SELÇUK ÜNİVERSİTESİ BEDEN EĞİTİMİ VE SPOR BİLİM DERGİSİ, 2011; 13 (2): 154–159
SELÇUK UNIVERSITY JOURNAL OF PHYSICAL EDUCATION AND SPORT SCIENCE

New Technologies for Motor Didactics

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ABSTRACT

Today's multimedia environments and information technologies represents a very effective tool to facilitating the processes of teaching and learning in schools, in the same way other technologies today available on the market, could hide some peculiarities and potentiality very useful for didactics process. Aim of the article is to analyze some instrument, chosen based on their potential and applicability in educational contexts, with special regards to the motor learning. It was decided to discuss here only two technologies selected for the high degree of involvement of motor skills that they make it possible. The two technologies that will be presented here are: (1) Kinect (2) Nirvana. Highly immersive didactic environments, such as those achievable through the use of the technologies mentioned above, could facilitate access to knowledge and give a valid assistance as high degree of involvement.

Keywords: New Technologies, didactics, motor- physical interaction, emotional affordance, integration, disabled people.

INTRODUCTION

The spread of the ICT (Information and Communication Technology) led to new ways to mean, acquire and elaborate data in that which today was renamed Information Society (13). The teaching methods found in these instruments new way of teaching which led to a restructuring and a re-working them through continuous feedback. Today's multimedia environments and information technologies represent a very effective tool to facilitating the processes of teaching and learning in schools, in the same way other technologies today available on the market, could hide some peculiarities and potentiality very useful for didactics process.

Aim of the article is to analyze some instrument, chosen based on their potential and applicability in educational contexts, with special regards to the motor learning. Obviously, is not enough a trivial use of technology to make it an effective support for the motor learning. For this to happen, it is necessary start from a theoretical basis that guides its use and its implementation, recognizing the key element in physicality.

1. Conceptual Framework

The theoretical basis from which we have chosen to start the research and the analysis of new tools consist of the constructivism thanks to the active role and the importance it attaches to these. Today the constructivism is a complex theoretical system composed of philosophers, educators, psychologists, epistemologists, etc... It stems from the collapse of an epistemic model based on the idea that knowledge can be exhaustively represented by the use of logical and propositional models (6). Knowledge is then configured within the constructivism, as something of subjective that do not exist outside of the perceptual patterns of the subject, of his personal experience, of its environment and its context. Therefore, in this perspective, the subject is the builder of its knowledge. It is therefore clear that the knowledge cannot be represented and transmitted through a set of objective notions.

Without going deeply into a detailed description of the different strands of the constructivism, we could say that the central core of this cultural trend can be summarized, in educational field, by the following statement: the didactics is not the cause of learning, it create a context where learning takes place as it does in other contexts (23). In this perspective the teacher can more effectively carry out its function considering its role as a creator of learning environments, designed to foster and guide the student to begin an active and aware training career.

The function of the teacher in this theoretical framework is therefore focused on designing environments that promote learning processes, through the splitting of complex contents into simple concepts. It is clear that the new technologies are instruments particularly suitable for this purpose and also those they are related to the concept of the body.

Just think to the net structure of a hypermedia or hypertext, they seem to respond very well to the

needs of active and subjective training such as required from the constructivism. However, the ability to create subjectives and reticulars learning environments is not the only need that has to be taken into account for the setting of a positive educational experience. A successful education cannot be focused only on the cognitive component; it must also consider the body, the feelings and the actions. Consideration should be given three forms of learning: the acquisition of knowledge (cognitive learning), the emotions or feelings (emotional learning) and improvement in physical activity and motor performance (psychomotor learning). They increase the ability of a person to give meaning to their experiences (15). The hypermedia environments, enabling integration of different media and different types of interaction, have greatly improve the emotional involvement of the user in comparison to the methods and to the tools of traditional teaching, but they generally they allow little chance of motor interaction, that often is made, in educational contexts, only through mouse and keyboard, and, in this way, they failing to meet the needs of psychomotor learning. It is therefore necessary to identify tools that allow a higher degree of motor interaction and of psychomotor involvement.

