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Doctoral Thesis

Cognitive artifacts in the didactic design: the role of visual communication in higher education

(Summary)

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Summary

Introduction

This research project comes from the need to reflect on formative practices and their models, lastly focusing on the consequences, not always explicit, that one and the other have towards behaviours and learning. The specific aim of this research is to analyse the main epistemological paradigms that guide university professors in the use of cognitive artifacts, paying particular attention to the web conference. In order to have a significant impact on learning processes, each cognitive artifact must be designed and used following precise theoretical paradigms binding its use.

The context is an experience of university teaching, at the University of Ferrara, supported by the use of technologies called *FaD to attend at distance*, not to be confused with the acronym *FaD distance learning*.

The field of reference is the one of *teaching with media* and the essential idea is that, if used according to the right methodologies, technology can contribute to the process of teaching and learning. This premise places the present work within a problematic framework, far from a technocentric vision, but at the same time close to those theories that consider cognitive artifacts, skilfully used from a pedagogical point of view, useful for teaching.

The work includes two parts, one theoretical, the other experimental.

Key words

Visuals, video pedagogia, artefatto cognitivo, apprendimenti multimediali, web conference.

Part I

Theoretical Foundations

The first part intends to retrace critically the use of audiovisual representation in teaching and learning processes, from cinema to the latest multimedia applications. This path that leads to a new discipline, defined by us as video pedagogy, is integrated by two important aspects: the principles of multimedia learning, investigated according to the perspective of cognitive psychology and of instructional design; the main learning theories that help a conscious use of technologies in teaching processes. This overview is essential to understand the principles underlying significant learning (Ausubel, 1968) that can be obtained through multimedia teaching communication.

I. The role of visuals in the construction of the knowledge: a historical path between cinema and television

From the 1960's onwards, research in between the fields of communication and education has dealt with the relationship between didactics and image according to the dual declination of "to the media" and "with the media" education, referring, in the first case, to the semiological paradigm based on the centrality of languages and meanings (media as an object of analysis and study: analysis of cinema and television), in the second, to a technological paradigm, functional to the use of audiovisual codes as representation of didactic content, supporting and enriching (with scientific film, with audiovisual, with didactic television) the teaching/learning processes.

In this chapter we investigated the use of audiovisual mass media in educational processes (cinema and television), trying to identify the actual results in light of initial expectations. Retracing the main stages of this path - the various theoretical positions in favor and against in the scientific debate - to identify limits and difficulties encountered in the past, can help to better understand the current scenario and to propose educational solutions effectively.

The moving image has been used in teaching and scientific practice since its birth. As Farné recalls (2002), around 1910, scientific cinematography and teaching films were born, which, in the context of a positivist pedagogy, focused on enhancing every technology applied

to teaching, were presented as the most effective and innovative instruments to develop school learning. In the United States one breathes, as Cuban (1986) remembers, that air of optimism, starting from the twenties, on the educational power of cinema, considered a powerful tool of teaching modernity at the service of a progressive teaching, able to create the more powerful weapon that has ever existed to combat ignorance.

Didactic potentiality derived from the capacity of the cinematographic image to bring learning closer to life: the character of realism allowed, it was thought, an effective transmission of knowledg, as well as an increase in the level of motivation. The debate has also determined positions superficial and approximate, but which nevertheless testify to the centrality of visual communication during the last century.

The opposing positions criticized the use of cinema in teaching processes, especially the sound and color cinema, guilty of increasing the spectacular and emotional dimension to the detriment of the "didactic rigor" that needed analysis, abstraction, conceptualization.

Starting from the fifties the enthusiasm for the teaching potential of television was higher than that shown for cinema (Ranieri, 2011). Its characteristics of "window on the world", of a realistic representation of reality, of communicative completeness, allow students real, authentic, superior experiences than those allowed by cinematographic technology. A second advantage is given by its diffusive capacity, television can bring its programs directly to people's homes, according to the distance education paradigm.

From these characteristics depend a series of educational and didactic transmissions created between the Fifties and Sixties in Italy - *Telescuola*, *Non è mai troppo tardi (It is never too late)* - whose analysis highlights the sure potential of audiovisual communication in the transmission of information, but also the limits of the television medium due to the impossibility of reproducing the relational aspect, central in the teaching and learning processes.

Although the success of these educational programs we realize how television can not overlap the school by becoming a substitute for it, impoverished by the lack of the relational part, but it can transmit educational contents in a different way, according to its own peculiarities. In fact, there have been criticisms of the educational quality of the programs, marked by the lack of "pedagogical intentionality". Technical and organizational problems were also evident: lack of hardware, movement of classes in equipped laboratories, difficulty in matching live programming (the practice of videorecording was not yet widespread) with

didactic programming. All this did not favor the normalization of the use of technology and television educational content, not even with the subsequent advent of videotape.

In conclusion, the cinema and even more the television made us to think of a society in which illiteracy would be defeated and richer from a cultural point of view. We have seen an enthusiasm for these technologies at the service of teaching similar to what we find today when we talk about the possibilities of the network and multimedia as tools to improve the teaching and learning processes. The concrete result is that over time it has been realized that the most optimistic visions have gradually lost energy. The school appears as an almost marble system in its procedural ritual, codified in its time and space, not inclined to use teaching methods other than those known: "the greatest difficulty lies in the inability to see in teaching a living terrain of cultural elaboration, epistemologically complex, in which the relationship between teaching and learning proves to be dynamic and problematic and where the communication technologies bring, with their own specificities, a factor of change and added value" (Farné, 2003, p. 56).

II. Video pedagogy and visuals cognitive artifacts: for multimedia design in higher education

The second chapter lead the path on the audiovisual cognitive artifact to the more recent teaching resources - educational videos, video lessons, interactive videos, web conferences - whose characteristics (ease of use, cost-effectiveness, personalized and interactive use) seem more suitable to a use in educational processes.

Between the Seventies and Eighties in Italy the debate related to the use of video as an educational resource testifies the interest of the scientific community toward such technology. Today, even in the absence of clear scientific evidence, numerous studies show how video resources can give a valid support to educational processes if their use is adequately prepared in the educational design phase.

