Pakistan Journal of Applied Sciences 3(1): 36-39, 2003

Virtual Reality in the Teaching of Motor Skills: Literature Review

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Abstract: The present work is a study aiming to present literature on virtual reality and to inquire the possibility of using virtual reality in the teaching of motor skills. Learning process in physical education and sports, as far as the cognitive and physical aspects concern, is an interesting topic, which has been worked out extensively. Nevertheless, the idea of using high technology in the teaching of motor skills is an inviting one, which needs further investigation.

Key Words: Virtual Reality, Instrument, Observation Learning, Education

Introduction

Researchers have worked on developing methods to improve physical exercise and athletic performance through learning of new motor skills on both cognitive and physical level, such as observation method (Sheffield, 1961; Bandura, 1962; Bird and Rose, 1984; Adams, 1987; Weeks, 1992; Kampiotis, 1998) and mental training (Richardon, 1967; Corbin, 1972; Lang, 1979; Weinberg, 1982 and Suin, 1985). Measurements using triadmills, cicle-ergometers, metabolic-cart, kinesthesiometers etc. have been used for the same purpose. The rapid technological evolution, specially on computers' systems, both hard- and software, have evoked the parallel development of methods concerning the learning and improvement of either cognitive or motor tasks, or both cognitive and motor tasks, using the computers (Rose *et al.,* 2000).

The fact that the use of modern technology and multimedia, especially virtual reality, in learning situations presupposes that the learners observe a model, involves the mediational - contiguity theory, which is also reported as symbolic representational theory (Sheffield, 1961). According to representational theory, when a person observes a demonstration of a motor skill, forms a cognitive symbolic representation of the skill. Afterwards he/she can recall symbolically the demonstrated skill. Bandura (1971) explained the procedure, in which the observer is standing between watching and recalling the demonstration of the skill. Bandura, like Sheffield, considered the involvement of cognition in learning process through model as very decisive. The symbolic representation, which is acquired by the observer, is stored in his/hers memory in two forms: virtual images and verbal equivalents of the demonstration. Afterwards, these symbolic representations serve as guides for the executed skills. Accordingly, learning through observation facilitates the observer, increases and improves his/hers abilities through selective attention, codification of memory and cooperation of senso-motoric and ideokinetic systems.

Virtual reality, which is nowadays used in different sectors of life, is the outcome of the progress in communication between man and computer. The term virtual reality describes an iconic environment, which can be changed by the user and the changes can be experienced as happening in real time. The user feels, influences and is influenced by the iconic environment through special entry and exit devices, which give the user the illusion that he/she is a part of the iconic environment (Fig. 1). The illusion is complemented with sounds coming from headphones or loudspeakers of the system of virtual reality. The formation and the control of the iconic environment are achieved through techniques and methodologies of assimilation of multimedia and robotics (Sideris *et al.,* 2000).

Fig.1: The User Feels, Influences and is Influenced by the Iconic Environment

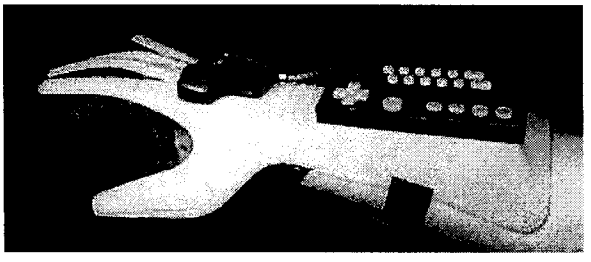
The technique used, when training with virtual reality, seems similar to the technique of mental training, due to the classification (Mahoney and Avener, 1977) in internal (first-person and kinesthetic) and external (third-person visual) approach, which is common in both methods. In internal, in the case of iconic environment the user feels and reacts to the changes that occur in this environment, while in external the user simply observes the changes that happen in the screen of the computer as an observer.

According to Durlach and Mavor (1995) virtual reality is the result of an advanced technology, whose stimulus, as far as the ratio of achievement concerns, remains on high levels. Other researchers (Rose, 1996; Rizzo *et al.,* 1998a and b) argue that the iconic environment includes many of the characteristics of an ideal training, as it reinforces the learning and improvement of skills, especially when facing difficulties in performance circumstances or in cases that the activities are dangerous.

Generally, training with iconic environment gives to the instructor the opportunity to control the stimulus and the nature and planning of feedback, as well as to register the performance in detail. Also, a combination of educational assimilation with some form of computer game using the iconic environment, can increase the level of motivation (Schroeder, 1995).

Virtual Reality Devices: The most popular devices, based on virtual reality, are:

Data glove (Fig. 2). This device put on the hand detects the movements of the hand and gives to the user the feelings of touch, pressure, resistance with the iconic object that he/she sees in the iconic environment with another device, which will be described underneath.



