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Social media and audio visual learning in the study of human anatomy

Study of a group of students on Facebook and YouTube

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Introduction

The development of social network sites (SNS) has been one of the most influential phenomena of digital technology in recent years. According to a survey by the Pew Research Center on the use of SNS in the United States (Smith, 2013), two-thirds of adults use tools such as Facebook, Twitter, Myspac and Linkedin and 60% of mobile applications used by smartphone owners are linked to the social network. The growing interest of Internet users for SNS is also confirmed by one of the latest Nielsen studies (2011).

According to this study, Internet users in Europe spend more and more time on social networks and blogs: for example, Italian users spend 31% of their total time on the Internet by visiting these categories of services. Among the various SNS, Facebook is now the most popular, with over 900 million users, of which over 500 million access via mobile products (Facebook, 2012). " Social Media" refers to a wide range of applications that allow users to create, share, comment and discuss a multitude of digital content. Social media is considered "dynamic", "interactive", "democratic", "people-

centred", "volatile", "social" and "adaptive" (Manca & Ranieri, 2016b).

Another aspect of SM that is often overlooked is its ability to transform teaching/learning into a more social, open and collaborative activity. Researchers have used many theories/models to determine the feasibility of using social media for educational purposes. With the exponential growth of social media and the ease of information flow, new horizons are opening up, as the technological progress that allows the teacher to create a student/group on a social media platform and motivating learners to ask questions at any time to clarify their doubts. In addition, teachers can regularly provide parents has been with immediate feedback about the students' progress.

The use of social media, especially Facebook and YouTube, has boomed in the field of education. Thanks to YouTube videos, students can learn through sight and hearing by fixing and memorizing the key concepts of what has been acquired. Multisensory learning, as the name suggests, is the process of learning a new topic through the use of two or more senses.

Sensory integration occurs in the central nervous system where complex interactions such as coordination, attention, emotions and memory are processed to give a meaningful response.

This can include the visual and auditory combination. By activating brain regions associated with hearing and vision, they indicate a direct relationship between knowledge and sensory mechanisms in the brain.

In this study I have examined with particular attention the relationship between technologies, digital media and the learning process. In the first part of the work the theoretical frame of reference is outlined for reconstructing the transition from a monosensory society to a multisensory society increasingly dominated by digital artifacts. The second part focuses on the results obtained by answering the question: "How do social media affect the visual and auditory learning of anatomy?" A multisensory integration model has been developed and there is a clear evidence that this model, based on social media Facebook and YouTube, has improved students' performance in anatomy.

Perceptual learning is a good testing ground for the multisensory as it is typically very slow, it requires many days of training and has been shown to be mediated by early visual

areas of the brain traditionally considered to be highly unimodal. An auditory-visual study has been chosen because visual motion stimuli are typically accompanied by sounds and because there is anatomical evidence in animals and human neurophysiology studies indicating that hearing-sight interactions affect visual processing in the primary visual cortex as well.

This study aims at the following:

- investigating the role of the visual element in the study of anatomy thanks to the use of YouTube;
- exploring how YouTube and Facebook technology have played a role in enhancing students' learning skills
- shedding new light on the importance of YouTube and Facebook as fundamental teaching tools and as a resource for both teachers and students.

This empirical research shows the positive results achieved using SNS and multisensory models in both higher and university education.

Part one

THEORETICAL AND CONTEXT FRAMEWORK

1.1.1 *Towards a multisensory society*

The pervasiveness of the media and digital technologies reflects the complexity of reality which, in turn, penetrates the links of the current training system. Reference to the key competences set out in the Recommendations of the European Framework of 22 May 2018, which renew and replace the 2006 precedents (2006/962/EC) - In the knowledge economy, memorizing facts and procedures is important, but not enough to achieve progress and successes. Skills such as problem solving, critical thinking, the ability to cooperate, creativity, computational thinking, self-regulation are more important than ever in our rapidly evolving society. These are the tools enabling you to exploit in real time what you have learned, in order to develop new ideas, new theories, new products and new knowledge» - and translated into the National Guidelines (MIUR, 2018), give the learning processes that totalizing connotation that contributes to the realization of the subject/person as an active citizen. Within the framework of Media Education there are different orientations in relation to the elaborations that are intended to be pursued; in it coexist the technical-practical dimension and the thematic one-content, all aimed at defining personal identity and increasing the cognitive

processes of those approaching the use of technologies. The student, no longer considered as a passive subject, acts as a responsible actor, possessing active and creative knowledge in a historical social and educational context, in which the media are not only the object/instrument of training while fostering at the same time the link between formal, non-formal and informal learning contexts. With the advent of New Media Education, we are consolidating a pedagogical perspective that aims to redefine the very concept of citizenship not only in terms of territorial extension, but also of participation of the subject in relation to himself and in relation to the other, "to ensure resilience and ability to adapt to change" (2018/EC). Current technologies integrate with teaching methodologies by modifying the traditional modus agendi of both the teacher and the learner. Digital natives are pervaded by technologies and, consequently, their way of learning is characterized by the tools they have available; they prefer to enjoy information quickly, They tend to be iconic mediators and have a strong orientation towards working together. The advent of digital media, defined by Mingrino (2010) "fluid and mutable", has led to a reorganization of the communicative logic in which the real protagonists become the subjects who come across a reality of screens. The changing characteristics of contemporary society lead to a renewed social

order that, as defined by Pinto (2005), channel into a "multiscreen society". The user, therefore, from passive spectator turns into active builder of cultural content. The digital delineates a society dominated by the use of gaze and digitation; the subject tends to externalize on the screen its mental processes by performing simultaneously several operations that provide for the coexistence of different cognitive activities (multitasking). A fragmented and segmented vision of reality is established in which the unchallenged power of interactivity prevails, combined with the ability to customize materials. The introduction of new technologies allows to combine different potentialities: from the communicative and formative ones to the expressive ones typical of the languages adopted by the media. With digital media the transition from a single-sensory society to a multi-sensory society requires the affirmation of new skills and a multidimensional approach to decode the multiple forms of communication available (Morcellini, 2005). "The new instruments will act in the context of a profoundly modified humanity, both by the causes that provoked the appearance of those instruments and by the use of the instruments themselves" (Eco, 2003). The reticular nature of knowledge is now set in a set of relationships and links in which technology becomes an integral part of the knowledge system and where digital technologies are simultaneously considered as

means of use and production of information. Among the key competences for lifelong learning is digital competence, to which the technological skills of using communication and information technologies refer, of course, at the level of the fields of «IMAGES, SOUNDS, COLOURS». In this cultural context based on the synergistic relationship between technology and training, we see the birth of a new system of skills based mainly on three levels: functional, critical and creative. The first level concerns the skills and language typical of technologies; the second refers to the analysis of meanings by virtue of a production aware of the objects of culture; the third relates to the processes of communication and expression of content (Rivoltella & Ferrari, 2010). It is not enough, therefore, to know digital devices, but "one must learn to navigate an ocean of uncertainties through archipelagos of certainties". Information and Communication Technologies (ICT), when integrated in the training setting, enable you to rethink, represent, communicate and personalize learning. Recognising the added value that technologies can bring to the learning-teaching process, Calvani (2013) proposes ten recommendations (Figure 1) to achieve a technological innovation policy that is effective and sustainable: five relating to the cultural context, five designed to enhance the relationship between technology and learning.

What criteria for a technological policy?
1. Take a step back in the run-up to the latest technology
2. Steer technology policy towards the future and think in terms of sustainability
3. Think about what you want to achieve with technology and not technology
4. Optimize the relationship between technique and method
5. Let teachers discover that technologies can make life easier for them
How to use technologies to learn? Learning technologies to learn almost never work.
1. technologies improve learning (in particular through of interactivity)
2. technologies have obvious advantages in themselves (communication channels or specific contents)
3. technologies offer "immeasurable" learning conditions
4. technologies offer mind tools (mindtool)
5. technologies enable digital skills to be developed

Fig. 1.

As for the literature in this area, the research about the technology-learning relationship presents mixed results. The introduction of the new devices is not effective if they are conceived only as a support to the traditional lesson; it has been found, instead, an improvement of the learning processes thanks to the new methodologies making use of the technology. Other empirical evidence has shown that educational actions using ICT, specifically the functional use of LIM, encourage the involvement

and participation of pupils thus improving their learning. Multimedia makes it possible to act in a digital learning environment using multiple content representation systems. In such an environment, meaningful construction practices are favoured by the joint mediation of multiple devices that amplify communication channels, implement the acquisition of information.

In general, a multimedia learning environment, if intentionally designed, stimulates a strong drive towards the acquisition and strengthening of fundamental skills such as design, determination and identification of the essential cores of a topic, the synthesis, the ability to realize logical relations between concepts.. The visual and auditory information, conveyed in a contiguous way, allow the elaboration of a greater amount of resources regarding those introduced using a single communicative channel. The possibilities offered by digital technologies and media, in this sense, encourage a multisensory immersion and a consequent adaptive process to knowledge and knowledge. This allows a greater customization of learning processes (Gardner, 1999; Rivoltella, 2006) that takes into account the cognitive patterns of each user. "A network of concept organizers is a necessary resource to allow the student to group together the multiple information he meets" (Giordan, 1998) and provides the possibility

of recoding the same messages several times, improving the quality of the transmission of the message and, therefore, the understanding of the meaning.

The editing of teaching material must become dynamic to adapt to different activities and individual needs and proposed in a classroom context as a place where the development of an open operational competence is encouraged. It is, therefore, extremely important to prepare educational activities according to an integrated approach and in which converge different communicative codes. The key moment of the didactic action, in fact, consists in the planning of inclusive formative programs that, in order to create a formative project, foresee to consider the characteristics of the students (previous knowledge, learning styles and rhythms, age, motivation) before defining the objectives to be achieved and identifying ways of interacting with/between pupils, so as to determine the type of graphical interface to be adopted, the nature of the icons and the links to select the contents related to the selected documents.

The flexible nature of new technologies can help to implement personalised routes and learning. Interacting with digital media also makes changes at the neurological and cognitive level. Wolf and Barzillai (2009) argue that intersinaptic connections are different from traditional practices and therefore complex skills

are required. ICT support for teaching and learning methodologies has been the subject of a wide-ranging and heated debate for many years.

1.1.2 Facebook

The choice of analyzing a discussion space within a Social *Network* for the analysis of a professional community was strongly directed by *the observation of an* impressive growth, recorded at a global level, in the use of the Net and of the Social Networks and consequently from the spread of theories and studies that recognize - and less often verify empirically - the formative potential of these spaces of encounter.

To get an idea of the spread and use of the internet on a local and global scale, you can look at the data of the Internet World Stats (Fig. 2). Out of a population of more than 7 billion people, mobile devices are accessible to more than 5 billion people (+2.4% compared to 2019), or 67% of people on earth. The people who access the internet are 4.5 billion (+7% compared to 2019), 59% of the world population; Active users on social networks are 3.8 billion, with an increase of almost 10% compared to last year.