2. Interaction and Presence

The concept of interaction, in its broadest sense means "the generation of meaning that the humans make trough the action in a simulated or real space" (8).

The informatics environments, generally, allow a wide range of possible interactions, however these interaction are directly related to input devices that are used. The input devices are devices that allow the computer to acquire data, the most common are keyboard, mouse, microphone, touch screens, etc.. Once the data has been imported into the computer, they make it possible to create many environments and many types of interaction, these, however, remain linked to the type of input data. Different input devices have, therefore, different properties and allow different types of interaction. In other words, an interface can be designed to allow a use through the keyboard using and the mouse, but the types of physical interaction that will engage the user during the usage will be very different depending on the device used. It seems clear that the level of involvement allowed by this type of technology comes not only from the integration of different media that they make possible, but also from the degree of motor interactions they offer.

The concept of motor and physical interaction is also closely related to the concept of "presence" which is generally considered a good measure of involvement of person. The concept of presence can be described "as a selective and adaptive mechanism, which allows improving the motor coordination ability, through the distinction between" inner "and" external "in the sensory flow".

The more the body experiences a high level of presence involvement in an activity, the greater the opportunity to carry it out successfully.

The digital tools that we find in schools, often are not designed to allow an interaction that makes possible to know the world through the sensory-motor learning, type of learning more natural for humans than the learning of symbolic-reconstructive type , mediated by the use of a keyboard or of a mouse, that is often used in the schools.

Aim of the study is therefore to analyze the properties of some technologies currently available to explore their potential educational and degree of motory and emotional involvement that they allow.

3. Instruments

In the last decade we have seen the emergence and spread of many types of sensors such as gyroscopes, accelerometers, infrared sensors etc.., the use of these sensors, originally designed for industrial and military applications, today has found application in many contexts of our everyday life through devices available on the market such as mobile phones, gaming devices, computers etc.

Each sensor has properties and peculiarities, and since the number of devices on the market today is very high, it would be impossible to examine the properties of each type of sensors.

It was decided to discuss here only two technologies selected for the high degree of involvement of motor skills that they make it possible.

The two technologies that will be presented here are:

- Kinect
- Nirvana

3.1 Kinect

Kinect is a device sold by Microsoft for the Xbox 360 gaming console. It is a complex non-invasive system of markerless motion capture, cost-effective, easily transportable.

The device is equipped with:

- Two infrared sensors able to obtain depth maps of the surrounding environment.
- A camera RGB
- 4 microphone to eliminate background noise and allow the device to obtain data about the surrounding space.

Although this device was originally designed to work with the xbox360 game console, it immediately aroused a great interest in computer science in general. Microsoft has recently released an SDK which makes possible to program this device to interact with a normal PC. The device is able to recognize the user's body segments and it allow opportunities for interaction with a high degree of involvement of motor skills.

By using this device is possible design and build sophisticated learning environments that, thanks to the allowed opportunities of interaction, are able to exploit more fully the sense of presence and to ensure greater involvement of the students in the teaching of motor activities.

At the University of Salerno it is currently developing an environment that fosters the learning of musical concepts through the use of the body, which uses this device as the primary tool for data acquisition.

3.2 Nirvana

BTS Nirvana is a markerless motion capture system developed by BTS and integrated with many other tools for motion analysis. Nirvana provides a complete visual and auditory sensory immersion in a virtual non-invasive setting. The system allows interaction with the body through virtual scenarios projected onto vertical and horizontal surfaces. Thanks to the infrared optoelectronic system, with which the system is equipped, individuals can interact with virtual scenarios in a natural way through the movement on the projection plane.

Initially designed for rehabilitation purposes, the technology offers interesting opportunities for applications in the field of motor learning, and potentially offers the advantage of being integrated with other tools developed by BTS motion analysis. Currently at University of Salerno it is working on a simulated environment for the motor learning that takes advantage of the peculiarities of this instrument.

4. Psychology of Media

In relation to the technological tools presented shortly before it is interesting to focus on how it may be possible to employ the technologies to produce and control positive emotions.