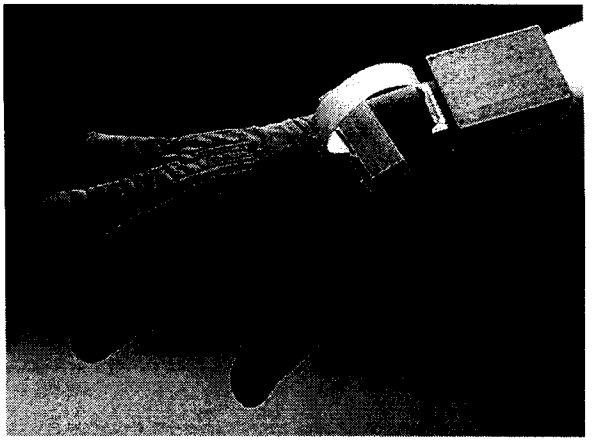


Fig. 2: Data Glove

Head-mounted display (Fig. 3). This device consists of special spectacles, which are connected to headphones and loudspeakers as well as to sensors, which detect the position and the movements of the head. The pictures of the iconic environment are projected stereoscopically to the user. The movements of the head are associated to the movements of the pictures, which are produced from the computer in three-dimensional form.

Body glove. It is the advanced form of the data glove. The body glove put on detects the movements of the body and creates different stimuli according to the movements executed.

Screen. It is used in planetarium and in completed assimilation systems for airplane flights.

Applications of Virtual Reality: Virtual reality has passed from the entertainment with computer games to sectors as shipbuilding, aircraft, car design, assimilation systems for airplane flights, architectural design, movie industry, medicine, education etc. As we can see in relevant literature, a great number of works, around 700 from 1991 to 2000, has been conducted on virtual environment, virtual digit persons, virtual circumstances etc.. These works refer mainly to psychology and medicine and some to sports. Around 1990, virtual reality was applied to pilot training with the use of assimilations in virtual environment, which gives the trainees the feeling of

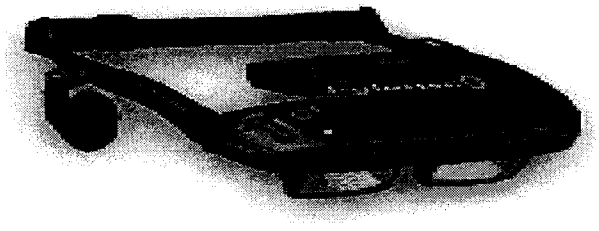


Fig.3: Head-Mounted Display

real training (Lintern *et al.*, 1990 a.b.). Accordingly, virtual reality was applied to firemen (Bliss *et al.*, 1997), to military physicians and medical personal (Satava, 1995), naval craft (Magee, 1997) and to car drivers (Mahoney, 1997). Lately, virtual reality is used in surgery for the training, the acquaintance and the improvement of surgeons (Riva, 1998; Glombitza *et al.*, 1999; Xia *et al.*, 2000; Gorman *et al.*, 2000; Haluck and Krummel, 2000; Phillips and John, 2000).

Virtual reality is, also, used for the treatment of people suffering of phobia (North *et al.*, 1997, 1998; Bullinger *et al.*, 1998; Riva *et al.*, 1998), people having kinetic disorders (Stanton *et al.*, 1996) and also people facing learning difficulties (Cromby *et al.*, 1996; Brown *et al.*, 1998). It is widely accepted that in virtual reality a

positive conveyance occurs from iconic to real environment (Regian, 1997; Waller *et al.,* 1998; Brooks *et al.,* 1999), which affects positively the performance in real situation.

However, we must be careful particularly when using the iconic environment for the training of children. In spite of the fact that training with virtual reality improves motor skills, control of the range of vision, attention, kinetic control, timing (synchronization) etc., it can create wrong impressions to the children, as they feel the iconic environment as real and think that dangerous things can happen without consequences, for instance a gun does not kill or a car is harmless. Rose *et al.,* (2000) pointed out that children playing with iconic environment may get the wrong message that making mistakes e.g. when crossing the street does not cause any damage.

Conclusion

Research on virtual reality with regard to physical education and sports, specifically to gymnastics, is rather limited. Nevertheless, 39 works are mentioned in relevant literature at the last decade, concerning sailing and golf, for example Walls *et al.*, (1998) used training with iconic environment in sailing and Kilfara (1996) in golf. Anyway, works on virtual reality in relation to particular motor skills and particular events, aiming to develop techniques, which can improve performance and also can be useful to physical educators and coaches do not seem to be conducted on a sufficient degree. The problem, whether we can influence learning of particular skills in particular events by iconic environment and in what degree this influence can occur, remains.

In our point of view it is interesting to examine if virtual reality can be used as a means for the training of people involved in physical education and especially in gymnastics. Specifically, we are interested in examining whether training with iconic environment can help trainees to detect, from the cognitive point of view, the mistakes they are doing when performing specific tasks in basic and apparatus gymnastics. Further to, we are interested in inquiring the possibility to conclude virtual reality in the education programs of physical educators and coaches, considering that virtual reality, as a learning approach, may be equally effective as the descriptive (and verbal) feedback.

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