In current teaching practices the use of video artifacts appears, from a quantitative point of view, increasingly important, in formal and non-formal environments: a lot of knowledge is acquired through multimedia applications, digital content offered in the form of tutorials (videocourse on any field of human knowledge, made by teachers, professionals, enthusiasts), from MOOC platforms (Massive online open courses), from YouTube (the edu channel has more than 10 million subscribers), from hundreds of video portals focused on educational editorial line, huge online databases of instructional videos.

The path includes the definition of video technology to differentiate it from cinema and television, its historical evolution in the direction of the web and hypertext applications, its communication characteristics in relation to the possible didactic applications, a series of methodological indications and guidelines relating to the realization and use of these resources. Our attention focused in particular on those audiovisual resources most used in the experience of the University of Ferrara, examined in the experimental part: instructional video, video lesson, web conference. Resources that, when linked to specific learning objectives, may be able to contribute to the learning process. Of course it is not enough to transmit information, but the result of the vision must have a significant impact on the student's ability to solve problems, to form concepts, to organize and use new information. If we want to make the visual stimuli contribute to the construction of complex meanings, the student's emotional involvement must be adequately accompanied by critical reflection, conceptualization and verbalization.

This can only happen if the audiovisual resources are prepared according to procedures based on research activities and precise methodological indications: on the role of the teacher in video, on the function of real and synthetic images, on the function of the text and its construction, on text-image syncretism, on the speed of elocution, on the density of verbal commentary, on the principles of multimedia learning and cognitive load.

Finally, it is necessary to consider how, with recent technological developments, many limits of cinema and television (passive enjoyment, unidirectionality, identification, emotional involvement) can disappear, bringing the fruition of audiovisual resources closer to the alphabetical-textual one. The two learning schemes, the alphabetical-text based on abstraction, the audiovisual one on immersion, can put in contact through the use of multimedia languages: the possibility of asynchronous use of audiovisuals, their management with multimedia player controls (pause , rewind etc.), modular fruition, hypertext links, forms of interaction in the direction of different levels of user participation, allow a view that facilitates conceptualization. The characteristics of digital video and the increase of experimentation activities in the field of educational technologies seem to give an stimulus to video pedagogy.

The web conference deserves a specific mention due to its characteristics which determine communication processes characterized by “rich information” (Daft & Lengel, 1984) thanks to the possibility of reducing the risks of misunderstandings existing in asynchronous communication. Thanks to its potential, of interactivity, use of different modal channels, variety

of usable languages, and especially the presence of social indicators, the web conference is second only to face-to-face communication.

We have investigated the technological and methodological methods that allow to live streaming a classroom lesson. The best choice is to carry out the web conference with minimally invasive procedures, almost invisible: to overcome resistance to technological innovation in working practices (Rogers, 2003, Bauer, 1995) we need to create a highly technological didactic set to be experienced in a natural way and not as a foreign body to be afraid of (technophobia). The illusion of not feeling any technological mediation in the communicative process (Lombard & Ditton, 1997) and the experimentation of a space in which the physical environment can be decontextualized and the body of the subjects can dephysicalized (Cattaneo, 2009), seems the conceptual scheme on to support the use of the web conference. The virtuous use of this mechanism, naturalization and disappearance of technology, on the one hand, and application of the principles of participatory and relational culture (social and collaborative dimension), on the other, is in our opinion the best method to allow students to distance *to enter in the classroom*.

III. Multimedia learning and cognitive processes: for design in higher education

The potentials of the use of images for representation and transmission of knowledge for educational purposes must be guided not only by the principles identified in the previous chapters, but also by the rules on multimedia learning able to favor cognitive processes. Our field of reference has been research in the field of cognitive psychology and of Instructional Design which has given two meanings to the concept of multimedia (Mayer, 2001):

1. multimedia as a presentation format that adopts multiple sensory channels. The interest of this perspective is directed to the multimodal perceptive aspects that must be highlighted to make the simultaneous presentation of more effective information;
2. multimedia as a dynamic cognitive process that leads to "assemble" information of different types into a functional mental representation to the learning processes".

Particular emphasis was given in the chapter to a series of theories on the functioning of multimedia learning: the work of Allan Paivio (1971; 1990) on *dual-coding theory*, related to the different coding of information, verbal and non-verbal, by the human cognitive system; *cognitive load theory* (Sweller, 1988, 2010) that regards the load imposed on working memory

by the information presented, and focuses on the analysis of cognitive resources used during learning and how they can be directed towards objectives specific didactics (Chandler & Sweller, 1991); the *generative theory of multimedia learning* (Mayer, 2001; 2009), a discipline aimed at the construction of mental representations based on the combination of words (narrated or spoken) and images (illustrations, photos, animations, films) ; the work of Clark and Lyons (2011) on the communicative and psychological functions of the different types of images.

The theoretical references resulting from the integration of these areas can provide useful indications to instructional designers, teachers who intend to use audiovisual and multimedia resources; as well as they can serve those researchers interested in deepening this line of research, in our opinion, fundamental in the Knowledge Society and Life Long Learning. In the chapter it is clear how students' learning through multimedia presentations does not depend on the presentation of the necessary information, but on the presentation of the necessary information according to the functioning mechanisms of the students' mental and cognitive processes. Experimental research shows a better level of learning when the material is presented in more formats than when the presentation is only graphic or verbal. There are, however, less optimistic and simplistic comments on the effects, sometimes negative, of multimedia.

The theories investigated in the chapter produced an important contribution to both the positive and negative aspects of the use of images in learning processes.

IV. Educational paradigms, cognitive artifacts and multimedia design

The introduction of technology into teaching and learning processes does not automatically imply educational innovation. Frequent are situations of mediatised teaching 2.0 in which the classic models of transmissive teaching are moved. They use video lessons, teaching units in pdf, other materials, without exploiting the true potential of the latest technologies towards paradigms of more participation, collaborative and relational. Equally frequent are cases in which multimedia documents are a support of their teachings, without considering the impact, in terms of significant learning, that these materials will have on the acquisition of knowledge by students.