A group of scientists (22) questioning about the link between technologies and emotional experiences have developed a new research field called the "Emotional Technology". This, it moves within the broader background of CyberPsychology that is "psychology of new media" (17), which has as its objective the study, the prediction and the activation processes of change that originates in the interaction with the new communication medium.

At first, scientists have focused their attention on the analysis of the factors that influence the experience of new media such as emotional technologies. A specific survey was conducted on the concept of emotional affordance, a term introduced previously by the cognitive psychologist Gibson (10); it is a resource that the environment offers to the person who is in turn able to take it.

The affordance can be considered a kind of "invitation" of environment to be used in a certain way; it is generated from exploration of the environment in which the body derives directly with its activity, the necessary information. According to Gibson, in fact, every object, or environment, is characterized by a set of properties that support a particular kind of action and not others.

With reference to the new technology of BTS Nirvana is necessary to understand, any emotional implications in people who come in contact with the VR (Virtual Reality).

How this technology is able to engage the emotional experience of the person? While the traditional media is characterized by its own technology represented by all the stable characteristics of the medium (interface) and that blend with the physical component (eg, telephone handset that is part of the physical structure of the medium that contains it), in the new media the interface is not part of the physical structure of the medium, but acquires its own life.

The RV provides a level of interface so advanced as to allow the user to actually see him/herself within the proposed three-dimensional world navigate and interact with the environment in real time (24).

Generally, RV systems can be grouped into two important categories depending on the technological components that are used. Indeed, there are non-immersive systems in which the virtual environment is received through a monitor and the interaction takes place through traditional instruments like the keyboard and mouse.

Those called immersive, however, using wearing a helmet with a tracking system that allows the wearer, to see changes, in the corresponding environment, dynamically related to his/her actual movements. The interaction with the virtual scene is with a joystick or with a virtual glove and the configuration can include a set of tools to provide feedback to the subject in terms of feel, grip and strength. People enter the virtual environment, bringing with them their experience, their expectations and their cognitive and emotional characteristics. One of the differences compared to other types of mediated communication, is the fact

that within the virtual environment, the cognitive and emotional response to that experience enables the subject to move from the perspective of user-observer to that of the protagonist of experience itself. In the virtual dimension, person does not receive information passively but by a series of intentional choices that in the communicative medium define their own subjective experience.

Another distinctive peculiarity of the RV compared to other media consists of particular combination of factors into play that helps to create the sense of presence which has been talked about before. Although the subject is aware that in virtual reality everything with which it interacts is not physically present and unconsciously responds as if it were.

At this point it is clear the level of potentiality and the fields of use of technologies that have very significant characteristics and that seem particularly flexible and integrated, and which seem to give particularly effective results.

As for applications in the field of learning and education the provided benefits by RV are obvious.

There is a shared agreement between the theoretical education, compared to a positive learning for experience, that is "the knowledge starts with action ", as emphasized Bruner (5), and the RV seems to be the experiential medium par excellence. In addition, virtual learning environments allow students to interact with a variety of complex information through intuitive processes and not just symbolic. Returning to the concept of emotional affordance in the mediated experiences is clear the potentiality of RV as not only an integral part of an educational strategy based on exposure to stimuli but also as opportunities to develop experiences that support emotional processes.

It is possible, then, according to a similar approach, that individuals who interact in an environment enriched with a variety of visual and auditory stimuli obtain significant positive improvements in self-efficacy and emotional states. It would, therefore, very good planning and design of virtual experiences that they see the subject in an active role in the life experiences that make him/her aware of their skills, abilities and their interactive strategies.

It is very significant highlight as says Bandura (2), who once settled the self-efficacy tends to generalize to other contexts.

For example, an individual, a subject to continuous situation of stress, such as the student, can live an experience that allow a series of specific skills related to management their emotions creates a sense of personal efficacy, which also prepares to contexts of real life.

The acquired skills, then, become then the tool to handle difficult situations and can be transferred and applied to different situations. The design of any "technological intervention" necessarily requires the psychological aspects can't be reduced to simple behavioral reactions, but must include the interactive and communicative dynamics, the choices and decisions of the individual in relation to the object of experience. It is necessary; therefore, groped to predict behaviors, mental and emotional complexity processes in the mediated experience.

