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## ORIGINAL

### DO ICT RESOURCES IMPROVE SPORTS TEACHING PROCESSES IN HANDBALL?

### ¿MEJORAN LAS TIC EL PROCESO DE ENSEÑANZA-APRENDIZAJE DEPORTIVO DEL BALONMANO?

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## **ABSTRACT**

Motivation (M) and game perception-analysis ability (PA), variables in the teaching-learning process, were evaluated after using different resources during the coach's explanations. Seventy-one players (Under-18) were divided into 2 groups: G1 (n = 35) traditional resources; G2 (n = 36) multimedia resources. Initial (i) and final (f) levels of both variables were evaluated after 10 training sessions.

Both variables showed a significant improvement in both groups. The improvements shown in G2 were greater in both variables ( $p < 0.001$ ). Intergroup differences were only found in the final evaluation in M and PA ( $p < 0,001$ ), where G2 obtained better results.

It was concluded that using multimedia resources has a greater positive effect than traditional resources on M and PA in under-18 handball players.

**KEY WORDS:** handball, training, motivation, perception-analysis, ICT.

## RESUMEN

La motivación (M) y la capacidad de percepción-análisis (PA) del juego, variables del proceso de enseñanza-aprendizaje, fueron evaluadas tras utilizar diferentes recursos durante las explicaciones del entrenador. 71 jugadores (Sub-18) fueron divididos en dos grupos: G<sub>1</sub> (n=35): recursos tradicionales; G<sub>2</sub> (n=36): recursos multimedia. Se evaluó el nivel inicial (i) y final (f), tras 10 sesiones de entrenamiento.

Ambas variables mejoraron significativamente en ambos grupos. Fueron mayores las mejoras del G<sub>2</sub> en ambas variables ( $p < .001$ ). Se hallaron únicamente diferencias intergrupales en la evaluación final en M y PA ( $p < .001$ ), mostrando el Grupo 2 mejores resultados.

Se concluye que la utilización de recursos multimedia posee un efecto positivo mayor que los recursos tradicionales sobre M y PA en jugadores de balonmano (Sub-18).

**PALABRAS CLAVE:** balonmano, formación, motivación, percepción-análisis, TIC.

## INTRODUCTION

Information and Communication Technologies (ICTs) applied to the teaching-learning process offer many advantages: easy access, flexibility, teaching centred on the student and better opportunities for collaborating. For this reason, their integration in educational and training systems constitutes one of the main concerns of the European Union (Becerra, 2003; Ferrer, Naya, & Valle, 2004, Correa & Paredes, 2009). Similarly, many authors have reported the usefulness of their application in the general educational context (Adell, 1997; Salinas, 2004; Cabero & Alonso, 2007; Clark & Mayer, 2007; Palomares, Fernández, Modroño, et al., 2007), and in particular in the context of university education (Ferro, Martínez & Otero, 2009) Comprehensive analyses have also been done on the new technologies in Spanish and international education (Martínez-Laborda, 2005), although the speed at which technological resources increase makes the results of such studies obsolete just a few years after their publication.

To date, most of the models and systems for applying ICTs, as well as the plans for evaluating their usefulness in the teaching learning process have been centred on the classroom (Tourinan, 2004). Although it is true that the use of this type of resource is more and more frequent in the teaching-learning process at different educational levels, as a means of increasing student motivation (Area, 2005), in the context of sports training it is very diverse. In this sense we find different areas of study which use ICTs, like for example the use

of videos in training sessions, training using virtual 3D designs, the use of different technologies which provide feedback to the athlete, or the use of different methodologies which provide better feedback to the players of team sports thanks to notational analysis (Liebermann, Katz, Hughes, Bartlett, McClements, & Franks, 2002). However, the aspects of ICTs that have been analyzed have mainly focussed on technological aspects and not their pedagogical value or the value they have in a training programme (Santana, 2005). In particular, Bota and Urzeala (2007) showed their importance for sports teaching as they help the integral learning of concepts and abilities, permit tasks to be specifically focussed on using ICTs and, what is considered most important, ICTs are an excellent resource for motivating players. In another context, that of the trainers, Tsamourtzis, Pechlivanis and Karipidis (2009) used ICTs to enhance the training process of 60 Greek basketball coaches, using ICTs in distance learning, and their main conclusions show that ICTs can help in the process of sports teaching and improve the processes of motivation and learning.