Our idea is that learning processes are not improved automatically when teaching is supported by recent technologies. It is known for certain that cognitive technologies play a

fundamental role in the cognition of the individual, favoring that exchange relationship that defines the teaching-learning action. It is no coincidence that the history of teaching is deeply linked to innovation and the use of technology. But only a correct use of them can bring to a significant learning, intended as: "a change in the human situation or capacity that persists beyond a period of time it is not simply ascribable to the growth process" (Gagné, 1985, p. 2).

For these reasons we have found it useful to summarize the main learning theories that have shown the way for a conscious use of technologies: behaviorism, cognitivism, constructivism, and connectivism.

The analysis of these theories has preceded by an introduction on cognitive artifacts and their characteristics in teaching: their use to avoid repetitive tasks and thus to free cognitive resources to enhance other mental abilities; their use to favor the so-called optimal flow, which determines the maximum concentration in the student's study activity; their invisibility or their natural appearance (like the pen, the book and the blackboard) in such a way as to direct the attention of the student on the task, not on the instrument (Norman, 2015); the creation of technological environments and human-centered interfaces to avoid technocentric attitudes (Norman, 2011).

IV.1. Behaviorism

Compared to the dynamics of learning investigated during the twentieth century by the psychology and pedagogy sectors, different models of interpretation have been used. The first theory that has foreseen within the didactic design the use of technologies is that of behaviorism. In practice the behaviorist paradigm, born from studies on the conditioning of animal behavior, considers the positive reinforcement (reward through good judgment) an important incentive to learn.

The programmed instruction of Skinner was already based on the following principles: use of short content units, student responses, immediate communication of results (feedback), reinforcement and individualization. In Skinner's indications are already evident advantages of the technologies in the learning processes: the immediacy of the reinforcement, the class control from the teacher, the personalization of the learning process, the structuring of teaching materials more and more complex.

More generally, the behavioral paradigm saw as central in the teaching processes the transfer of information to the student according to a transmissive and technocentric model, centered on the figure of the teacher. The teaching and learning process can be summarized in the teaching information propose and in the subsequent verification activity, reinforcing the positive performances. The didactic model appears as a closed system (contents, objectives and education strategies are predetermined), within which the transmission of contents takes place collectively (from the teacher to all those present in the classroom). The book, due to its linearity and sequential characteristics, appears as the suitable artifact for conveying didactic communication. As a result of this model, the computer programs implemented have been characterized by technocentric methods and lack of flexibility: closure, little didactic interaction, no dialogue between the student and the system, reduction of the complex mechanisms of learning to strict rules.

IV.2. Cognitivism

Starting from the 60s and 70s, more than the investigation of observable behaviors (external), it becomes important to investigate the cognitive and mental processes (internal) that come into play in the learning processes. The idea is that the knowledge of such cognitive mechanisms can give rise to teaching methods able to exploit the functioning mechanisms of the mind. A recent orientation in this sense is constituted by the theory of cognitive load that deals with the limits of the human cognitive system, in the relationship between contents, students, and learning contexts (Sweller, 1988). These studies focus on the analysis of cognitive resources used during learning and how they can be directed towards specific teaching objectives (Chandler & Sweller, 1991).

The teaching of cognitive inspiration in addition to the achievement of established educational objectives takes into account therefore the cognitive factors that favor the achievement. The distance from behaviorism is clear: to explain the mechanisms of learning, the accent is no longer placed on the stimulus-response function, rather on the analysis of cognitive processes and on the study of the possible forms of representation of knowledge that our mind is capable to operate.

Not only the cognitive processes, but also, the dynamism of the learning process, the motivations of individuals, cooperation and collaboration that determine relationships and communication exchanges, are the basis of the model. Model that determines big changes on

teaching practices and on the role of the teacher. "His role is no longer transferring declarative knowledge or explaining it better to ensure correct decoding-interpretation, but rather helping to choose the correct method to solve problems, also proposing operative ways to" practice "(not exercises!) and using communication media able to create friendly and emotionally involving contexts" (Galliani, 2004, p. 22). In cognitivism the student is an active subject, no longer a receiver of messages, but an actor participating in the educational process. Of course, not all individuals react in the same way to environmental stimuli, these will be interpreted according to individual cognitive structures.

Technologies are no longer seen as tools for distributing information, but they become perceptive-cognitive extensions of the human being, functional to the representation of the world but also to its understanding and exploration. This technically means the non-centrality of predefined and rigid didactic paths, but flexible paths, generated ad hoc basing on the attitudes of the students.

Starting from the seventies of the last century, the concept maps, developed by the American biologist Joseph Novak, have been often used in the relationship between cognitivism and educational technologies. Assuming that meaningful learning implies the assimilation of new concepts into an individual's existing cognitive structures (Ausubel, 1988), Novak has elaborated the concept mapping system with the aim of formalizing knowledge. The maps graphically represent the interconnection of the concepts possessed within a given domain of knowledge, making explicit what is implicit (Novak, 2002). The cognitive map represents the mental structure of the individual, whose behavior is organized through conceptual schemes, gradually more complex, in which place the acquired knowledge.

In conclusion, it is evident that the cognitivist paradigm considers inadequate the traditional practice of the teacher who explains, and of the pupil who takes notes and memorizes; and recognize to students the responsibility of the meaning creation, aided by the teacher "tutor", "coach", "guide". This is reflected in the design of educational software based on concepts of openness and interactivity, able to complete (and not compete with) human skills.

IV.3. Constructivism

The basic principle of constructivist epistemology, developed from cognitive theories in the last 20 years of the last century, is that knowledge is not transmitted but constructed. Despite behaviorism and cognitivism continued to exert their influence, constructivism assumes, since the 80s and 90s, centrality in the field of educational technologies (Ranieri, 2011). This general paradigm in which different trends develop, means the learning process in more active terms than the previous paradigms. The student is not a passive subject who receives only information from the outside world, but through a personal exploration and his previous knowledge, he builds his own representation of the world.