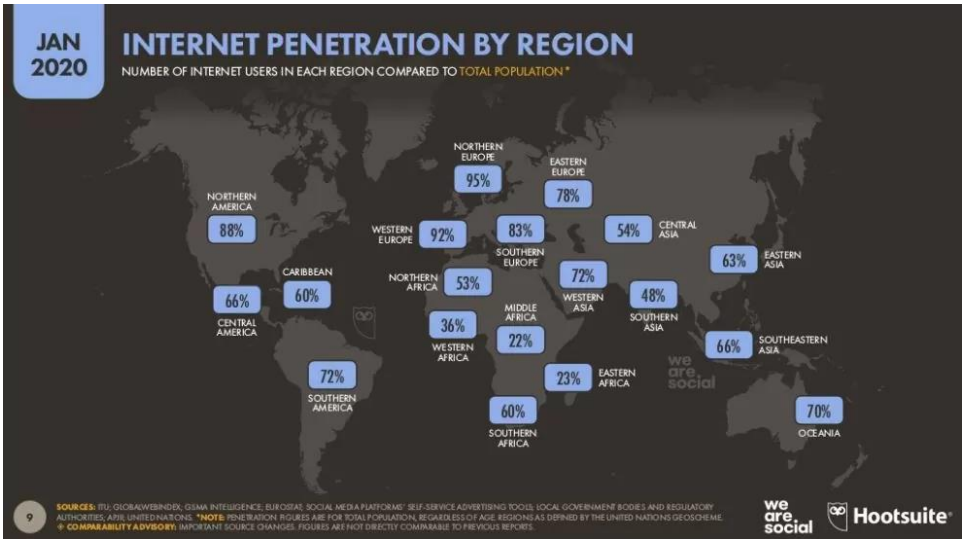


Fig.2 - Internet diffusion in the world

In Italy, internet was used by 37.8 million people in 2013, with a penetration rate of 62% of the population, today this percentage has increased to reach 82% with a number of users that exceeds 49.48 million.

As you can see from the Fig.3, 82% of internet users in Italy use Facebook with 29 million users, of which 50% women and 50% men, while 88% use YouTube.

Threefold, almost the percentage of those using social media for professional reasons. If last year the figure was 11%, in 2020 the figure grew to 31%, so more than a third of total users. The number of users using social networks in Italy is around 35 million (58% of the population).

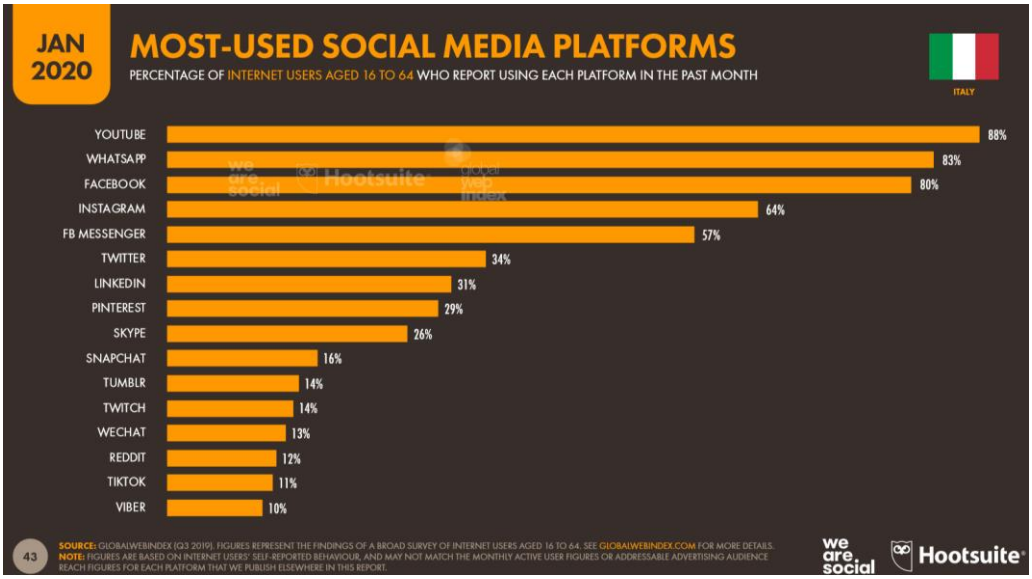


Figure 3 - Use of Social Media in Italy 2020

The increase compared to 2019 is 6.4%: 2.1 million more Italians use social networks; users active on social media from mobile devices are 98%.

99% of social users visit or use the social network in 99% of cases, and 88% of these users show engagement or claim to have contributed content in the month before the survey. The average time spent each day is almost 2 hours (1 hour and 57 minutes) and each user has an average of 7.8 accounts but only 31% of users use social media for work activities. One of the most interesting aspects for those who deal with Internet advertising or want to promote their activity on the Internet is what content involves the most users. To follow the data relative to Facebook (Fig. 4).

While the average engagement is 3%, videos have an engagement of 7.59%, while for posts using images we are around 4.63%. Engagement here means how many of the people reached interact with the post, in percentage terms.

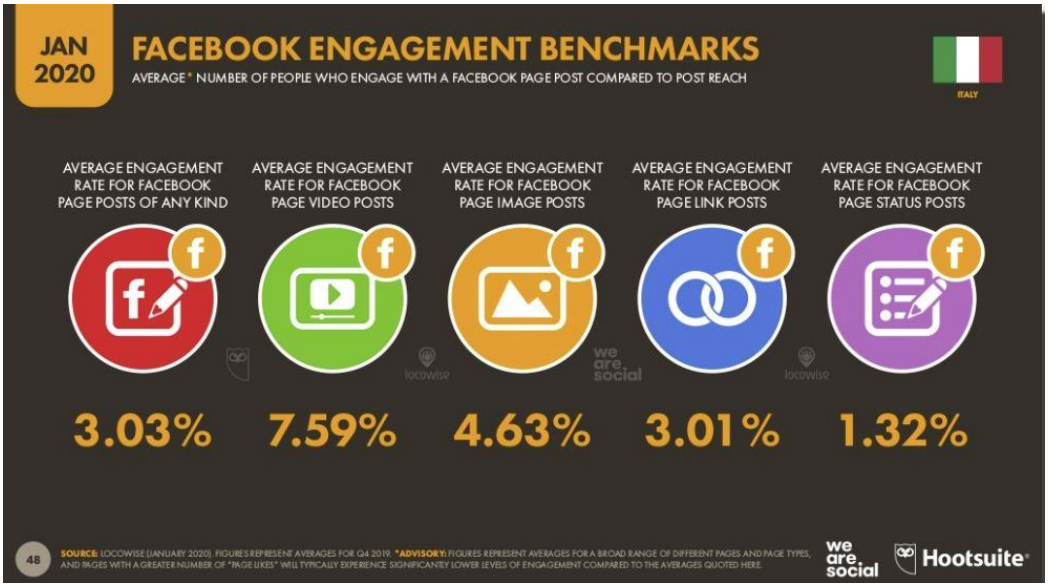
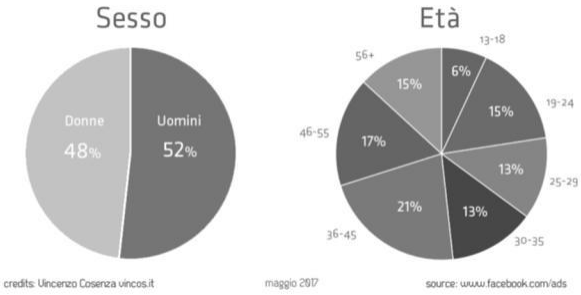


Fig. 4 Facebook data

Fig. 5 - Facebook Distribution in Italy



In Italy 53% of Facebook users are over 35 years old. Moreover while the band of enrolled users older than 45-55 years (Fig. 5) is

increased, compared two years ago, the segment of younger customers is at present constantly decreasing (including those under the age 18).

So far, SNS in general and Facebook in particular have payed great attention either on privacy policy (Waters & Ackerman, 2011), or on the relationship between the profile and the articulation of friendship. In the educational field, the focus has been on the educational use of SNS by students or their use by teachers in pedagogical practice. More specifically, some surveys have explored the possibility of using SNS in the context of curriculum-related activities, suggesting that they are used as teaching tools in formal learning contexts. Other researches have investigated how social platforms such as Facebook can be integrated into more traditional learning environments. Going beyond these specific approaches, it should be noted that most cases, research on the use of Facebook in education mainly concerns the higher and higher education sector. In fact, since its creation in 2004, Facebook has become one of the most visited websites on university campuses and high schools.

As Redecker (2010) points out, in a system in which teaching and learning take place within the walls of a classroom, teachers find it difficult to exchange teaching methods and experiences, but today social networks supported by technology, have enabled

greater participation (Ranieri & Manca, 2013; Ranieri, Manca & Fini, 2012a, 2012b;).

The tools of the web 2.0 (O'Really, 2007), are configured in such searches as an opportunity to overcome the isolation often denounced by the teachers, offering in some cases valid mechanisms of support and knowledge.

As highlighted by Ranieri and Manca (2013), "informal learning, free from curricular constraints and context characteristics to be considered in formal learning, manages to find an appropriate place in "social" environments where the expression of common interests, the sharing of professional objectives and practices, distinctive features of the communities of practice (Wenger, 1998), can be fully expressed".

The difficulty of explaining or sharing the reflexivity inherent in daily practice, would therefore be overcome through asynchronous communication tools mediated by computers, such as Facebook, within which we can find the stories of students, their considerations and testimonies.

The use of technologies thus plays a decisive role, offering new opportunities for students to participate actively in the educational process. Among the opportunities not to be underestimated, the opportunity to "learn navigating information" taking opportunities of *incidental learning*. These opportunities are

particularly interesting in the context of continuing education and training, moments when the ability to provide for their own needs of knowledge become strategic (Trentin, 2004).