It is not only to consider through which modality the subject will react in the face of an object that has certain perceptual features but to think about the potential behavior "suggested" by technologies. For the reasons described above the design criteria should be as consistent as possible with the way we organize knowledge of the mind.

5. Use of Technologies for Disabled in Didactic Motor Field

Use of technological tools in motor special didactics "…to which many people, by belief or by convention, allow great potentiality and are the new and the future, it must involve some adjustment of the modality of organization of educational proposals and methodologies, and therefore their redefinition ..." (3).

The application of new technologies in educational field for disabled, in fact, has allowed the construction and development of new didactic scenarios. In this frame, the didactic-motor processes for teaching - in-disabled-, aimed at educational, health or sports contexts are no exception; they, in fact, like other fields of didactics, need specific and compatible tools with their organizational, technical, legal and usable ties through the application of methodologies giving objective feedback that can be helpful for the experienced eye of instructor / technician / educator (11).

The analysis of the movement, for example, in the special didactics, is now conducted through many technological tools that allow very accurate measurements, can offer reports with accuracy up to very recently unthinkable.

In this perspective, the technologies used in disability, are considered a "psychomotor laboratory ", whose characteristics make it an investigative tool transferable in specific environments. In a psychomotor-laboratory of analysis of some factors on didactic- motor-experience are, in fact, working with many tools that can effectively measure the three main aspects of the movement-in disabled-

(external forces, the internal forces, kinematics), through multiple and simultaneous analysis of the trajectories of body segments, of the reaction of the ground and activation muscle (16).

To put more emphasize on the possible applications of this type of analysis in the didactic and evaluation field in the disabled, can be useful a description of some of the most important technologies, among which are:

1) Systems of "motion capture", i.e. systems able to provide extremely correct measurements (mm) of the kinematics of body segments;
2) The force platforms, able to measure the external forces through the reactions of the ground;
3) The surface EMG, which measure changes in electrical activity of muscles;
4) Insoles and gloves equipped with sensors for measuring pressure, useful for measuring the pressure expressed by the hands and other gesture and for survey of distribution of plantar foot pressure.

These are the most important types of tools in the motor analysis for disabled. Obviously, every instrument has its own sensitivity, depending on the type of sensor which is equipped, the type of model, etc., very complex and specific issues, such as building models, evaluation standards, etc.., whose treatment certainly must be deepened.

At these technologies for the analysis of the movement, different other technologies such as calorimeters, ECG, etc.., all instruments for the measure in disabled, of other body parameters.

This technologies have a very high costs, however, the study on the didactics of motor activities in the disabled, can also use other types of instruments, though less accurate, such as computers, software cameras of video analysis, etc.. The use of computers, for example, as tool of processing and storage of data becomes absolutely essential in this area. This instrument allows obtaining highly accurate data relating to many useful parameters for motor analysis in disabled; to process, however, there are many problems that are relative for the interpretation of data.

In educational field they allow not only to obtain more objective data and, therefore, more reliable, but to follow the evolution of a motor-formative path throughout its process.

The development of specific protocols allows, also, to evaluate, in objective form, the acquisition of a certain technical movement and to understand on which factors act to improve the performance and the process didactic-generative of motor learning in an integrative point of view.

DISCUSSION

The use of these devices allows evaluating the motor profile and the potential of disabled and not disabled people, making conscious and effective the didactic-motor pathways. In didactic field they allow you to follow more accurately the development of motor skills of disabled students and to intervene through the design of motor custom programs.

These technologies can also benefit the disabled people during the activities of daily living and working in conditions of safety and may allow them to communicate and then participate in the social and cultural context in a broader sense. For example, one of the strengths of the use of these tools for disabled people is that dramatically increasing the motivation to learning and therefore the obtained results.

The technology in the motor field to support educational and social integration of disabled people can play an important role if it is able to consider, however, the needs of the user, so it must be a focus/pivot in the framework of social integration.

It is clear that technological tools can play a central role in the didactics of motor activities; these technologies are, in fact, able to provide support to the design and remodeling of the didactic, giving scientific dignity to the assessment processes of disabled students in motor field.