In this perspective, then, the process of reflection on students' learning paths, guided by the teacher, appears fundamental. It is evident how this paradigm attributes centrality to the individual, as an alternative to an approach based on the centrality of the teacher as the depositary of universal knowledge, abstract and independent from the context. The aim of the educational process is not therefore the acquisition of content that has been pre-structured and permanently cast, but the development of skills, of a personal methodology, which progressively makes the subject autonomous in his cognitive processes. So learn to learn. A very current and functional methodology for a society like the present one that requires the acquisition of cognition and knowledge throughout life.

Naturally some of these principles, as seen, have also been developed by cognitivism. In constructivism, the cultural dimension takes the field the cultural dimension in knowledge acquisition processes, neglected by cognitive scholars, capable of influencing the development and learning of a subject. The cultural data functional to the acquisition of knowledge is evident, as indicated by Bruner (1992): "it is not exclusively located in our mind, but also in the notes we take on our notes (...), in the manuals we have learned to consult, in the sources of information that we have uploaded on the computer, in the friends that can be traced to ask for a reference and so on, almost to infinity".

Naturally in this learning model the student can't be left alone but needs the guidance of a *mentor* or a *coach,* expert in teaching strategies with the task of managing collaborative activities, of assigning specific tasks to individuals. The teacher's role is no longer to transmit knowledge but to contextualise, to orchestrate the exploration of the student's world.

Today the characteristics of the new technologies favor the teaching paradigms based on collaborative activities and contextualised in real situations: from researches on *Computer Supported Collaborative Learning*, at the beginning of the 90s, based on environments able to

favor dialogic processes of collaborative construction of the knowledge; up to the latest logics of the web 2.0. The latter are linked to aspects of participatory culture, activities within online social networks (social networking), collaborative forms of knowledge construction (wiki) etc.

IV.4. Connectivism

The fourth paradigm investigated is that of connectivism, naturally linked to the latest generation of web environments. The boundaries of connectivism, try, according to George Siemens, to cover a space open by digital technologies and not covered by the most classic paradigms born in a different context.

It is the concept of Web 2.0 that has catalyzed the attention of the scholars of the connectivist area: in particular the possibilities offered by Digital Networks to increase the ability of individuals to connect, to enter into relationships with experts, with communities of practices, to create and find information. Centrality of the Net, of the nodes, of the connections, intended as a metaphor to explain how the learning processes take place. In this there is a connection with constructivism, but in the idea of connettivist area scholars, “the ability to connect to information sources and networks of people through digital technologies is more important than the knowledge actually possessed: learning means ultimately remaining connected (Ranieri, 2011, pp. 129-130).

The relationship of individuals with digital technologies (and therefore the relationship between the subject and the information) appears to be the most important aspect, superior to the impact that technologies have on cognitive processes: learning depends on the logic of networking, way to connect and increase its network.

The most widespread criticisms of this paradigm concern the lack of scientific evidence when talking about the effectiveness of "open" technological environments in the autonomous construction of knowledge by students. In the presence of experienced and motivated students the logic of connection to information nodes can make an important contribution to the learning processes (think of the MOOC platforms, Massive Open Online Courses), but one can not disagree with Antonio Calvani (2008): according to Calvani, a wild use of connectivism at school could lead one to believe that it is enough to put students on the net to produce knowledge; consolidating the stereotype that technology, in whatever way it is used, increases learning.

Part II

Experimental research
Multimedia teaching: case study at University of Ferrara

This research project born from the need to ponder on the training practices and their models, within a university teaching experience (at the University of Ferrara) supported by the use of technologies called *FaD to attend at distance*, not to be confused with the acronym *FaD distance learning*.

Once a hypothesis has been identified, an experimental research has been carried out with intentional manipulation of independent variables; the result was measured through a dependent variable (learnings). A control group and two experimental groups participated in the study. A methodology and the related tools to be used have been prepared. Finally, after having identified the sample, an operative plan was elaborated including times and places, methods of analysis. Experimental research was preceded by a descriptive investigation.

V. The FaD model and its characteristics

At the Humanistic Department of the University of Ferrara, a part of the university conventional lessons, starting from the academic year 2013-14, was structured according to a new didactic model: this model is based on the integration of the classroom lesson with the distance learning methodologies.

The declared objective of the University of Ferrara at the beginning of the experimentation was to apply the FaD model to all the University courses over time, in order to:

1. enrich traditional teaching methods using technologies and related paradigms;
2. build more flexible university courses to allow a personalization of the educational path, especially for workers or off-site students;
3. erase the concept of non-attending students;
4. reduce the number of students enrolled for supplementary years;
5. foster the management of inter-university courses;
6. improve student's performances;
7. make the educational offer of the University of Ferrara more interesting and closer to

the new learning "styles" of the young generations.

Basically, two different methods have been developed in addition to the classroom lessons: one basic, the other advanced.

Basic model. The lecturer's lesson, recorded with both audio and video, is broadcasted via live streaming allowing students to make use of it also in the virtual classroom (through a web conference system) on any devices connected to the internet. The basic mode was design with the purpose of:

1. to avoid to create any difficulties for lecturers not used to using advanced teaching technologies; the web conference was provided through non-invasive procedures with the aim of making the technologies invisible within the didactic setting. To overcome resistance to technological innovation in work practices (Rogers, 2003; Bauer, 1995) a highly technological environment was created, to be experienced naturally;
2. involve university professors little by little in order to gradually bring them closer to the advanced mode.

Advanced mode. In the advanced mode, alongside the basic teaching methods, teachers were asked to use a series of teaching strategies that are more functional for distance learning and teaching 2.0, in line with the best practices used internationally: integration of transmission activities with use of video lessons and educational videos, MOOC, use of relational, social and collaborative activities (wikis, forums, chats, etc.), self-assessment activities.

V.1 The numbers of the FaD model trial

In the first year of experimentation (2013-14) the courses involved were 43, the students enrolled in FaD 737, the total hours of lesson 1720. In the current year (2017/18) the courses were 140, the students enrolled to the FaD mode 5562, the streaming hours (and recording) 5.676.