1.1.3 YouTube

As documented by Buzzetto-More (2012) YouTube is one of the technologies used as an effective tool to optimize student learning. Analyzing with greater attention the Digital 2020 report for the second year in a row, YouTube is confirmed as the most loved and used social in Italy, with a penetration rate of 88%. (Fig. 3). In the world it is the second with its 2000 active monthly users (Fig. 6)

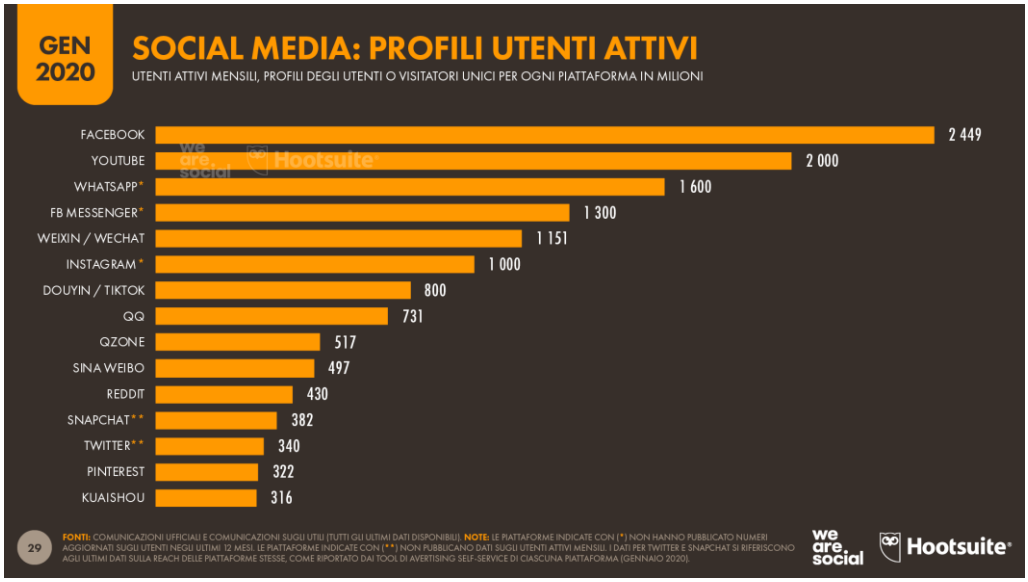


Fig. 6 Facebook and YouTube data

Researchers around the world have stated that YouTube is a useful means to improve students' skills through the interpretation of visual clues.

The use of YouTube in the classroom is becoming commonplace as more and more educational videos are available online as a source of self-learning .

YouTube's popularity is also evident from the growing number of users, surpassing 1.8 billion each month in 2018 .

This awareness has prompted many studies, of which there is little literature, on the effectiveness of additional teaching tools in a school context, such as YouTube.

YouTube, in the first place, has improved the motivation of the students by varying the activity in the classroom, as it moves the walls of the classroom and pushes the forces of the lesson in the real world, outside the classroom. YouTube videos can be used to allow the student to immerse himself in the reality he studies and become a protagonist, as if he made a real journey within the human body, if we take as an example the study of anatomy.

In addition, the components in the video are better in supporting attention and concentration than the words of a written text. In addition to this, YouTube videos, besides, are often inherently more interesting; People are more familiar with

watching television and videos than they are with listening to audio or reading a book.

YouTube can provide a complete picture: understanding listening enhanced by sight. YouTube is also potentially able to develop non-verbal signals and show the relationship between linguistic and paralyngual characteristics.

Given the importance of using video and visual objects for teaching, some universities use YouTube as a complementary teaching tool.

This study aims to clarify two factors: the use of YouTube by students and its effectiveness from the point of view of teaching and learning by students.

According to experience, entertainment, information research and academic learning are some of the main motivations for using YouTube.

It is important, therefore, that teachers integrate traditional teaching approaches with YouTube into their respective courses to benefit from its characterizing advantages in the context of learning/teaching, such as cultivating the student-teacher coordinated efforts, improve learning, process and allow real-time feedback of students .

Blended Learning theory was used to examine the use of YouTube in a school context.

YouTube ensures student satisfaction through the use of videos in a traditional classroom environment . Clifton and Mann (2011) reported that the use of YouTube to teach nursing procedures has improved attention and retention, as it is much easier to remember visual signals than auditory ones (Johnson & Mayer, 2009).

Dupuis, Coutu and Laneuville (2013) also reported that biology students who had volunteered to watch online videos related to their course of studies get better grades than their classmates who had chosen not to watch the same videos .

Indeed, a pedagogical approach combining both online learning and traditional face-to-face learning should be implemented in all higher education institutions: social media-related technologies should play a key role in achieving higher education objectives.

1.2.1 Social cognitivism

The theoretical framework adopted in this study is that of social cognitive theory, which initially proliferated as a theory of social learning. Bandura, fundamental author in the transition from the behaviourist approach to the definition of cognitivism, proposed for the first time this theory in 1960 (Bandura and Walters, 1977). The theory states that the student's learning is based on their interaction with the social environment. He first pointed out that learning did not involve only direct contact with objects, but it happened, changing, also through the observation of the behaviour of another individual, who acts as a model (modelling).

The transition from the behaviourist approach to the cognitive process-oriented one takes place through the development of a new behaviour analysis: the perceived self-effectiveness and the adaptation of the individual in the environment.

The concept of human agentivity (human agency), the main point of the entire social-cognitive theory, can be defined as the ability to act actively and transformatively in the context in which it is

inserted. This human function, which affects both individuals and groups, translates operationally into the ability to generate actions targeted to certain goals. Bandura distinguishes the conduct aimed at achieving a result, from the effects that the execution of this course of action produces. Agentivity is understood as a function of intentional acts, regardless of their outcome. The starting point in the study of this faculty is the conviction that it can actively exert an influence on events. According to Bandura human behaviour is determined by many factors interacting with each other, but above all internal personal factors consisting of cognitive, affective and biological elements and environmental events circumscribing the individual.

Social structures, in turn, impose constraints and provide resources for the development of the people and groups that are part of it. Social and organizational structures provide a set of shared social practices, while within such rules there remains much personal variability regarding their application. Bandura highlights how people with a high degree of agentivity know how to take advantage of the opportunities offered by social structures, and build ways to circumvent the institutional constraints of the same structure. On the contrary, ineffective people are less able to exploit the resources offered by the system, and more subject to discouragement in the event of problems imposed by it. The

circularity of model P (person) C (behaviour) A (environment) focuses on the definition of two types of behavioural outcomes: external results, and self-assessment reactions. These consequences can be complementary or opposed, with completely different outcomes in terms of achieving the objectives set.

The primary goal behind this theory is to bridge the learning gap by exploring the factors that contribute to the development of the student's skills. Drawing on the general and social environment, the teacher will be helped to match the goal of the study with the student's individual objectives.

The effectiveness of education comes from innovation.

"Education" means promoting one's personality through the unhindered implementation of one's innate qualities. The use of technology in education can greatly improve students' areas of interest, their psychology during maturation, their learning and feedback preferences .

1.2.2 Grounded Cognition or Embodied Cognition?

We live in a world where all our senses are constantly involved. For example, when we eat, we appreciate the visual aspect of food, which together with the taste helps to produce a complete culinary experience.

In the scientific community, perception is traditionally seen as a function that can modulate other senses acting as independent entities. However, recent studies suggest that cross-modal interactions in various perceptive activities are the rule rather than the exception in the human being. It is not, therefore, unlikely that multisensory interactions can make the processing of sensory information more effective in terms of coding and also learning.

So the traditional separation between scientific and narrative thought, between the sciences of man and the biological sciences, which is of Platonic as well as Cartesian ancestry, has no longer any reason to exist. In fact, since the early nineties, thanks to studies born in the Anglo-Saxon area, There has been a real epistemological shift, as neuroscience and cognitive psychology have pointed out that in correspondence with every mental or cultural activity there is something changing inside the brain. So the cultural element cannot be separated by the biological one.

In recent years in the field of cognitive sciences we hear more and more often about embodied Cognition and Grounded Cognition.

To better explain these theories we need to take a step back and go back to the so-called "sandwich model" (Hurley, 2001), according to which cognition is a set of processes placed in the middle between perception and action: I perceive a spoon on the table; perceptual information is transmitted to my cognition and so the concept SPOON is activated, which consists of representations different from those that were activated during perception; cognitive information communicates to my motor system how to interact with the perceived object and therefore results in a motor task.

As Barsalou notes, the cognitive processes thus conceived are modular: they are part of a mental module separated from perceptive and motor systems and must therefore be studied independently from these.

On the contrary, the perspective of Grounded Cognition rejects this "sandwich model": in order to effectively understand the functioning of human cognition, it is necessary to consider also four other domains:

a) Sensomotor systems: the idea is that human cognition is based on the constitutive modalities of perception, action and

proprioception. This means that, according to this perspective, the concepts are constituted by modal representations (that is codified in the specific perceptual or motor modalities).

b) The body: cognition can often influence/be influenced by bodily states or physical actions (when we perceive objects, our motor systems anticipate the actions associated with the object; or, again, there were bodily states influencing cognitive states).

c) The physical environment: cognition depends on the physical environment in which we are located and in which the entities with which we interact are located.

d) The social environment: cognition also depends on the social environment, because in cognitive processes our representations of others, their minds and their intentions come into play.

The perspective of embodied Cognition, the theory that cognitive processes are not limited to instantiated operations within the cognitive system, but they include wider bodily structures and processes of interaction with the environment overturning the classic Cartesian conception in which mind, brain and body are separate units, is therefore only a component of Grounded Cognition, because it focuses only on one of the four domains related to cognition: the body. The central idea of embodied Cognition is that human cognition depends and is closely linked to the states of our body. This perspective, however,

overlooks other elements that for the Grounded Cognition turn out to be equally fundamental: that is, the sensomotor systems and the physical and social environment we belong to as individuals with a mind.

The embodied Cognition proposes, therefore, a holistic conception according to which the mind constitutes a dynamic and complex system that emerges from the brain and the body . According to the embodied Cognition therefore cognitive processes are deeply rooted in the body's interactions with the world and the body plays a central role in shaping the mind.

With the approach of embodied Cognition, the spotlight is focused on the idea that the mind must be understood and analyzed in the context of its relations with a physical body that interacts with the surrounding world: Individuals are but the evolution of creatures whose neural resources were primarily devoted to perceptual and motor processing, and these cognitive activities consisted largely in immediate interactions and in response to the environment. Thus human cognition, instead of being centralized, abstract and distinct in input and output modules, can have deep roots in the sensomotor process .

To conclude, the different approaches can be summarised in two main guidelines:

- Embodied Cognition that emphasizes the role of body features and action for cognition according to which cognition is bound by the physical characteristics of our body. The key notion is action.
- Grounded Cognition that instead argues that cognition is bound to our sense-motor system in its interaction with context . The key notion is that cognition is based on perceptual and motor modes (Barsalou, 1999, 2008).

1.2.3 Brain based learning (BBL)

Brain-based learning (BBL), also known as educational neuroscience, examines learning as a biological process. In the past it was thought that intelligence was fixed and the same for life. Most of the academic dialogue and scientific research on brain-based learning focuses on neuroplasticity. More recent discoveries have revealed that physical changes occur in the brain during learning. Research in neuroscience has provided evidence that can alter our understanding of learning. One of the key concepts in improving learning is the plasticity of the brain and the concept that learning ability is not a stable and predetermined condition. In other words, all people are on a journey of development, through their experiences and what they acquire. Plasticity describes how experiences reorganize neural pathways in the brain. In this way, when someone learns new things or stores new information, long-term functional changes occur in the brain. Neural connections in the brain remap, reorganize, and modify themselves when new concepts are learned. This also happens when the individual has a new experience or practice different abilities over time. The human brain is able to perform multiple activities

simultaneously. In addition, identical information can be stored in different parts of the brain.