In spite of the above mentioned studies, there is a lack of research studies on analyzing the efficacy of applying ICTs during the stages of sports initiation and advanced training, both in handball and other sports modalities. Therefore the present study is centred on pedagogical application and the evaluation of the changes produced by the use of ICTs in sports teaching-learning processes. According to specialist authors (Liebermann et al., 2002; Bota & Urzeala, 2007; Tsamourtzis et al., 2009), the use of multimedia technologies can represent an important resource which both improves the predisposition of the players towards teaching activities and increases the level of acquisition of the contents of the sports training itself.

Nowadays, the modern multimedia and computer techniques have different applications in the sports context (Moya, Vera-García, López, Aracil, Reina, Gutiérrez & Paredes, 2007) although they are not primarily used in teaching-learning processes. Play analysis in team sports using computer programmes, both of one's own team and of the rival team, are becoming common practice, not only in the top teams but also in lower categories (Norton & Glancy, 2008). However, although multimedia technologies are widely used nowadays for play analysis, no studies have been found that take a more in-depth view of their usefulness in the sports teaching-learning process. The application of these IT resources could be oriented towards the assimilation, on the part of the players, of the basic technical-tactical concepts of the sport they practise or towards the training of sports technicians.

The player's motivation (M) is a fundamental factor which defines his or her attitude towards teaching-learning activities. In experiments carried out in the educational field, it has been clearly determined that motivation is very important for encouraging the learning of the student (McFarlane, Harrison, Somekh, et al., 2000; Arriaga & Madariaga, 2004; Balanskat, Blamire & Kefala, 2006; Trucano; 2005; Condie & Munro, 2007). ICTs incorporated into the

coaches' explanations as a teaching aid could have a very positive influence on increasing the players' motivation, although at the moment there are no analyses or evaluations which ratify this statement in the field of sports training. With regard to motivation we should think about the influence that the improvement in the presentation of information by the coach has on the improvement of the players' competencies. The development of educational models which enhance players' motivation will positively influence the training stages. In particular, it would be interesting, as is described in the present study, to look for resources linked to information technology which produce the greatest improvements in handball players' competencies (Duda, 2005).

By using multimedia resources it is possible to improve perceptive capacity in general and visual ability in particular. Different studies have determined that perceptive capacity and especially visual abilities are trainable and that with suitable exercises the improvement in visual abilities can transfer to sports performance (Stine, Arterburn & Stern, 1982). It should be emphasized that visual abilities are not only important for the athlete during sports practice but also for the coach, especially during the sports teaching-learning process (Hitzeman & Beckerman, 1993) and even for referees (Armenteros et al., 2010). Sports training processes improve the visual abilities of the athletes and positively affect the performance of experienced players (Williams, Janelle & Davids, 2004) which is why it is an aspect which should be improved and monitored to enhance sports training processes.

Based on an analysis of the situation with regards the application of ICTs in sports training, it would seem to be a positive strategy to use multimedia resources for training coaches and players. In the light of previous research which has been carried out (Rivilla & Sillero, 2009; Tsamourtzis et al., 2009; Rivilla-García, Díaz, & Sampedro, 2010) and bearing in mind the important consequences which could derive from the specific teaching of sports training, it would seem appropriate to study the effect of using technological resources (ICTs) in the teaching-learning process in the context of the training of young sportsmen and women, in more depth.

The purpose of the present study was to analyze the influence of the use of ICTs on two concrete variables, one variable with a direct influence on improving the teaching-learning process and another variable which would measure the result of the process. The motivation (M) of the players was used as the fundamental variable for measuring and evaluating the optimization of the teaching-learning process. Play perception-analysis capacity (PA) was chosen as the variable related to the result of the process, a variable which would indicate the improvement of the learning process using ICTs. In this way, it was aimed to test the influence of the application of these resources both for the process in itself and its final result.