The technologies make it possible to create environments and interfaces experiential, in which the perceptual component (visual, auditory, kinesthetic) merges with the interactivity.

The disabled and not disabled student, knows, then, the objects and learns to use them through direct experience, and in a real-time, of their reactions to his/her actions. They thus make possible the testing of new methodologies focused on learning sensory-motor and use the body for access to knowledge. Highly immersive didactic environments, such as those achievable through the use of the technologies mentioned above, could facilitate access to knowledge to not disabled people and give a valid assistance as high degree of involvement.

REFERENCES

1. Antinucci F. *La scuola si è rotta*, Laterza, Bari, 2001.
2. Bandura A. *Social learning theory,* Prentice Hall, Upper Saddle River, New Jersey, 1977.
3. Bosio P, Menegoi Buzzi DI. *Scuola e diversità in Europa. Strumenti per la formazione dei docenti sull'integrazione dei disabili in Europa,* Milano, Franco Angeli, 2005.

4. Bruner JS. *The culture of education*, Harvard University Press, Cambridge (Mass.) – London, 1996.
5. Bruner J. *La ricerca del significato. Per una psicologia culturale,* Bollati Boringheri, 1992.
6. Calvani A. *Costruttivismo, progettazione didattica e tecnologie*, in D. Bramanti (a cura di) *Progettazione formativa e valutazione*, Carocci, Roma, 1998.
7. Carassa A, Morganti F, Tirassa M. *A situated cognition perspective on presence*. In B. Bara, L.W. Barsalou, M. Bucciarelli(Eds.), XXVII Annual Conference of Cognitive Science Society. Alpha, NJ: Sheridan Printing, 384-389, 2005.
8. Carassa A, Morganti F, Tirassa M. *Movement, Action, and Situation:Presence in Virtual Environment*. In M. Alcaniz Raya, B. Rey Solaz (Eds), Seventh Annual International Workshop Presence 2004. Valencia UPV,7-12: Editorial, 2004.
9. Gardner H. *Intelligenze multiple*, Anabasi, Milano, 1994.
10. Gibson JJ. *The ecological approach to visual perception*, Houghton Mifflin, Boston, 1979.
11. Hughes M, Lipoma M, Sibilio M. *La performance analysis. elementi di base ed aspetti applicativi in campo educativo ed integrativo*. Milano: Franco Angeli, 2009.
12. Lodrini T. *Didattica costruttivista e ipermedia*, F. Angeli, Milano, 2002.
13. Machlup F. *The Production and Distribution of Knowledge in the United States*, Princeton: Princeton University Press, 1962.
14. Morganti F, Riva G. *Conoscenza, comunicazione e tecnologia*,Milano: LED Edizioni Universitarie, 2006.
15. Novak J. *L'apprendimento significativo*, Erickson, Trento, 2001.
16. Puglisi F. *Biomeccanica introduzione alle misure strumentali di postura e movimento*, Roma, Marrapese, 2007.
17. Riva G. *Psicologia dei nuovi media*,Il Mulino, Bologna, 2008.
18. Tarr MJ, Warren WH. *Virtual Reality in behavioral neuroscience and beyond,* Nature Publishing Group, 2002.
19. Varisco BM. *Alle radici dell'ipertestualità*, in A. Calvani e B.M. Varisco (a cura di), *Costruire/decostruire significati*, CLEUP, Padova, 1995.
20. Varisco BM. *Costruttivismo socio-culturale*, Carocci, Roma, 2002.
21. Vigotskji LS. *Il processo cognitivo*, Boringheri, Torino, 1980.
22. Villani D, Grassi A, Riva G. *Tecnologie emotive: nuovi media per migliorare la qualità della vita e ridurre lo stress*, LED, Milano, 2011.
23. Wenger E. *Communities of practice. Learning meaning and identity*, New York: Cambridge University Press, 1998.
24. Wiederhold BK, Widerhold MD. *Virtual Reality Therapy for Anxiety Disorders, Advances in Education and Treatment*. American Psychological Association Press, New York, 2004.