Similarly, in addition to genetic factors, a person's brain is shaped by the characteristics of the environment and its actions. Based on these data, one cannot fail to reconsider the fact that some people are able to achieve expected learning while others are not. So if students don't get expected results, it's not because of their brains, it's because of other factors. As a result, people need to be trained so that when they come across a difficult topic, they become aware of it and strive to strengthen the brain areas needed by insisting more on the subject rather than deciding that they are unable to address it. After all, no one is born with a brain suitable for a particular subject. On the contrary, everyone can and should develop the neural pathways they need.

Therefore, when we learn something, we develop our brain in one of the following ways: a) creating a new path, which is initially thin, but it is strengthened as we deepen the concept under consideration, b) further strengthening of an existing path, c) forming a new connection

between two previously disconnected paths. Also, when these routes are no longer needed, they gradually disappear.

Therefore, the structure of our brain changes with each different activity we perform.

Brain-based teaching is emotional learning, social learning, cognitive learning, physical learning, and reflective learning (Data 2007). Surveys has revealed that exercise, diet, stress and emotional state influence learning. In the brain there are specific areas: for memory, for attention, for language and for processing. The hippocampus is essential for storing: "These memories, once formed, must therefore reside elsewhere, outside the hippocampus, probably in the neocortex, outer layer of the brain, cradle of human consciousness, a complex network tissue in which each area has a specific purpose. The area responsible for vision is in the rear region. Learning must be distributed giving space to the storage of content. Contrary to the study technique that provides many consecutive hours in a single day, however, when you try to remember something, the more effort you make to search for the information file stored in the brain, the more memory develops.

According to current research, it is necessary to overcome the idea that the speed of thought is an important component of learning compared to flexible and deep thinking. In particular,

it has been proven that learning is optimized when students approach concepts and ideas with creativity and flexibility. On the contrary, when people work under pressure, their memory is compromised and, as a result, they become anxious and feel that "their mind is stuck". According to the above, when people learn something quickly, they are likely to improve existing neural pathways or create new ones, but the formation of these and synapses is a slow process.

To develop the students' thinking it is time that educational practices are integrated and implemented to support the progress of education in order to achieve better results in learning. When someone practices certain skills, they find it easier over time to continue improving those skills. Learning has been shown to improve resilience, working intelligence and brain function. The implications of brain-based learning are far-reaching. By putting this knowledge into practice, schools can create academic programmes more suited to each annual group. Individual teachers can also structure the most appropriate educational experiences for their students.

In the context of evaluation, the exploitation of errors plays a crucial role. From an educational point of view, however, mistakes are valuable as they provide opportunities for brain

development. In particular, addressing obstacles and correcting errors in the learning process improves neural connections, thus speeding up and enriching learning; Students look at problems through a new perspective and gain confidence in their own abilities. Error detection, progressive error, reduction strategies and practices that encourage experimentation can lead to an ideal learning experience.

Students prefer the visual learning style to achieve good learning outcomes and understand, remember and connect facts and concepts . Visual learning styles are effective if information can be viewed as graphs, flowcharts, symbolic arrows, circles, hierarchies, and other devices. Teachers should choose learning that can improve brain chemistry, improve mood and perseverance in order to improve learning outcomes (Jensen, 2009).

1.2.4 Lifelong learning (LLL Life long learning)

Lifelong learning has been conceptualised in different ways over time (for example, London, 2011). Initially, it was used to express the general idea that learning is a fundamental part of life, not limited to compulsory education. A broader approach

to lifelong learning, which includes more than labour force/training, is incorporated into the classic definition of the European Commission: "all learning activities carried out in the course of life, with the aim of improving knowledge, skills and competences in an apersonal, civic, social and/or employment perspective" (European Commission, 2002, p.9). From a Social and Economic Perspective, Field (2006) has viewed lifelong learning as a new educational order, resulting in the government's promotion of adult participation in lifelong learning in order to achieve a viable learning society. Regardless of focus, a key premise of lifelong learning is that people need to continually update their knowledge and skills to meet the challenges of everyday life, therefore empowering them with the ability to self-manage their learning becomes crucial for their personal and professional development (Bentley, 1998; Sharples, 2000). In this context, ICT has been studied in two occasions in last years. On the one hand, they have been considered a factor that requires continuous retraining of the workforce, both for their continuous evolution and for the impact they have had on the skills needed for new "digital works". On the other hand, they have been perceived as a cause of change; that is, as a resource that enables innovation

processes and supports learning at any time and anywhere, in other words, lifelong learning. For example, the European Union has promoted various programmes which reflect these ideas. From the Lisbon Strategy to the recent Life Long Learning Programme (2007-2013), the European legislator has described ICT as a strategic tool to broaden civic engagement and improve lifelong learning. It should be stressed that it is not technology itself that supports an informal learning process, but the way in which this technology is used.

1.3.1 Learning as a social process

Among the theorists of social constructivism, Lave & Wenger (1991) focusing on the analysis of informal contexts, highlight how authentic learning does not take place in an individual environment, but rather in precise contexts and within a participatory framework.

In addition to being targeted and contextual to the performance of a specific activity, learning takes place in a process of negotiation of meanings and is mediated by the different perspectives of the participants.

As Hanks (2006) points out, the work of Lave and Wenger appears stimulating because it places learning in the process of co-participation: instead of defining learning as the acquisition of propositional knowledge, Lave and Wenger place it in the context of specific forms of social co-participation drawing attention to the highly interactive and productive role of the person in the acquisition of skills.

Learning is a way of being *in the social* world, not a way of knowing it: a collective subject creates learning through a continuous and transformative collaborative process, in

contrast to the simple exchange of information or execution of assigned tasks. The formative impact of group research activities has been widely highlighted by constructivist theories: through the process of co-building knowledge, the subject is an active protagonist of his own learning process .

The development of technologies now allows access to self-managed learning communities that learn collaboratively on the net. Although less effective, they also play an important role in the process of students' growth.

As Galliani (2004) points out, virtual communities of study and work or entertainment are "pedagogically to be pursued if they reflect the meaning of physical communities, such as places of life and imagination, of interpersonal and social relationships in which identity takes root in bodies and places its desire and its need for the other and in which it gives meaning to subjective stories and reconstructs the social memory of the past".

Thanks to the SNS, it is possible to learn not only in institutional fora in a formal context, but always and everywhere (Merieu, 1990).

Open Education *environments*, defined as the learning experience that gives the student a degree of flexibility in

choosing what (topics), where (place), when (pace) and how (method) learning/studying, can improve the learning modes of the students, allowing learners to freely and selectively access open and flexible spaces. The use of ICT to promote this type of learning has proved useful in many ways: removing barriers to entry into education; to allow access to knowledge at all times and everywhere; increase the possibility of collaboration with others; improving opportunities for personalisation (including different learning rhythms and paths); and facilitate the possibility of self-guided learning through access to open educational resources (OER; defined by UNESCO, 2012) and Massive Open Online Courses (MOOCs).

Online networks and Social Media extend this possibility by enabling you to share ideas and learn from other students. Open and participatory learning through blogs, wikis, and social networks thus becomes part of the daily life of many students. New online relationship spaces allow you to develop and share knowledge by deciding what and *when to* learn.

The networks developing through new technologies and social media have the potential to respond to the individual and collective needs of students enabling them to create

learning processes that are consistent with current social changes, in a climate of openness.

Wenger, White, and Smith (2009), highlight in particular how the advent of new technologies has amplified the possibilities of development of communities, changing their nature and making possible new ways of participation: the possibility of accessing groups of different sizes, to decide the degree of openness (either public or private) makes possible new ways of participation "peripheral". This allows students who do not wish to participate directly to have access to important learning sources .

1.3.2 The visual neurosciences

Neuroscience, particularly visual neuroscience, is a growing field that has greatly shaped the format and effectiveness of education. In addition, the results of visual neuroscience are a continuous source of great progress in pedagogy.

Before dealing with visual learning it is important to take a step back and deepen the action of the brain and vision in understanding a written text.

The elaboration of the written text begins in the eye: only the center of the retina, called fovea, has a sufficiently high resolution to recognize the details of the letters and, whatever

the size of the characters, only the letters closest to the centre are legible. While we are reading a page, our eyes move through small and rapid movements, called ocular sacs, which lead a region of interest to coincide with the "fovea" so that they can be the subject of a kind of scan. The visual system identifies the words on the page and breaks them down into a thousand fragments; In general, the ocular movements allow to realize the active visual exploration or scanning of the object, which is not recognized in a global and immediate way, but decomposed in thousands of small fragments, to be reassembled by the brain. Then two large parallel ways of processing information enter the scene: the phonological and lexical way; The former allows you to convert the sequence of letters (graphemes) into sounds of language (phonemes), the latter allows you to access a sort of mental dictionary where the meaning of words is stored. Actually, while remaining an essential cornerstone, the traditional two-way reading model, probably continues to underestimate the complexity and divergence of the neuronal pathways of reading. The picture is even more complicated and synapses play an important role in it, namely the connections between nerve cells. In fact, reading triggers the activation of neuronal networks where thousands

of visual neurons work in parallel on three different levels - level of strokes, letters and words - and, through excitatory and inhibitory synapses, conspire or rather "vote" to support one word or another in order to propose the best possible interpretation of the perceived word. Therefore, learning to read means connecting visual areas with language areas according to bidirectional interconnections that are not yet known in detail . So reading is a very complicated operation. How does our primate brain, the product of millions of years of evolution in a world without writing, get to adapt to the specific problems that word recognition poses? Dehaene proposes a strong thesis, which is based on the concept of neuronal recycling: our brain is not made for reading, but in one way or another it is reconverted thanks to its innate plasticity. In other words, the human brain has not evolved for reading, but on the contrary it is the reading that has evolved to acquire a shape suitable for our circuits; The activity of reading would therefore be possible thanks to the recycling of equipment present in our brain, the so-called "reading neurons", located in the left occipital-temporal region . We could define this hypothesis as "grammatological evolutionism", since it is not the neurons that evolve, but the

writing that little by little must select the most recognizable signs for our brain. From a neuroscientific point of view it can be said that the learning of reading and writing is linked to the ability of the brain to connect different sources of information - visual, auditory, linguistic and conceptual -; integration depends on the maturation of the areas responsible for this information, on the speed of communication between these regions but also on the myelination of axons of nerve cells. Reading is also fully part of a life-long-learning project contributing to empowerment, that is, a process that allows the individual to broaden the range of tools - knowledge, behaviour, ability - which you can have to increase your choices and action, in short, control over your life. Reading is also good from a neurophysiological point of view. A survey carried out in the United States in 2009 shows, through the use of neuroimaging techniques, that an intensive rehabilitation of reading in dyslexic children is able to anatomically modify the so-called white substance, that is, those large bundles of nerve connections linking the distant cortical regions; Thus, at the end of the experiment, the children, all between eight and ten years, showed a significant increase in fractional anisotropy - the microstructural organization of white matter -, associated

with an increase in myelination of nerve fibers . Overall, the experimental results obtained over the past decade support the view that sensory regions in the adult cortex, including the primary visual cortex, are modifiable throughout life .