## METHOD

### *Participants*

The sample was made up of a total of 71 handball players, in the under 18 category who were participating in a training course, concentrated in a microcycle of a total of 10 sessions. During this period the players were divided randomly into two groups:

- **Group 1 (G<sub>1</sub>) (n=35)**: was characterized by the use of traditional resources like books of class notes, a magnetic white board, simulations with players, and no use of ICTs.
- **Group 2 (G<sub>2</sub>) (n=36)**: was characterized by the preferential use of multimedia resources like dynamic graphs, video sequences and images.

General characteristics of the sample are shown in Table 1

Table 1 General characteristics of the sample (Mean + SD).

GROUP	AGE (years)	HEIGHT (cm)	WEIGHT (kg)	EXPERIENCE (years)	Comments
Group 1 (G <sub>1</sub> ) (n= 35)	17.39 (0.68)	177.0 (4.42)	76.2 (5.1)	7.5 (2.85)	No use of ICTs Traditional Resources
Group 2 (G <sub>2</sub> ) (n=36)	17.35(0.52)	174.0 (6.85)	72.5 (7.9)	7.9 (3.23)	Daily use of ICTs Multimedia Resources

The participants belonged to three teams from the regional category, with a high degree of heterogeneity with regard to competitive level and playing position (specific position). However, with regard to their sports practice and experience, the groups were homogenous as they had practised on average 6-8 hours a week for the previous 4 years. Similarly, at this sports stage (under 18) the players selected for the present study had a homogeneous level of technical-tactical knowledge in different aspects of handball: rules, defence and attack techniques, and defence and attack tactics. This was measured with a questionnaire created by a panel of expert coaches and based on long term sports training according to the specialized literature.

### *Procedures*

The selected analysis variables were:

- a. **Motivation (M)**: The variable related to the teaching-learning process. The section which refers to motivation from the “*Características Psicológicas relacionadas con el Rendimiento Deportivo*” [Psychological characteristics related with Sports Performance] questionnaire (Gimeno, Buceta & Pérez-

Llantada, 2007), based on the “*Psychological Skills Inventory for Sports*” questionnaire by Mahoney (Mahoney, Gabriel & Perkins, 1987; Mahoney, 1989) was used to evaluate this variable, as it collects information on: motivation-interest of the athletes in training and improving day by day, the setting and achievements of goals or objectives, the importance of sport with regard to other activities and aspects of the athlete’s life and the cost-benefit relation that the sports activity has for the athlete. The answers were quantified on a Likert type scale of values from 1 (minimum score) to 5 (maximum score).

- b. Play perception-analysis capacity (PA):** The variable related to the result of the teaching-learning activities carried out: the test to evaluate PA was performed using an analysis of multimedia sequences and images projected from a laptop computer. To be able to quantify this capacity a questionnaire was used which had been drawn up by a group of expert coaches with appropriate questions for the relevant sports stage (under 18). The characteristics of the panel of expert included having a degree in Physical Activity and Sports Sciences, having the highest qualification in handball and more than 10 years experience as a handball coach in the training categories. The questionnaire was made up of ten closed questions (four possible answers, only one of which was correct). Each question alluded to a multimedia resource shown to the athletes. The questionnaire was marked using a scale of points from 1 (minimum score) to 10 (maximum score).

In order to control the extraneous variables which could have influenced the results of the present study, the coaches chosen to give the training sessions to each group had no connection with their respective group. These coaches also possessed the highest qualification in handball and had experience and training in the use of each of the types of methodology with experience of more than 10 years training handball.

The two groups also carried out the same number of training sessions (10) during the same microcycle. The sessions, training contents and learning tasks were planned and programmed jointly by all the coaches of both groups who were involved in the training. The time devoted to each training topic (Technical explanation of the coach, warm up, technical-tactical exercises, physical conditioning) was monitored so that it was the same for both groups. This ensured that the sessions were as similar as possible. The only differential factor between the groups was the different use of support aids for the coaches’ explanations: traditional resources v multimedia resources. These differential practices related to the use of ICTs were put into practice during the part of the training sessions devoted to the theoretical assimilation of the contents.