VI.The major premises of the research

The objective of this experimental research is to monitor the effects of the teaching innovation described through strict procedures. Our starting point is the result of the survey observational, a mapping carried out in the second semester of the 2016/17 academic year (February 2017-May 2017) on the *FaD model*. This mapping, made with the support of a grid, provided for the consultation of the teaching activities explored in the virtual classrooms within the moodle platform of all the courses involved in the Humanistic Department (140 courses). The intent was to identify the teaching tools, provided by the advanced mode, actually used.

VI.1. The results of the mapping

From this analysis we obtained some important data; the most significant one, which can be considered the starting point of the experimental research is the following:

> *In almost all cases, the teachers involved in the experience have used exclusively the web conference, despite the tradition of the University of Ferrara in digital education area. The teachers have completely neglected all the teaching tools 2.0; the percentage of teachers who used 2.0 tools is negligible.*

The data collected from the analysis of all the virtual classrooms within moodle, for the *FaD model* showed that these tools have been hardly ever used (136 out of 140 moodle areas have been unused): very few exceptions (only 4 areas include advanced modalities) revolved around the activities of "already experienced teachers" (applications included in the platform by themselves have been used in two cases out of four), i.e. teachers directly interested in educational technologies for their personal and professional interests.

Compared to the overall analysis, what emerges is that in the fifth year of activation of the FaD model, the almost complete absence of educational elements 2.0 continues to appear evident. The transmission-based frontal lesson is predominant.

VI.2. The purpose and objectives of the research

In light of the mapping carried out, our analysis focused on the only technology used by all teachers, the web conference, to understand:

1. the didactic attitude of the teacher. We have already said how any cognitive artifact if it has to have a significant impact on learning processes must be designed and used on the basis of precise theoretical paradigms. These paradigms determine their correct use;
2. a second objective of the research is to go beyond the limits of the laboratory to offer operative indications to both, university teachers and Instructional designers, in order to make a media teaching communication more effective, in terms of significant learning (Ausubel, 1968).

The final aim is naturally to make a contribution to the improvement of learning processes in media teaching situations.

VI.3. *The research questions*

In the didactics with the web conference the fundamental aspects from a teaching communication standpoint are two, beside the teacher's speech.

1. *The use of visuals to support/integrate verbal communication (multimedia presentation)*. Does the use of visual elements allow deeper learning? Which visuals are more effective? How can we evaluate how appropriate the visual materials are? How is it possible to design a correct use of images? How can we adapt visuals to student characteristics? How can we use them to increase the student's motivation? In the theoretical part we have answered these questions through the study of international research: we refer to the identified principles to give an answer to the research question.
2. *The teacher/student relational activity*. The relational aspect, as previously stated, assumes great importance for education mediated by technologies. When web conferencing tools are used to stream the classroom lesson, the synchronous and interactive communication dynamics, if well exploited, allow students at home to "obtain the keys to enter in the classroom" and fully living experience the teaching process. In practice, continuous and feed-back activity is, as indicated by pedagogical research, indispensable for the success of teaching processes (the teacher can intervene based on the students' response) and learning processes (students can improve the performances if they are aware of their didactic criticalities) (Domenici, 2016).

The main question that the research wants to give an answer to is the following:

Does the university professor involved in the "FaD model" experience, use effectively the web conference (audiovisual cognitive artifacts) in a media teaching system? More precisely, the teacher uses well the educational communication rules of the multimedia learning principles that come into play in the case of the use of web conference: visuals and relational activity?

VI.4. The hypothesis

In terms of learning the effects of a lesson built using the web conference are different depending on the way the teaching communication is structured. There are two important aspects of educational communication with the web conference: the use of visuals to support speech (multimedia presentation), a constant relational and feedback activity. The hypothesis is therefore the following:

The valorization of the didactic content presented by the professor of higher education using web conference in according with multimedia learning principles, regarding visuals and visuals combined with chat activities, increase the learning outcomes in the FaD model experimentation.

VI.5. The independent variables

We have identified two independent variables.

The independent variable 1 consists in the visuals inside web conference tool. We will use the same contents of the lesson (the teacher's speech), and we will intervene on the modification of the visuals through the intervention of the researcher. The visuals will be modified through compliance with the guidelines identified in the theoretical part. This is the general principle that has guided our work: learning by students through multimedia presentations does not depend on the presentation of the necessary information, but on the presentation of the necessary information according to the functioning mechanisms of the students mental and cognitive processes.

The independent variable 2 consists in the visuals combined with relational activities (Chat). Researcher will help the teachers to use 25 minute session of chat as integration of the modified visuals (through compliance with the guidelines identified in the theoretical part).

The experimental groups will be subjected in different ways to the two independent variables.

VI.6. *The dependent variable*

> *The dependent variable consists in learning outcomes. More precisely, in the measurement of some learning elements that can be highlighted by the results of the verification tests: the level of knowledge which was measured using a Multiple choise question tests; the level of learning skills, which was measured using an Open-ended question tests.*

Our goal is to verify the activation of metacognitive behaviors, the result of which, obviously, can be fully evaluated in the medium and long term.

VII. Phases and research methodology

Once a research hypothesis was formulated and the main variables of the model were identified, a teaching organized following the FaD model was subsequently identified. Prof. Anita Gramigna (degree course in Educational Sciences, Literature teaching for children, first semester of the academic year 2017-2018) was made available. Finally, a sample was identified and an operational plan was elaborated, including time and place, analysis method and the relative tools to be used.

VII.1. The sample of subjects

The students enrolled in the *Children's literature* course, by Prof. Anita Gramigna, are involved in the experimentation (First semester of the academic year 2017-2018). The students are a total of 127 and have been divided into 4 groups on the basis of a *voluntary sampling of convenience* (thus through a non-probabilistic methodology).

- *Group 1*. 72 students who attend the lecture in the real classroom. These students were excluded from the study. We did not want to work on the comparison between teaching in presence and at a distance.
- *Group 2 (control group).* 18 students attending online (via web conference) following the Lesson in Conventional Mode. We mean by conventional method the lesson taught

by the teacher according to his normal teaching method (before the intervention of the researcher).