According to Lastufka and Dean (2008), full understanding is achieved through the interrelation of the visual element with the "network of interaction between the verbal and non-verbal components". Normally, the interrelations between auditory and visual elements are between two extremes, where one depends on the other to varying degrees, while, in reality, they complement each other.

Neuroscience provides an effective tool for investigating how individuals actively acquire and process new information throughout life (Goswami, 2006; Shonkoff & Levitt, 2010).

Educational neuroscience offers many potential advantages, but the downside of these advantages is the proliferation of "Neuromyths", which are popular misconceptions based on neuroscientific findings and evidence. Many neuromyths are distortions of scientific facts.

In visual neuroscience and developmental psychology, it is commonly accepted that in a child's life there are periods sensitive to visual development. The concept of synaptogenesis

was first demonstrated in 1975. During early development, the increase in the number and density of synapses is related to learning .

In the 1990s, US and UK governments promoted educational neuroscience.

In 2011, the U.K. Royal Society published a report entitled "Neuroscience: Implications for Education and Lifelong Learning (The Royal Society, 2011). "

In May 2017, the Chinese Society of Cognitive Sciences established a division of educational neurosciences covering a myriad of disciplines such as education, psychology, medicine, and computer sciences to promote reforms in teacher education and training.

Visual neuroscience holds that the dorsal and ventral pathways play distinct roles in the perception of forms, faces, movements, and actions. In the brain there is a region specialized in the identification and processing of words called visual word form area (VWFA).

Vision and visual experiences are prerequisites for normal psychophysical development and maintenance of cognitive and sensory functions that allow people to learn efficiently and adapt to their environments. In people with congenital

blindness, auditory actions can produce cortical network responses that are comparable to brain activity responses produced in people without blindness when they perceive objects. This suggests that individuals without visual experience can use representations of visual events and actions to interact effectively with others (Ricciardi et al., 2009). In addition, the plasticity mechanisms of the brain allow individuals with non-existent vision to reorganize the brain circuits to compensate for visual deficits and sharpen other sensory modes such as hearing and touch .

The visual mode provides rich information for learning and for interacting with the environment.

Following the increasingly common application of VR (virtual reality), the use of visual learning has been recently extended to several fields, including anatomical education .Visual neuroscience has focused largely on the processing of space-time information in the visual scene. The results of visual-spatial attention could be successfully applied in teaching. For example, classrooms with traditional rectangular space could be improved by adopting a circular one thus enabling the audience to maximize the visibility of the blackboard (screen)

from different angles while fostering the students' attention at the same time.

Visual neuroscience from a development perspective could optimise the design of teaching materials (including textbooks). A challenge for the application of visual neuroscience is how students can quickly select visual elements in the disorder of the environment and exclude/minimize the influences of distractors. Digital media and virtual reality have offered excellent means to simulate learning in a richer environment and thus to improve learning under the pressure of social interactions .

Neuroscience research has a great potential for educational transformation, but the neural bases of academics and cognitive abilities are little known. For example, there are gender differences in cognitive visual styles in terms of spatial object visualization.

Educational neuroscience could facilitate learning in individuals with limited vision through experiments that simulate visual field defects. In addition, results from educational neuroscience and experimental psychology could be used to develop interventions for children with conditions

involving atypical development such as autism and for children suffering from dyscalculia or dyslexia.

1.3.3 The study of anatomy in the medical curriculum

Anatomical education has always been considered an essential requirement in the medical curriculum. In fact, in the early 20th century in the United States, anatomy itself constituted preclinical education (Bardeen, 1905). In the 1909 report to the Council on Medical Education of the American Medical Association (Bardeen, 1909), macroscopic anatomy occupied about one fifth of the medical curriculum, counting more than 800 hours of lessons and workshops with a number of schools that still have more than 1,000 hours of anatomical teaching . However, starting with the Flexner Report (1910), there has been a separation between preclinical and clinical studies, due to the increasing importance of other basic scientific disciplines. This led to a reduction in the time devoted to anatomical sciences and in 1923 a report of the American Association of Medical Colleges (AAMC) recommended limiting the time devoted to anatomy to 471-814 hours . In addition, in 1927 Zapffe proposed an integrated curriculum based on a 1923 report by the AAMC (Zapffe, 1927), in which anatomy teaching

was vertically integrated into all four years of medical curriculum and limited to 566 hours. Included in this integrated program was macroscopic and microscopic anatomy in the first year, topographical anatomy in the second year, and clinical anatomy in the third and fourth years incorporated into medical and surgical employees. This innovative curriculum has not been widely accepted by medical schools and has had no impact on basic scientific education. A few years later Reid (1931) reported that the average time devoted to the teaching of anatomy was still around 780 hours (interval 480-1185). The time between the early 1930s and the late 1980s can be characterized as an uncomfortable status quo. During this period, teaching hours gradually decreased, traditional teaching methods continued to prevail, Basic scientific education lacked clinical relevance and any integration with clinical education caused dissonance and dissatisfaction between preclinical teachers and students . Most anatomy was taught in a passive format without inserting teaching into a clinical context, despite knowledge of anatomy plays an important role in clinical practice .

Although anatomy is considered a significant part of a medical education curriculum, there is controversy over the

appropriate method of teaching anatomy .Blended learning, which combines teaching strategies in presence and online, is an educational approach that, according to Estai and Bunt (2016), is promising and can understand the use of social media, especially YouTube.

El Bialy and Jalali (2015) demonstrated that social networks can positively influence medical education, but the authors addressed the use of social networks in medical education in general, without focusing on anatomy and visual approach-auditory of his learning.

Universities and medical schools around the world are beginning to recognize the importance of innovative education that adapts to rapid changes in the healthcare environment, implementing new educational technologies and changing the style of teaching.

In this context, the main objective has been the study of the use of social networking sites in anatomy education until now, through a review of the literature, answering the question: "To what extent does the existing literature support the view that social media could play a significant role in anatomy education? "

Second part

THE RESEARCH PROJECT

"SOCIAL MEDIA AND AUDIO-VISUAL LEARNING IN THE STUDY OF HUMAN ANATOMY"

OBJECTIVES, INSTRUMENTS AND METHODOLOGICAL ASPECTS

Chapter I

2. 1 Case Study n.1 : student groups on Facebook and YouTube

2.1.1 Objectives of this study

We have already described in the first chapter dedicated to the theoretical framework of the research project, how the international scientific community has recognized and accepted the responsibility to question itself on how the Network -and in particular the Social Networks- can support students' learning processes today and in the future.

At the moment, most of the studies developed at national and international level have enabled the following:

- verifying, through the use of surveys, questionnaires and interviews, the motivation and perceptions of students on the usefulness of social networks for their learning process;
- detecting the most widespread practices in the use of different social networks through the use of observation and classification tools of a purely qualitative nature.
- clarifying the model and purpose of using YouTube among students.

The analysis aims at promoting the advancement of research and debate on the opportunities inherent in Social Networks to

support and nurture the learning of students, using methodologies of a quantitative and qualitative nature.

2.1.2 Methodology and instruments

As Ranieri, Manca and Fini (2012a) point out, the peculiar features of *social networks* are the participatory and collaborative architecture; the collective exchange of resources and information and the creation of new social networks.

Riva (2010) also focuses on the production of resources within this and other contexts: in web 2.0 environments users are no longer mere consumers of *information* resources but also prosumers *and co-creators* of digital resources.

To facilitate the learning of human anatomy (allowing students to study also on public transport), and to be able to communicate with their students (belonging to various degree courses located in various locations in the Rome area), quickly and effectively, The Professor of Human Anatomy (HAT) has created a professional Facebook profile (HATPFP) and a YouTube channel dedicated to human anatomy topics (HATYTC).

In order to gather the opinions of students belonging to various degree courses on the usefulness of two social media in the learning of human anatomy and to get in touch with the professor

of human anatomy, A survey was carried out at the end of the course year and distributed to students through HATPFP.

The topics of the anatomy course are in line with the recommendations of the Italian basic program and the international suggestions (Mchanwell et al., 2007; Drake et al., 2009). The anatomy course of the health professions takes place during twelve weeks in the first semester of the first year of the degree course. The anatomy course of Medicine and Surgery takes place in three semesters in the first and second degree courses. Both in the health professions and in medicine and surgery students attend lectures, seminars and practical laboratory lessons. During practical lessons, students work in small groups under the supervision of teaching tutors, using cadaveric prosection, plastinated samples, plastic models, plastic bones, X-rays, MRI and CTI scans.

YouTube allows viewing of thematic multimedia movies, facilitating their organization by topics using the playlist tool. This is a great utility to collect organized and consistent videos from different sources. You can also add to videos the same keywords and labels, making the search faster and more targeted. HAT has created playlists divided by topic, containing videos from some scientific channels such as Anatomié 3D Lyon, Agorà Biomedical Sciences, UCD Medicine, Nucleus Medical Media, Neuromatìq,

Great Pacific Media and VMV3D (Virtual Medical Vision 3D)associated with other videos uploaded by the personal channels of university professors of various nationalities. The videos are mainly in English, but also in Italian, French and Spanish.

The YouTube channel contains 459 videos of human anatomy and 130 videos of cytology, histology and biology. Videos are classified as shown in Graph 1 and 2.

The students who participated in this survey belong to the following degree courses of the Faculty of Medicine and Psychology: Medicine and Surgery, Nursing, Obstetrics, Physiotherapy, Podiatry, Occupational Therapy, Orthopedic Techniques, Techniques of psychiatric rehabilitation. Their distribution is shown in Graph 3.

Two surveys were designed and then distributed. The first was a pilot survey and the second was a multiple choice survey. The first one consisted of 21 questions, some with dichotomous answers and others with open answers, involving 25 students belonging to the Degree Courses in Medicine and Surgery. Students were recruited via a voluntary HAPFP call. A qualitative analysis of the content (Graneheim and Lundman, 2004; Hsieh and Shannon, 2005) allowed us to identify the categories of answers to turn open questions into closed-ended questions and

select the most relevant questions to prepare a multiple choice final survey that has been distributed to a greater number of students. This second survey consisted of 15 multiple choice questions divided into 5 sections. In the first section, personal information was collected (age, gender and membership in the degree programme). The second section explored the familiarity and use of a Facebook and YouTube account before enrolling in college. The third section concerned the use of HATPFP and the perception of its usefulness. The fourth section focused on the use of HATYTC and the perception of utility. The fourth section focused on the use of HATYTC and its usefulness. The fifth section requires an overall assessment of the usefulness of social media in learning anatomy.

The questionnaire was distributed as a Google Modules file to students recruited by HATPFP.

The collection of answers took place between June and October of the same academic year in which the students attended the lessons. Then the statistical analysis of the results was performed.

Participation in the survey was anonymous, voluntary and free.

2.1.3 Analysis of results

100 polls were collected, 35% belong to males, 65% to females. The average age of students was 20,73±2,96 years. Most of the students filling in the questionnaires came from courses in Medicine and Surgery (38%) and Nursing (29%). The percentage of students per degree programme is shown in Graph 3.