Two evaluations were carried out of the variables **M** and **PA**:

- **Initial evaluation** (<sub>i</sub>): carried out before the intervention period on both groups of players.

- **Final evaluation** ( $f$ ): carried out after 10 intervention sessions.

### *Instruments*

The support resources used in the case of the technical explanations for  $G_1$  were: exercise books with specific diagrams for handball, a magnetic and a traditional blackboard.

In the case of  $G_2$  the multimedia contents used as a support for the explanations of the coach were presented to the players on a screen using a projector connected to a laptop computer. The classification, selection and analysis of the video sequences were performed with a video editing programme specially designed for the observational analysis of handball matches (*SkautAnalyst Compact*). These contents were presented on PowerPoint, from the Microsoft Office<sup>®</sup> package.

The material used for the evaluation process was as follows: to evaluate the M variables, the section of the questionnaire related to motivation on the “*Características Psicológicas relacionadas con el Rendimiento Deportivo*” [Psychological characteristics related with Sports Performance] questionnaire (Gimeno, Buceta & Pérez-Llantada, 2007), while for the evaluation of the PA variable a projector connected to a laptop computer.

### *Statistical analysis*

The data analysis, processing and statistical tests were performed with the SPSS 19.0 statistical programme. The descriptive statistics used were the Mean and the Standard Deviation (SD). The difference between the initial ( $i$ ) and final ( $f$ ) values were analyzed using the t test for related samples. Statistical significance was always set at  $p < 0.05$ .

## **RESULTS**

The global analysis of all the results showed statistically significant differences both between initial motivation ( $M_i$ ) and final motivation ( $M_f$ ) ( $M_{i-f} = -1.09 \pm 1.14$ ;  $t_{(70)} = -8.127$ ;  $p < .001$ ) and between initial ( $PA_i$ ) and final perception analysis ( $PA_f$ ) ( $PA_{i-f} = -1.72 \pm 1.63$ ;  $t_{(70)} = -8.862$ ;  $p < .001$ ). The values for both variables increased during the intervention period. However, in the specific analysis carried out by groups, the results differed according to the variable analyzed.

The results referring to the changes which occurred in motivation showed a significant increase in both groups, although it was greater in the group which used ICTs ( $M_{i-f G2} = -1.42 \pm 1.34$ ;  $t_{(35)} = -6.46$ ;  $p < .001$ ) than in the group which used traditional resources ( $M_{i-f G1} = -0.79 \pm 0.85$ ;  $t_{(34)} = -5.46$ ;  $p < .001$ ) (Figure 1).



