the DigiStylus database to communicate,

b. the users accessing the database have different rights and powers: 1) the user with the least rights on the data is the one who can only query the system; he/she can see plates, transcriptions, the list of the bibliographic materials and any other information on the materials in the site, but he/she cannot insert or modify information in the database, 2) at an upper level are the contributors (students) who can access a special Web area (by means of their ID and password) with a menu of the allowed operations, i.e. they can manage the records on the plates and their transcriptions, the bibliographic cards and the electronic blackboard, 3) the scientific administrator/s can manage all the data in the data base and write, modify and certify the bibliography, also if this last operation can be done only once (i.e. when the bibliography has been verified it can no longer be accessed by the administrator/s), 4) at the top of the access pyramid is the system administrator who can do all the operations allowed to the scientific administrator/s and can access the verified bibliography to modify or to delete it,

c. once the record on a given plate, the transcription and the bibliography are written by the contributor/s, the scientific administrator/s can verify it. When the information is verified it can be queried from a generic user. People interested in the information in the database have different query pages to access them: a) the first one asks for the author of one or more manuscripts and lets people access the plates of the manuscripts containing texts by that author (the list of the links to the web pages with the plates and their transcriptions completes the system answer); b) the second one lets the user select the author of one or more catalogues and gives back the list of the catalogues used for the reproduction of the plates (like in the former case the list of the links to the web pages with the plates and their transcriptions completes the system answer); c) the third query page lets people search for key words (or parts of them) in the transcription of a plate and gives back the list of the plates containing them; d) the fourth and last query page lets the user input the name of the author of a text, the topic, words in the title or in the text and search for any document in the web site which respects these constraints,

d. when the system starts the database is empty and the system administrator has to input the data for at least one scientific administrator; when a scientific administrator is enabled he/she can input the data for one or more contributors and make them access the system, he/she can also input the records on the plates and their translations and the bibliographic data. After that the contributor/s can compile the bibliography in the database. At last the bibliography is analyzed, revised and verified by the administrator/s and it can be read and queried by a general user.

Once the site has been completed people will be invited to use it and to compile a satisfaction questionnaire letting them express if they felt the site easy and comfortable enough to be used.

At the end of the course the suggestions from the generic users will be discussed with the students who were contributors in the input of data in the database.

Conclusion and Implications for Informing Science

It is too early to say whether the aims and the targets of the DigiStylus project will be hit by the underlying information system, or the pedagogical ideas underpinning it will be confirmed by its use, due to the early stage of the information system.

Until now some considerations on the implications for informing science can be made on the basis of the choices which have been made for the creation of the information system digistylus.

Following E. Cohen's (1999) definition of the informing science, in fact, it is the discipline which "provides its clientele information in a form, format and schedule that maximizes its effective-

ness". In this definition it is central the role of the provision of information with respect to the creation of new information or meta-information to let people build their own knowledge structures and overcome their problems. Otherwise stated we are in a situation very similar to that of the comparison of Semantic Web and socio-technologies, described in former paragraphs; in that situation the lack of suitable feedbacks for students and teachers led to choose the use of information systems, under the constraints of a model for knowledge construction, to let students overcome the problems they had in searching and finding information.

The question is then how informing science can maintain its features when its main aim is to help people build meaningful knowledge and wisdom. Accepted the principle that knowledge acquisition needs the use of digital technologies for building other information with respect to the one to be provided, the informing science will very difficultly limit its analyses to the instruments and the processes concerned with the information management, it will necessarily extend its field of interest to knowledge construction phenomena and to the features and methods of human sciences.

At last, when the reported ideas will be discussed in the scientific community and found useful for the development of the informing science, the problem of the connections and the dependencies between the different disciplines will be far from being solved. How psychology, sociology, anthropology, pedagogy etc. can receive useful suggestions from the informing science and vice versa?

The answers to the above questions are probably some of the challenges of study and research in informing science for next years.

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Biography

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