- *Group 3 (experimental group).* This experimental group made up of 18 students with the same characteristics as the control group follows via the web conference the Modified Lesson from the Researcher.
- *Group 4 (experimental group).* This second experimental group consisting of 19 students with the same characteristics of the control group follows via the web conference the Modified Lesson from the Researcher, as for group 2; the group will participate in 25 minutes of relational activity (via chat).

72 students in group 1 were excluded from the study because they were not beneficiaries of the web conference service, so the sample object of the study went from 127 subjects to 55.

VII.2. The content sample

The experimental phase takes place only on a part of the teaching. The module used for experimental research, lasting 2 hours (the total teaching lasts 30 hours), is called *Literature for children and new digital technologies*.

VII.3. Measurement of learning outcomes (dependent variable)

The tool used for the misurement of learning outcome was the written questionnaire:

- *Multiple choise question tests* (test_0 and test_01) to mesaure the level of knowledge;
- *Open-ended question tests* (test_02) to mesaure the level of competence.

The control group and the experimental groups carried out the tests at different times: the control group immediately after the frequency of the conventional lessons, the experimental groups after the frequency of the lessons modified by the researcher. To avoid interference factors that could nullify the reliability of the research two different tests were prepared: one for the control group, one for the two experimental

groups. The tests have been prepared keeping the same didactic objectives, only the formal structure has changed. In this way the passage of information from the control group to the experimental groups was avoided.

The results of groups 3 and 4 (experimental) were compared with those obtained from the control group (group 2). To obtain a more objective picture, the results obtained were compared with the students' pre-knowledge, measured with a multiple choice questionnaire (test_0).

VII.4. Preparation of questionnaires

The construction of the questionnaire and its correction grids were carried out by Prof. Gramigna. The work carried out by the researcher concerned the analysis and intersection of data through a statistical program ("R" Project for Statistical Computing). The following are the phases of the work for the preparation, the method of execution and evaluation of the questionnaires:

1. definition research objective and evaluation related to the choice of the sample;
2. clear and precise definition of the teaching objectives to be tested;
3. questionnaires' tipology;
4. item's content;
5. decisions on the verbalization of the items: terminology to be used, that is to say the use of a simple and clear language, with terms known to the students; avoiding negative sentences or double negation; it is important to check the student's ability to respond and not them ability to understand the question;
6. actions for the organization of the items in the test: number of questions, sequence of questions according to difficulty levels;
7. form and scale of measurement of responses (assessment grids);
8. execution tests' modality: explained to the students very thoroughly the structure of the tests, to avoid the possibility of copying, time for each tests, etc.
9. pre-test and subsequent revision.

VII.5. Data analysis methods

In table no.1 we summarize the general framework in terms of tools, independent and dependent variables, relationships between variables and groups.

1. the test_01, comparing the results of the two experimental groups (both exposed to independent variable 1) with those of the control group, will tell us if the independent variable 1 has worked;
2. the test_02, comparing the results of the experimental group 4 (exposed to independent variable 2) with the control group, will tell us if the simultaneous use of visuals and chat has worked;
3. the test_02, comparing the results of the control group with those of the experimental group 3 (still exposed only to independent variable 1) will tell us if the independent variable 1 has continued to work. It is an indicator of validity: same sample but different contents;
4. the comparison of the increase difference between test_01 and test_02, of the experimental group 4 and of the control group 2, will tell us if the independent variable 2 had a greater impact than the independent variable 1. If the increase of the experimental group 4, in the test_02 compared to the control group is higher than that obtained in test_01, then the independent variable 2 certainly worked better. This is an indicator of how chat plays an important role;
5. the comparison between the differences of increase of the two experimental groups (test_0/test_01; test_0/test_02; test_01 / test_02) will give us some other information on the weight, on the importance, of the two independent variables.

Table no.1. General pictures

Tools	*Independent variables*	*Dependent variable*	*Group 2*	*Group 3*	*Group 4*
Test_0		Pre-knowledge	X	X	X
Test_01 (a)		Knowledge	X		
Test_02 (a)		Skills	X		
Test_01 (b)	Visuals	Knowledge		X	X

Test_02 (b)	Visuals	Skills		X	
Test_02 (b)	Visuals and chat	Skills			X

VIII. The experimental stage

Phase 1 - Entry exam (Test_0) to test pre-knowledge

Professor Gramigna the day of the first lesson (of 26 September 2017), after explaining very precisely the objectives of her course, asked to answer an entry exam (test_0) to all the students present in the classroom. The aim was to test the pre-knowledge possessed by the students on a part of the course topics: those related to the module on *Children's literature and new digital technologies*.

Phase 2 - Sampling on a voluntary basis of the participants in the trial

The teacher during the first lesson asked the students present (127) to decide whether to attend in the classroom or in the virtual classroom (with web conference): 72 students opted for classroom attendance (group 1), 55 opted for virtual classroom attendance. These were randomly divided into three groups, two from 18 (group 2, group 3) and one from 19 (group 4). As mentioned, group 1 was excluded from the study because it is not a beneficiary of multimedia teaching. The study population then went from 127 to 55. Of these 6 students did not complete the course, so the sample of our study is equal to 49 subjects.
Group 2 was defined as a control group, groups 3 and 4 experimental groups.

Phase 3 – Group 2 (control group) attends the virtual classroom lesson (lesson 1 and 2)

Group 2 attends the lessons of the *Children's literature and new digital technologies* module in virtual classroom, in web conference. On October 17th, 16 people were present in the virtual classroom (lesson 1); 19th October 16 (lesson 2). Access to registered lessons is not allowed to students. The lesson is prepared by the teacher in an autonomous way, the power point has been prepared with the usual style.

Phase 4 - Assessment tests (group 2)

Assessment tests group 2:

1. on October 18th the first assessment test (Test_01) was carried out, at 18.30. It was a multiple choise question test;
2. on October 20th the second assessment test (Test_02) was carried out, at 18.30. It was an Open-ended question test.