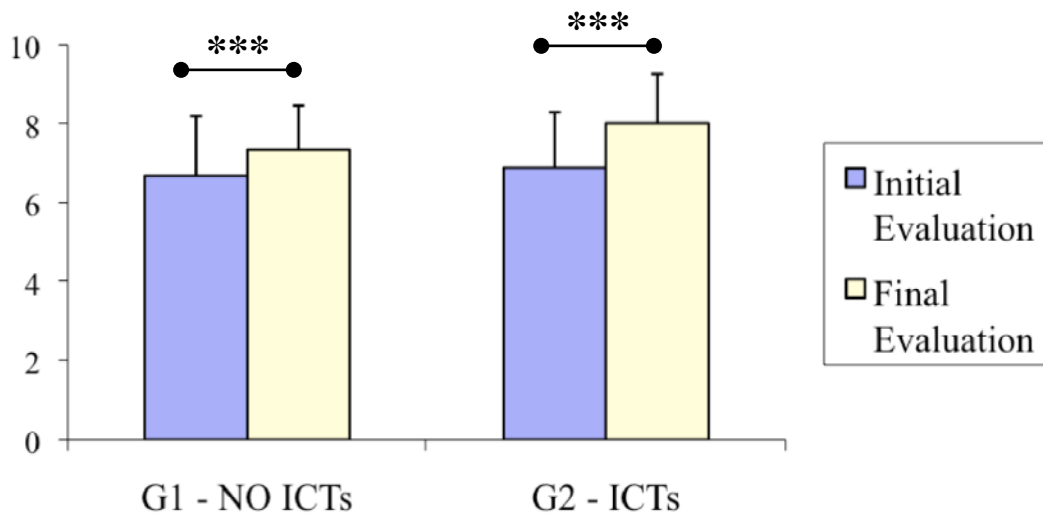


Figure 1- Values of  $M_i$  and  $M_f$  in  $G_1$  and  $G_2$  (\*\* $p < 0.001$ )

Equally, the data related to perception analysis capacity revealed a significant increase between the initial and final levels of both groups. The greatest increase was recorded by  $G_2$  ( $PA_{i-f G2} = -2.97 \pm 1.19$ ;  $t_{(35)} = -14.92$ ;  $p < .001$ ) compared with  $G_1$  ( $PA_{i-f G1} = -0.42 \pm 0.81$ ;  $t_{(34)} = -3.15$ ;  $p < .01$ ).

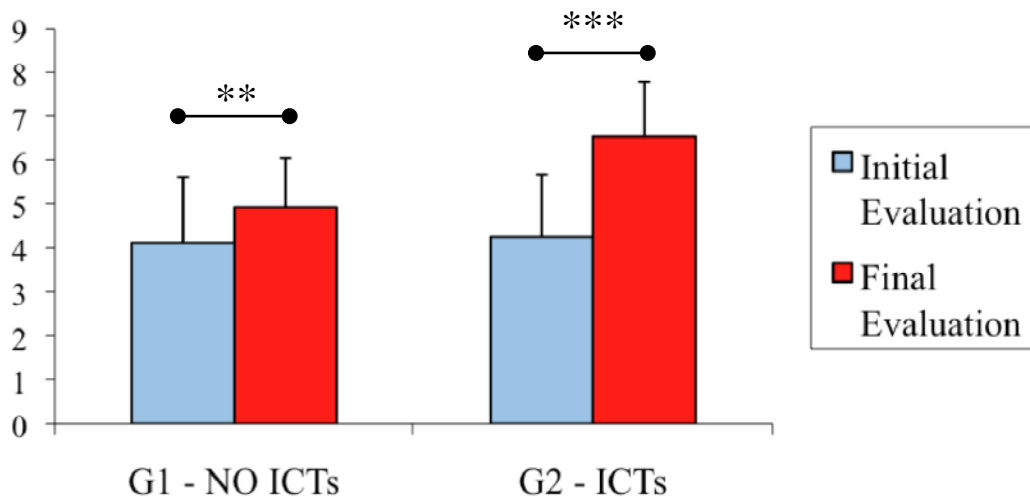


Figure 2- Values of  $PA_i$  and  $PA_f$  in  $G_1$  and  $G_2$  (\*\*  $p < 0.01$ ; \*\*\* $p < 0.001$ )

With regard to the intergroup differences, it should be emphasized that the mean initial evaluation between both groups was not significant, either in the case of  $M$  ( $M_{i G1-G2} = -0.55 \pm 1.38$ ;  $t_{(69)} = -1.69$ ;  $p = .95$ ) or in the case of  $PA_i$  ( $PA_{i G1-G2} = -0.15 \pm 1.82$ ;  $t_{(69)} = -0.18$ ;  $p = .85$ ). However, when  $M_f$  and  $PA_f$  were considered, significant differences were obtained between  $G_1$  and  $G_2$ , with a greater difference with regard to the variable  $PA$  ( $PA_{f G1-G2} = -2.59 \pm 1.07$ ;  $t_{(69)} = -$

10.14;  $p < .001$ ) compared to M ( $M_{f\ G1-G2} = -1.16 \pm 0.92$ ;  $t_{(69)} = -5.42$ ;  $p < .001$ ) and always in favour of the group that used ICTs as a teaching aid for the coach.