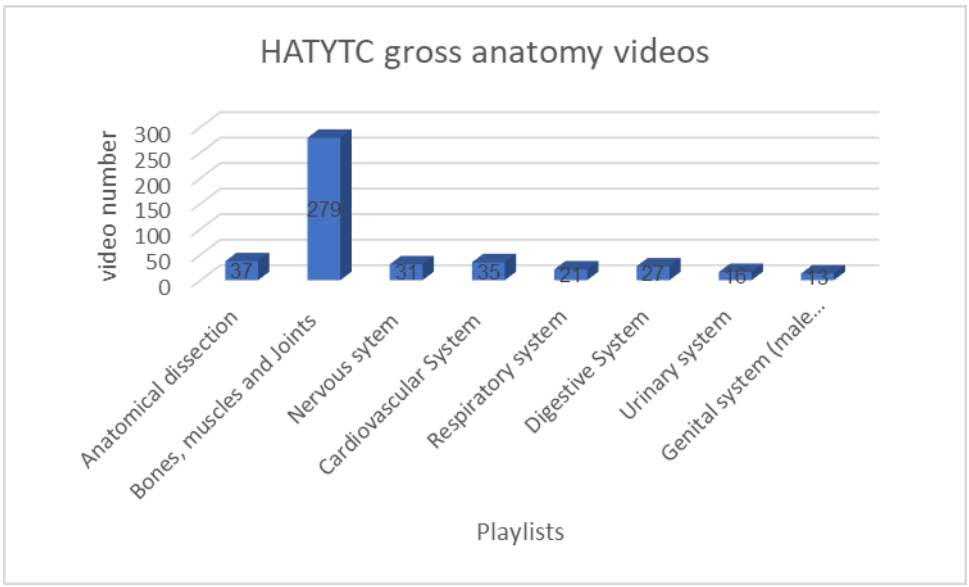
The results show that all students examined belong to the generation of digital natives, and that the use of social media Facebook and YouTube is part of common practices already in high school. In fact, 98% of students had a Facebook profile before entering the university and 99% of students said they used YouTube before entering the university. Most of the students (84%) used HAPTFP and the main motivation was to have information about the exam (68,6%) followed by news about the videos published on the YouTube channel (46,5%). The request for clarification on the topics covered in the lesson and the requests for material to go deeper into the contents of some chapters were placed on an equal footing (38.4%). The request for information on the integrated course in general (23.3%) and information on seminars of possible interest to students (15.1%) were the options that received the least interest. 94% of students consider HATPFP

a useful means of general communication with the teacher, especially for its speed (75.8%), ease of use (63.7) and informal mode of communication (Table 1).

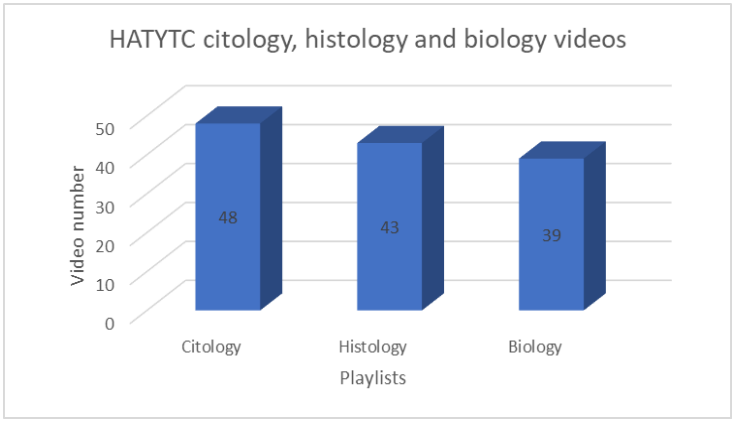
About two-thirds of the students (71%) used HATYTC, of which almost all (97%) claim that HATYTC is a useful tool for anatomy learning. Analyzing the reasons for this opinion, it emerges that about half of the students (52%) believe that the vision of video facilitates both the understanding and the memorization of anatomy. The understanding of the three-dimensional structure of organs and the ability to visualize the concepts studied are around 17.4% and 15.3%, only for 13.3% of videos implements the content of textbooks, while 2% indicates the other voice. It is very interesting to note that the use of HATYTC pushes students to independently search for other video material (63%) both of anatomy (49.2%) and of related subjects (39.7%) (Table 2). The fifth section asks the student to express an opinion on the usefulness of the two social media in the study of anatomy. HATYTC was the most voted (38%) followed by the Both statement (30%). HATPFO received 21% of the vote. Only 11% of students declared both social media useless for learning anatomy (Graph 4). Even in Italy, some exploratory studies have proposed to check whether the social network can provide an environment suitable for the

pooling of knowledge and skills related to the practice encouraging professional development and *life long learning.*

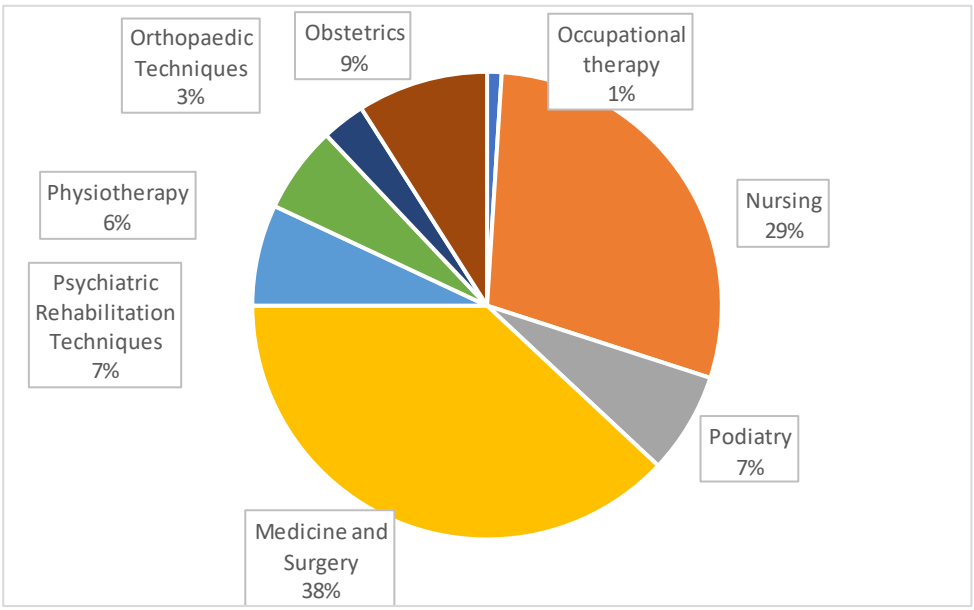
Graph 1



Graph 2



Graph 3 Distribution of students in courses



Graph 4

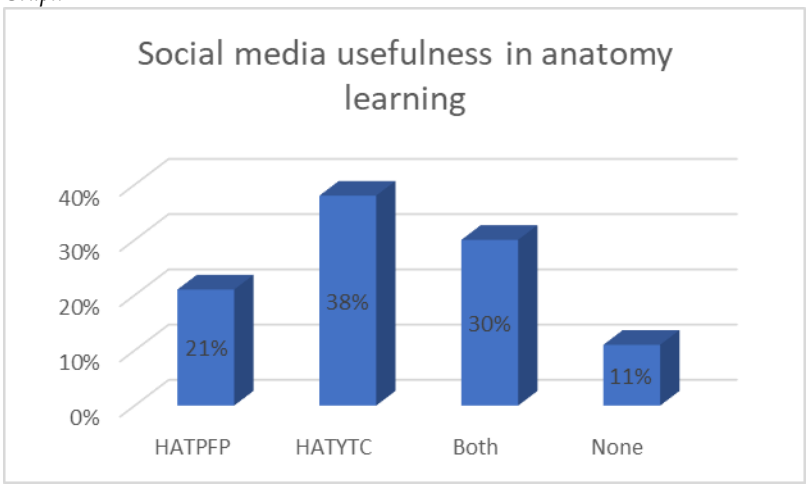


Table 1: The use of HATPFP and the perception of its usefulness

Did you use HATPFP?	Yes	84 %
	No	16%
If Yes, What did you use it for? (it was possible to select all applicable items)	To ask HAT for examination details	68.6%
	To request for explanations on topics Dealt with in class	38.4%
	To get information about seminars	15.1%
	To get information about video published in the HATYTC	46,5%
	To acquire materials and files for deepening the lessons	38.4%
	To have explanations on some topics	23.3%
Do you think HATPFP is a useful way to communicate with the anatomy teacher?	Yes	94%
	No	6%
If yes, for what communicative characteristic? (it was possible to select all applicable items)	Fast communication	75,8%
	Informality of communication	31.9%
	Ease of use	63.7%

Table 2: HATYTC use and usefulness perception

Did you use HATYTC?	Yes	71%
	No	29%
Based on your experience, do you think that HATYTC is a useful tool to support anatomy learning?	Yes	97%
	No	3%
If yes, why? (choose only the answer that	Because videos allow to easily Visualize the studied concepts	15,3%

best reflects your opinion)	Because videos implement textbook content	13.3%
	Because videos allow to understand the three-dimensional relationships between Organs	17.4%
	Because videos facilitates anatomy understanding and memorization	52%
	Other:	2%
After viewing the material on HATYTC, did you search for other teaching material on YouTube by yourself?	Yes	63%
	No	27%
If yes, what kind of material did you look for? (choose only the answer that best reflects your opinion)	More Anatomy Videos	49.2%
	YouTube channels related to other subjects (e.g. biology, Histology, general pathology, embryology)	39.7%
	Other:	11%

The Pilot study survey

	Question	Answer
1	Which degree course are you enrolled in?	
2	How old are you?	
3	Please indicate your gender	Male-female
4	Did you already have a Facebook profile before entering university?	Yes/no
	If the answer to question 4 is YES answer questions 5 and 6	
5	Did you use it only for personal contacts (friendships, cultural interests, etc.)?	Yes/no
6	Did you use it for contacts with high school teachers?	Yes/no
7	Did you ever use YouTube before entering university?	Yes/no
8	Did you use it only to display content?	Yes/no
9	Did you use it to view content and upload videos prepared by you?	Yes/no
10	Did you use HATPFP?	Yes/no

11	What did you use it for? List the main uses (open answer)	
12	Do you think HATPFP is a useful way to communicate with the anatomy teacher?	Yes/no
13	Why? (open answer)	
14	Do you consider HATPFP to be a useful way of promoting anatomy learning?	Yes/no
15	Why? (open answer)	
16	Did you use HATYTC?	Yes/no
17	Do you think that HATYTC is a useful tool to promote the learning of anatomy?	Yes/no
18	Why is that? (open answer)	
19	After viewing the material on HATYTC, did you search for other teaching material on YouTube by yourself?	Yes/no
20	If yes, which one? (open answer)	
21	Which of HAT social media was most useful in anatomy learning?	HATPFP/ HATYTC/ both/ none

2.1.4 Conclusions

The use of HATPFP and HATYTC by teachers and students in the study of anatomy has been positively perceived in several international studies (Cho, Hwang, 2011; Craig et al. 2010; Drake et al. 2009 Jaffar 2014, Topping 2014). These data, the first related to the Italian context, document that the use of social media Facebook and YouTube in the teaching of Human Anatomy was perceived by most students as useful and positive. Even within the limits of an exploratory study, we have highlighted how social media can be an effective support for the teaching of anatomy facilitating social interactions (in terms of time reduction,

simplification, immediacy, less formality), improving learning (in terms of memorization and understanding of concepts: and notions of anatomy) and making students autonomous in their search for new knowledge of anatomy and access to other information resources in other fields of medicine.