Phase 5 - Analysis by the researcher of the visuals of the lesson

The researcher analyzed the recording of the lesson to verify the communication-teaching functionality of the visuals and the relational part. The reference parameters, on the basis of which the verification was carried out, were the guidelines identified through the study of the theories of multimedia learning in relation to cognitive processes.

Despite the good communication skills of the teacher and his colloquial and persuasive style, in the relationship between the word and images, many aspects appeared not in line with the guidelines identified in the theoretical part.

Here are the most obvious:

1. use of words (teacher's speech) and images in a non-complementary logic;
2. use of images with a decorative function;
3. use of very long texts and absence of the principles of adaptation (division into paragraphs, highlighting key words or concepts, use of targeted lists presented in synchronous mode, etc.);
4. redundancy effects;
5. lack of graphic organizers to explain relationships and organize knowledge;
6. noise (visual and sound disturbances) due to lack of slides and some technical problems.

Phase 6 – *Visuals modification by researcher (Independent variable 1)*

The researcher modifies the visuals of the lesson on the basis of the guidelines identified to favor multimedia learning. The modified power point has replaced the original one through a post production operation.

Phase 7 - *Attend the lesson modified in the virtual classroom (web conference) by groups 3 and 4.* Group 3 attend the lessons in the virtual classroom as follows:

1. the speech is identical to the lesson attended by group 2;
2. the multimedia presentation was modified on the basis of multimedia learning principles.

The mode is like fake live streaming but equal to the "real live streaming". the lessons are attended on 24 and 26 October, there are respectively 17 and 16 students.

Group 4 follows the lesson in the virtual classroom (a virtual classroom different from that of group 3).

The lesson of 24 is identical to that followed by group 3. The lesson of 26 is identical to that followed by group 3, plus it includes 25 minutes of chat during which the teacher answers the questions of the students.

Phase 8 - Assessment tests: Test_01 and Test_02 (group 3 and group 4)

1. on October 25th, the first assessment test was given (Test_01), at 18.30. The test is related to lesson 1;
2. on October 27th, the second assessment test was given (Test_02), at 18.30. The test is related to lesson 2.

IX. The post-experimental stage (*data analysis)*

The table no.2 highlights the general picture.

Table no.2. Result of 3 groups

Group 2 (control group)				Group 3 (experimental group)				Group 4 (experimental group)			
Nome	*T_0*	*T_01*	*T_02*	*Nome*	*T_0*	*T_01*	*T_02*	*Nome*	*T_0*	*T_01*	*T_02*
Id2	10	22	26	Id4	12	27	X	Id8	8	26	28
Id6	9	22	21	Id11	10	25	28	Id21	5	X	X
Id10	9	X	X	Id19	12	24	23	Id31	8	26	28
Id14	14	27	25	Id23	10	25	24	Id35	13	23	26
Id17	8	14	20	Id25	4	28	26	Id36	6	25	29
Id28	14	25	24	Id40	15	26	27	Id39	10	28	30
Id44	14	30	28	Id52	4	22	24	Id47	8	26	29
Id54	13	X	X	Id56	4	23	25	Id58	13	27	30

Id57	10	24	23	Id61	6	25	28	Id63	7	X	X
Id60	10	22	13	Id65	6	14	21	Id71	16	24	27
Id77	7	23	23	Id72	10	X	X	Id75	12	26	28
Id88	13	24	25	Id79	14	28	30	Id76	10	25	28
Id89	8	23	20	Id92	14	26	29	Id83	10	24	27
Id101	14	26	24	Id97	15	24	26	Id86	11	25	24
Id105	14	22	21	Id103	10	25	25	Id93	9	26	30
Id107	9	22	23	Id11	8	20	21	Id99	14	27	30
Id109	14	25	23	Id115	12	15	13	Id116	11	25	26
Id122	14	22	24	Id120	12	30	30	Id124	18	25	27
								Id127	10	25	28
Media A	**11,3**	**23,3**	**22,7**		**9,75**	**23,8**	**25**		**11**	**25,5**	**27,9**
Media B		**23**				**24,4**				**26,7**	

The outcome of the test_0 highlights the normal distribution of the sample, the average of the results on the pre-knowledge is: 11.3 for group 2; 9.75 for group 3; 11 for group 4. If we observe the averages scores of the two tests (t_01 and t_02) we see how the two experimental groups obtained a higher score, respectively 24.4 (experimental group 3) and 26.7 (experimental group 4), compared to the control group 2 (23); the comparison between the control group 2 and the experimental group 3 always shows a small difference (equal to 1.4); the comparison between the control group 2 and the experimental group 4 shows a significant difference of 3.7 points; the comparison between the two experimental groups is in favor of group 4: 2.3 points more than group 3. These data show immediately how the independent variables have had positive effects, but this analysis is too general. Research variables require more in-depth analysis.

IX.1. Test_01 and Independent variable 1

In test_01 the control group 2 reported an average score of 23.3; the experimental group 3 a slightly higher average score (23.8); the experimental group 4 is the one that reported the highest average score (25.5). The final results are rather homogeneous, especially between the control group 2 (23.3) and the experimental group 3 (23.8). Experimental group 4 (25.5) seems to have responded better to the independent variable 1. For a more objective evaluation we considered the difference in increment between the

input test that measured the pre-knowledge (test_0) and the test_01. The results are as follows: in group 2 the increase was 12; in group 3 to 14; in group 4 to 14.4.

Result one. The independent variable 1, the use of visuals according to the identified international guidelines, has had a positive impact on dipendent variable (learning outcomes). The two experimental groups seem to have responded well to the manipulation of the independent variable 1, obtaining higher learning outcomes than the control group.

IX.2. Test_02 and Independent variables 1 (visuals) and 2 (visuals and chat)

In test_02, 22.7 was the average score of the control group; 25 the average score of the experimental group 3; 27.9 the average score of the experimental group 4. The two experimental groups still obtain a higher score than the control group.

The experimental group 3, exposed to independent variable 1, obtained better learning results than the control group 2 (2.3 points more). This result improved the performance of the experimental group 3 on the control group of 1.8 points compared to the first test_01 (the difference was 0.5). The result is even better if we take into account the difference in increase between the two groups, comparing the results of the test_0 on the pre-knowledge and the test_02 (the experimental group 3 grows almost 4 points more than the control group).

The experimental group 4 subjected to an independent variable 2 obtained better learning results than the control group: 5.2 points more; 5.7 if we consider the difference in increment between test_0 and the test_02.

Moreover in test_02, the experimental group 4 grew 3 points more than the experimental group 3. This means that also the independent variable 2 had a positive impact, higher than the independent variable 1.

Result two. In the test_02 the experimental group 3 improves its learning outcomes compared to the control group. Therefore the single use of the independent variable 1 continues to have a positive impact on the dependent variable.

The experimental group 4 obtains the best results, both compared with control group and experimental group 3, therefore the independent variables 2 has had a positive impact on the dependent variable, higher than independent variable 1: both experimental groups have grown

compared to the control group, but the experimental group 4, also exposed to the chat, has grown more.

IX.3. Independent variable 1 and Independent variable 2 compared: differences in increase of two experimental groups (test_0/test_01, test_0/test_02, test_01/test_02)

To have further confirmation on the effectiveness of the chat, we can verify the differences in increase between the two experimental groups. Table no.3 shows the comparison of the learning outcomes of the two experimental groups.

Table no.3. Differences in increase between the two experimental groups (with indication of variables involved)

	Increment Group 3	Increment Group 4	Differences
t_0/t_01	14 (VI 1)	14,5 (VI 1)	+ 0,5 gruppo 4
t_0/t_02	15,25 (VI 1)	16,9 (VI 2)	+ 1,65 gruppo 4
t_01/t_02	1,25 (VI 1)	2,5 (VI 2)	+ 1,25 gruppo 4

The difference in increase between test_0 and test_01 shows a small difference of 0.5 points in favor of the experimental group 4. The difference in increase between test_0 and test_02 shows an increase of 01.65 in favor of the experimental group 4. The difference in increase between test_01 and test_02 is equal to 1.25 always in favor of the experimental group 4.

This seems to confirm what we have said. When the experimental groups have been exposed to both independent variable 1, they grew in the same way, with a slight difference in score. When the experimental groups have been exposed differently to the variables 1 and 2: the difference of increase of the experimental group 4 was higher. This means that the independent variable 2 resulted in a greater increase than the independent variable 1.

Better learning, therefore, most likely due to the chat, although this should be verified in a more scientific way (with an independent variable concerning only this aspect): it is also possible to assume from our data how the relational aspect, central in the training in presence, takes on even more importance in the training mediated by technologies. In the case of the web conference, the dynamics of synchronous and interactive communication, if well exploited, allow students at home to obtain the keys to enter the classroom for live fully the teaching experience.

Conclusions

The learning outcomes of experimental groups confirmed the hypothesis: *the valorization of the didactic content presented by the professor of higher education using web conference in according with multimedia learning principles, regarding visuals and visuals combined with chat activities, increase the learning outcomes in the FAD model experimentation.*

The use of the web conference can not be considered a "communicative fashion" accessory, but must be carefully prepared and planned in order not to produce overload cognitive and learning difficulties: in order to have a significant impact on learning processes, each cognitive artifact must be designed and used following precise theoretical paradigms binding its use.

Unfortunately this does not happen, there is no awareness on the part of the university professor of the relationship between multimedia teaching and learning. The study highlighted like distance learning practices are being metabolized in conventional teaching methods (in the presence). This, alongside the obvious positive aspects (disappearance of the concept of non-attending, aid to disabled people and economically disadvantaged people, facilitation of educational activities for those who need ongoing training), is leading to the implementation of inefficient e-learning procedures, as a move of the frontal lesson and use of educational transmission paradigms.

Hence the need to accompany the standardization process with a new didactic model, with a strong epistemological impact, that would optimize the learning potential and minimizing the critical elements detected. Lo abbiamo fatto attraverso una proposta operativa concreta, che riguarda in modo particolare una serie di aspetti.

The first concerns the improvement of technological infrastructures (in the direction of invisibility). Naturally the technical part plays its role in mediatised teaching processes, that is, the teaching processes which takes place in virtual web environments, whether using multimedia materials and artifacts, requires good network infrastructures, large and secure storage systems. But it must be cleared how technology should be subordinated to the methodological aspects and not create any cultural and technological obstacle to the leading actors during the training process (teachers, students, tutors). Technology results must be so refined and not invasive, almost invisible, appeared natural and remained in the background. In order to overcome a resistance to technological innovation, we need to create an educational set to be experienced naturally and not as a foreign body which is in panic (technophobia). The

teacher-students' attention should be addressed to a didactic task, but not the tools, as it happens with pen, book and a blackboard.

The second, more long-term, concerns the training of the university teacher. Since the eighties, many projects have been implemented in schools to introduce what is now called teaching 2.0 and substantial resources have been invested in teacher training. Little or nothing was done in the university in Italy where, moreover, there is a lack of value of teaching compared to research.

Finally, the realization of a Teaching Center with a focus on digital teaching. To encourage teacher training, the establishment of a teaching center focusing on digital technologies is proposed. The professor of the University of Ferrara as it happens in traditional teaching cannot be centralised in the entire production chain of his teaching in FaD mode. Rather, it must work within an educational team, in a team, specially set up to manage social, communicative, technological, and naturally didactic aspects. It is proposed to assist the teacher, on the one hand, with the document production workshop in order to improve the didactic and communicative impact of tools used for multimedia, and on the other hand, through the support of an online tutor who is prepared for managing the network interactions. In particular, the work of the tutor must play an important role if one wants to distinguish learning as a social process rather than as an individual one. This would allow to enhance the formative cooperation and the principles of social constructivism within the remote FaD model.

It is clear how such interventions (training of teachers, technological / methodological support for teaching activities, innovation of teaching models, role of the center of technologies, etc.) can only take place with the definition of an explicit and shared University policy, which sees the technologies as a strategic element for the University of Ferrara.

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