Chapter II

2.2 Case study no.2: Visual audio learning in anatomy

2.2.1 Objectives of this study

If in the first part the usefulness of social media in the university study was analyzed, in this second part the focus was on multisensory learning.

We know that sensory-motor modes facilitate learning: many studies have shown that understanding language and its production involve the use of sensory-motor resources (Fischer and Zwaan, 2008). On the basis of these acquisitions, the research project aims to demonstrate the effectiveness of an "embodied-centred" teaching that makes use of this system of functioning of the mind. It is therefore possible to assume that learning materials presented in a multisensorial way are more effective than materials presented in an abstract way because the sensory-motor modes always facilitate learning.

This paper analyzes the students' perspectives on the use of YouTube for learning, their usage patterns, and the associated factors that drive them to use YouTube.

The analysis was carried out on 90 students in the 16 to 20 age group.

This study has two main objectives:

1) Measuring students' perception of the effectiveness of YouTube videos in the context of learning

2) Develop a method that can be used to measure learning as one of the determinants of student YouTube usage

3) Design and develop a multisensory integration approach.

4) Implement the multisensory integration approach and improve working memory in science learning.

Italians, according to the Digital 2020 report, spend most of their time on social media, with a daily average of 1 hour and 57 minutes; Italian students, aged between 16 and 20, spend this time mainly on Instagram and YouTube.

The study takes place in different phases:

1. Check between randomly selected student groups
2. Subject a survey to students on the usefulness of audio-visual learning

2.2.2 Methodology and tools

The hypothesis is that learning is facilitated if the mode of presentation of information is as close as possible to the actual motor sense experience.

This research consists of two phases:

1. The first requires that the subjects are subjected to the study of two different anatomical apparatuses: urinary apparatus and endocrine.
2. The second involves the provision of a questionnaire on the usefulness of audiovisual learning.

Step 1

Students are randomly divided into three groups of 30 subjects. The groups are homogeneous both for the didactic development of the students and for gender (50% male and 50% female).

The first group, called verbal and considered the control group, is presented with a stimulus through verbal input (only written words) following a traditional approach and limiting learning to

only one written text. (test n.1 unisensory stimulus). The didactic manual without images has been used.

To the second group, called visual, the stimulus is presented through perceptive-visual and verbal input (3D image+ words written at the base as subtitles) (test n.2 unisensory stimulus). A YouTube video is used without audio but with subtitles.

To the third group, called audio-visual and considered the experimental group, the stimulus is presented through 3D audio-visual input (3D image + spoken explanation) (test n.3 multisensory stimulus). A YouTube video with audio explanation is used.

The experiment aims to verify that the learning performance improves in terms of speed and accuracy with the realistic presentation of the stimulus (audio-visual input in 3D mode).

The three groups were subjected to a multiple choice test to check what was learned. The test applications were selected from the ones given to the entrance tests at the biomedical faculties.

The experiment was repeated after 30 days and the students were subjected to a test similar to the first to check if what had been learned had been remembered later.

The videos on YouTube have been specially selected by the teacher among those present on the web.

Step 2

It is administered to 307 students a questionnaire of 16 questions on the usefulness of studying anatomy with texts on images and to use this new multisensory methodology in their course of studies. The group of students is randomly chosen throughout Lazio in an age range between 16 and 20 years of age. So we can consider them digital natives. The questionnaire was distributed as a Google Modules file to students after they have seen human anatomy videos on YouTube.

75% of students are female, while 25% are male.

2.2.3. Analysis of results

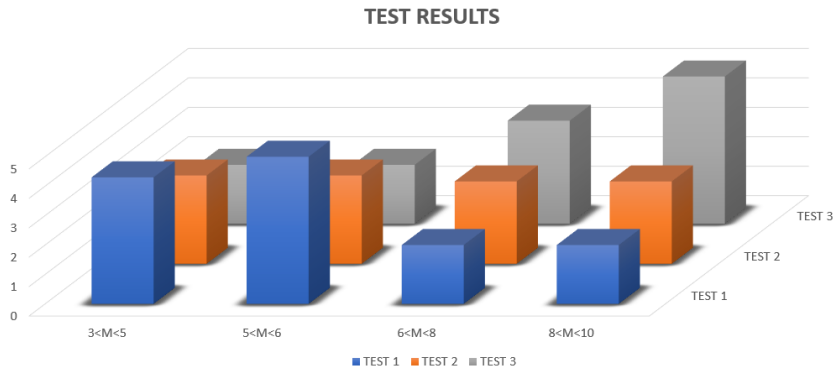
Step 1: Quantitative analysis

The results show that learning has been much faster for the multisensory group than for the unisensory group and that multisensory training offers advantages over the unisensory one. Subjects in the multisensory group showed very significant learning and achieved almost optimal performance.

Considering the results obtained, it can be said that training with an audiovisual stimulus produces improved learning both within a session (i.e., fast learning) and through days, most likely facilitating coding and better consolidation or retention of learning. Although over time unisensory training may be able to provide similar performance levels as those produced with multisensory training, multisensory training is much more efficient. This shows the exciting prospect that multi-sensory training can reduce the number of training days and perhaps the duration of training in each day, needed to produce equivalent performance on a read-only unisensory task.

The effectiveness of an *embodied centred teaching* is verified as the data show a major effect of the condition due to lower accuracy and longer re-enactment times in condition 1 compared to 2 and 3. It is possible that realistic 3D presentation improves the further performance: so condition 3 is more accurate and faster than the other two. The advantages of multisensory training are particularly surprising as it is generally believed that learning visual movement stimuli is mediated by a low-level view of certain brain areas. Although crossmodal interactions are ubiquitous in human perceptual processing, the contribution of crossmodal information to perceptual learning has not previously been applied to the study

of human anatomy in students of this age group. The results show that multisensory interactions can be exploited to achieve a more efficient learning of sensory information and suggest that the multisensory approach in training programs would be more effective for acquiring new competencies (Graph 5).



Graph 6 – Test results

Step 2: Qualitative analysis

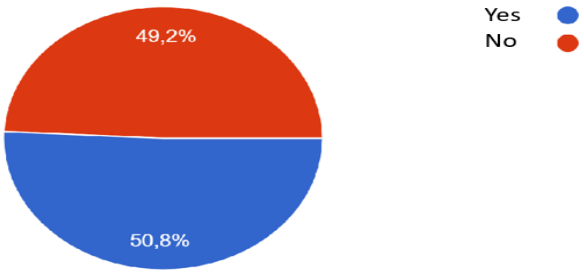
The results of the questionnaire show that 61% of the students were already aware of the visual learning methodology and had made use of it in the course of high school studies, but only 49% of students used concept maps and power points to visualize the content to be learned (Graph 6). 61% of students make use of images and videos to better understand text information, while 18% to get more detailed information and only 10% to deepen topics already covered (Graph 7).

58% of students believe that audio visual learning is very useful in the study of anatomy because images facilitate the understanding and memorization of anatomy, 28%, on the other hand, believe that it is useful because images allow to easily visualize the concepts studied (Graph 8).

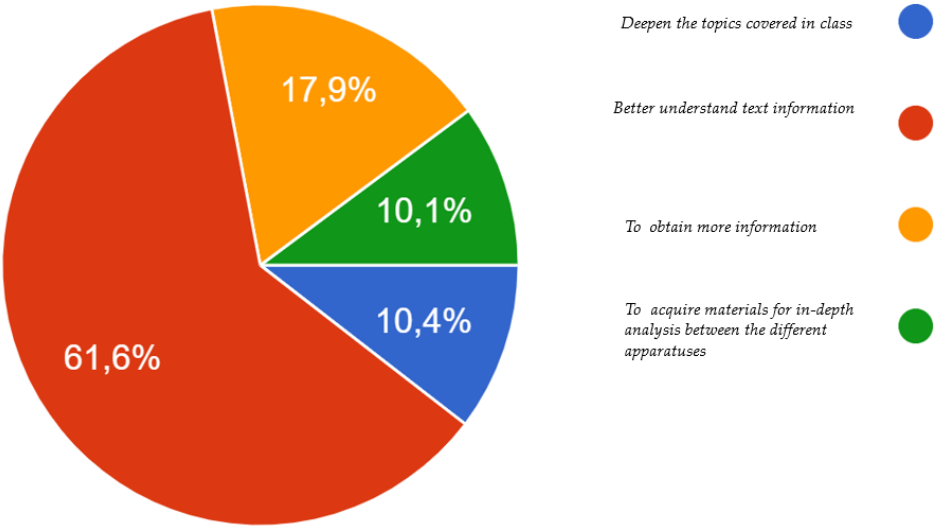
Surely multisensory learning causes interest and involvement in the student who is passionate and is pushed to search for other teaching material on his own (videos and images related to other subjects) to deepen their study.

To the question: "What kind of material were you looking for?" 40% of students respond: "images related to biology and histology", 28% "other images of anatomy", while 33% say "other" (Graph 9). Finally, the students are asked a question that refers to an experiment by Rubens and Waters in which the researchers asked children to produce images after reading a text; Those who had produced the image more easily recognized the contradictory elements within the text and, building images of the scene read, showed greater control of understanding. 55% of the students replied that they had found contradictory elements between the written text and the image proposed by the text in the study of a certain apparatus, demonstrating that multi-sensory and

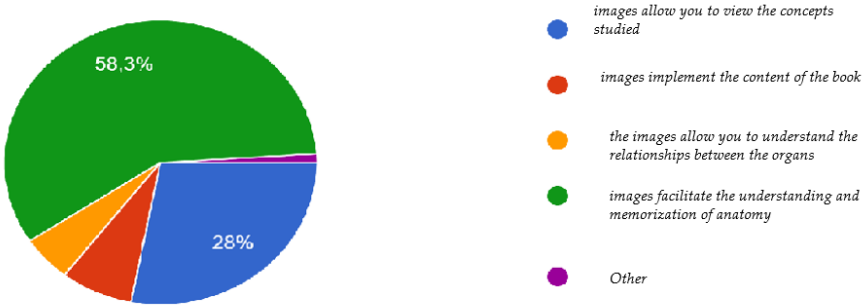
audiovisual learning allows a better understanding of a given topic and highlights the details. (Graph 10 and 11) .



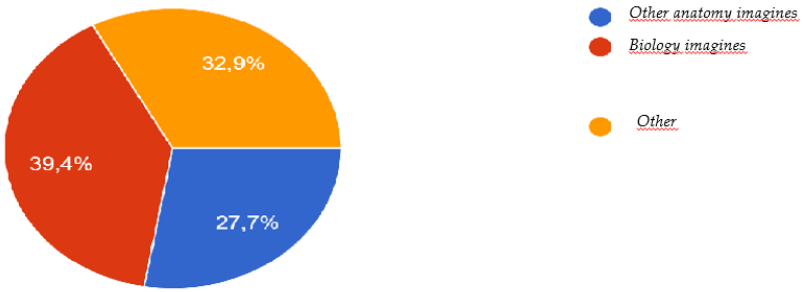
Graph 6 - To study you prepare maps and power points with images that display the contents?



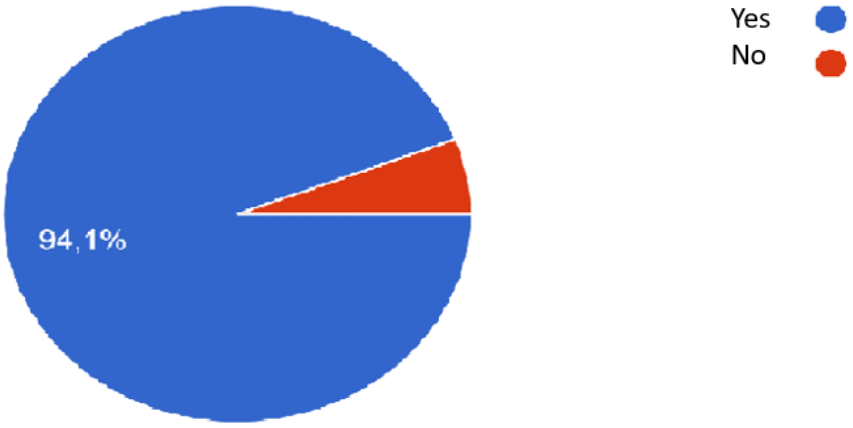
Graph 7-When studying an apparatus do you use images for learning?



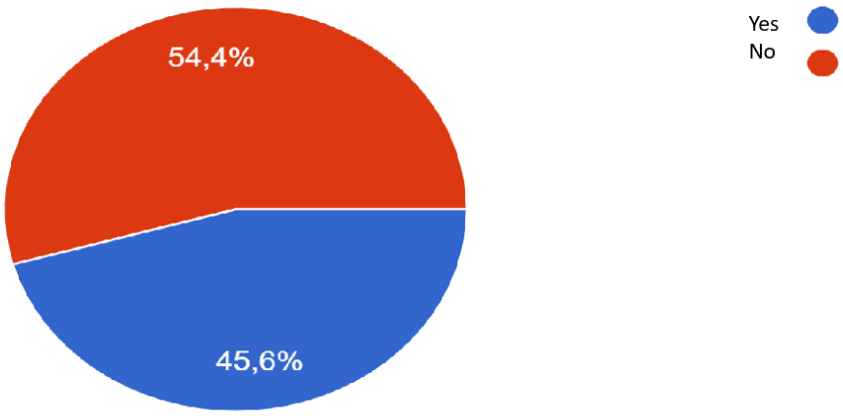
Graph 8-Based on your experience, do you think that VL is a useful tool to support anatomy learning? If so, why?



Graph 9-After seeing the material on the text, did you look for other teaching material alone? If so, what kind of material did you look for?



Graph 10- Rubman and Waters in an experiment asked children to make illustrations after reading a text; those who built the image more easily recognized the contradictory elements inside the text and, building the image of the scene read, showed greater control of understanding. Do you agree with this experiment?



Graph 11- If Yes, did you happen to find contradictory elements in the written text by studying and observing the images?

2.2.4. Conclusions

Multisensory learning, as the name suggests, is the process of learning a new topic through the use of two or more senses. This may include visual, auditory, tactile, or kinesthetic, olfactory, and gustatory combination (Scott 1993).

The activation of brain regions associated with touch, taste, hearing and vision, indicate a direct relationship between the approach of multisensory integration, knowledge and sensory mechanisms of the brain. The data revealed that all students use YouTube for entertainment. And almost everyone watched videos for information and educational purpose. Most of them pointed out that YouTube not only offers entertainment, but also educational material, which is easily accessible. YouTube helps them solve academic problems and increase their knowledge by learning effectively.

Learning from YouTube is easier and more fun and its highly visual content makes it easier to understand.

YouTube is definitely attractive because videos are more interesting than words and understanding topics is faster.

On a broader level, the results obtained are consistent with a general sensory processing paradigm in which perceptual and cognitive mechanisms are tuned for the processing of multisensory signals. Under such a regime, the storage and

retrieval of perceptive information is intended to operate in a multisensory environment, and unisensory processing is not optimal because it would correspond to an artificial mode of processing that does not use the perceptual machine at its maximum potential.

Concluding remarks

The results of this study allow some useful consideration to be given to the rate of participation of users in the activities.

This data makes it possible to state that the Social Network is used by most users as a space for access to a flow of information, materials, ideas, suggestions useful to enrich their professional background.

Another aspect worthy of attention concerns the predominant activities in the group: as we have seen, the most widespread are the requests for support and the sharing of teaching materials to confirm the presence of a high level of sharing among students.

As far as support requests are concerned, it is important to point out that there are predominantly questions aimed at collecting ideas, materials and tools to be used in the classroom or to receive support for the resolution of technical problems. Less frequent instead the demands of methodological nature or feedback, characterized by a greater reflexivity.

The literature shows that university students have different views on the educational usefulness of social media. In some studies the data show that students would prefer to use social networks (for example Facebook) only for social purposes without giving them formal teaching purposes (Selwyn 2009; Madge et al.2009; Wise et al., 2011). In others, the results are the opposite,

because they highlight the greater opportunities for sharing teaching materials, mutual support and building relationships (Bosch 2009). According to Roybler et al. In 2010, students are more likely to use Facebook together with classroom work than teachers, who prefer the use of more traditional technologies such as e-mail. Since there is no literature on the Italian reality, the aim was to verify the usefulness of HATPFP and a HATYTC in the study of human anatomy at some degree courses of the Faculty of Medicine and Psychology of the University La Sapienza in Rome.

Since both media are already used by students, we can say that HAT's use of HATPFP and HATYTC is not an unknown practice but rather fits into virtual habits and places already familiar to students. We therefore believe that linking teaching to already widespread communicative and cognitive practices among students can be very effective both to improve teacher-student communication and to improve the way students study. This result confirms the general data on the generation of digital natives also at Italian level on this specific population of students.

The results obtained therefore confirm what Anderson (2009) said, emphasizing how social networks, such as Facebook and YouTube, can encourage students to share themes and interests usually excluded from the typical interactions of traditional courses.

So that HATYTC worked as a kind of 'precursor' for the independent research of in-depth material on the web, not only for anatomy, but also for other areas of medicine, thus favouring the acquisition of an autonomous and transferable study method, transversal competence and continuous learning.

The two media are used for different purposes: HATYTC is appreciated for its effects on learning, while HATPFP for communication and relationship with the teacher. This result shows an important distinction to be aware of when designing the educational uses of technologies; this result warns us that the properties of different media are linked to different functions in the educational process (eg. social networks such as Facebook to communication functions, social media such as YouTube to informative functions) and how it is appropriate to think of heterogeneity configurations or ecology of the media rather than a single technology (Heath and Luff, 2000; Suchman, 2007; and Alby and Zucchermaglio, 2008).

Turning traditional training contexts into authentic learning environments is one of the most challenging and decisive challenges facing existing education systems. This will be possible if the barriers between the real world and formal knowledge are removed. In this context, technologies are an indispensable tool of mediation, they become the preferred channel to fertilize learning

environments with the communicative codes that dominate the world. Jonassen (1994) already stressed the important role played by ICT in integrated teaching. These tools are now essential to facilitate and customize learning processes as they solicit poly prospective analysis of reality and offer the student a variety of information/ resources of different nature.

Activating training courses aimed at the development of visual learning is however only one of the current challenges. Another important and indeed fundamental question should be stressed: The integration of digital in the training setting emphasizes the importance of cognitive aspects of an individual and social nature that can be fully realized through the use of effective teaching methodologies. Only if intentionally designed, a multimedia learning environment can, in fact, allow the cognitive immersion of the subject forming in a techno-constructive context that stimulates self-reflection and the relationship with the other, a context in which cognitive flexibility and meta-regulatory processes provide multi-perspective representations of reality. The use of digital media in educational contexts therefore requires a new design that is expressed in a renewed way of "making school". Rethinking, in this sense, teaching (and learning) with/in digital means first of all encouraging the acquisition of specific knowledge and the

development of sound professional skills of a methodological nature.

This research has suggested that the multisensory approach plays a vital role in improving working memory and learning in science and especially in the study of anatomy.

YouTube has been used as a complementary tool for learning thanks to its visual signals that make it easier to understand.

These results confirm that the use of videos to teach has a beneficial effect on student performance. According to Clifton and Mann (2011), the use of YouTube videos ensures greater student engagement, critical awareness, and deeper learning faster.

These results are consistent with those reported in other studies that claim that YouTube videos will simplify the understanding of a topic (Dewitt et al., 2013; June, Yaacob, & Kheng, 2014; Orús et al., 2016) and will improve the teaching experience (June et al., 2014).

The results highlighted the importance of mixed learning and the use of complementary tools to improve traditional learning approaches.

The wide use of YouTube among students, their familiarity with it and the effectiveness of learning videos make it necessary to adopt appropriate teaching technologies and new educational methods must be redesigned. New technologies can be used as a complementary tool for the educational system, which must

eliminate the weaknesses of the traditional method and improve teaching/learning. Using visual objects, especially videos to explain something, will make it easier for students to actually visualize and understand the topic and at a faster pace.

In recent years, neuroscience, starting with the discovery of mirror neurons, and cognitive sciences are increasingly intensifying their relationships to talk about a single MBE science, Mind Brain Education Science (Tokuhama-Espinoza, 2010). The common field concerns the classic themes of learning - memory, attention, language - but also the themes of consciousness and body. The paradigm of theoretical and empirical research born at the end of the twentieth century that is now affirming in the sciences of cognition is causing the shift of research interests from the study of the mind as such to the study of the ecological mind, that is, an ontologically interdependent mind between body and environment: the focus is on the mind-body-environment concatenation. It is no longer possible to think of the abstract domination of the mind over a mere executive body, but of cognitive functions, as explained by the theory of Embodied Cognition, *closely* related to perception/interaction with concretely lived experiences.

Brain areas of cognition, always considered abstract, now seem to fall into the embodied device so much to simulate the action without realizing it, or when it is observed performed by others. The embodied turn (embodied-turn) of learning and reasoning (Chandler &Tricot, 2015) represents an original critique of traditional models and urges the experimentation of new educational strategies (Lindgren & Johnson, 2013). From the Embodied Cognition we pass to the Embodied Education, that is, to the attention to didactic strategies that foster the awareness of the active role of the subject thanks to which it can build its own vision of the world on the surrounding reality.

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