## DISCUSSION

The aim of the present study was to analyze the influence of the use of ICTs on two concrete variables, the improvement of the teaching-learning process using the evaluation of motivation (M) and the improvement in the learning results using ICTs through play perception analysis (PA). According to the specialized literature, there is a lack of studies which have made an in depth analysis of the application of ICTs in the teaching-learning process in the context of training young athletes (Rivilla & Sillero, 2009; Tsamourtzis et al., 2009; Rivilla-Garcia, Díaz & Sampredo, 2010). The analysis performed seems to show the positive effect of including multimedia resources (ICTs) in the training of young handball players.

The results make it possible to highlight the greater improvement in the M variable in the group which used ICTs during the training periods devoted to the assimilation of technical-tactical concepts. This variable will condition a greater predisposition and a more positive environment for developing teaching-learning processes with the young players (Roberts, Kleiber & Duda, 1981; Gill, Gross & Huddleston, 1983; Gordillo, 1992).  $G_2$  showed a greater increase in M than  $G_1$  at the end of the intervention period and the differences between the initial and final values were only significant in the case of  $G_2$  ( $p < .01$ ).

Moreover, the variable selected to evaluate if the teaching-learning process had improved (PA) showed a greater increase in  $G_2$  compared to  $G_1$ . The improvement in both groups with regard to the initial evaluation was significant ( $G_1$ :  $p < .05$ ;  $G_2$ :  $p < .01$ ). The learning objective was achieved both with traditional resources and with the application of ICTs although the improvement was greater in  $G_2$ .

The results appear to support the idea that the application of ICTs has a positive influence both in the variable selected to reflect those which condition the teaching-learning process (M) and the one which reflects the result of the process itself (PA).

Based on the positive effects found from an analysis of the results, it would seem appropriate to consider the different aspects which may make the result of applying ICTs to teaching-learning processes in the sports setting vary. These variables can be structured as proposed by Simonet (1986) in the case of the application of video feedback, in three groups:

- a) **Variables which affect the subject.** As indicated by Bota & Urzeala (2007) the characteristics of the group with regard to age or sports experience are aspects which possibly modulate the effects of the application of ICTs in the

sports setting. Rothstein & Arnold (1976) analyzed the effects of video feedback in learning sports skills and indicate that the beginners need their attention to be directed to the relevant aspects of performance, something that was not the case with the more advanced subjects. Newell & Walter (1981) suggest that a possible explanation is that the video provides too much information for the beginners, who may select irrelevant data and neglect the most fundamental aspects for improving their learning. The more experienced subjects do not seem to have this problem as they probably know how to extract the most important aspects of the video. There does not appear to be any published study which compares the application of ICTs among different age groups and this could represent a field of study which could contribute new knowledge to the topic.

- b) **Variables which affect the task.** This implies analyzing if the application of ICTs has a greater influence on the learning of open or closed tasks. No studies have been found on ICTs in this sense although Del Rey (1971) analyzed whether the use of video as feedback was better for learning open or closed tasks. His work, as well as the review carried out by Rothstein & Arnold (1976), seem to indicate that this form of making the players aware of their performance is more appropriate for closed tasks.
- c) **Variables related to the procedure.** In this regard it is necessary to define the appropriate time during which multimedia resources should be used during training. Hypothetically a short period devoted to applying these resources could have a negligible benefit while their over use could have a negative effect on the achievement of other training objectives. It would be interesting to define some time limits for their use to guide the application of these techniques in the sports training process.

Lastly, we consider it would be interesting to establish the minimum number of sessions for achieving the positive effects pursued with the application of ICTs. There are references which quantify the necessary period applying video feedback to improve technique in other sports disciplines as 5 weeks (Rothstein & Arnold, 1976) and mention weeks of application to accustom the athlete and achieve the predicted improvement. In the present study the results showed positive effects after using ICTs for 10 training sessions corresponding to a training microcycle. It would therefore be interesting to be able to establish a minimum time for application as it would help the coaches to determine the application periods in their sports periodization to ensure that positive benefits for the athlete can be achieved.

Within the future lines of research, the physical and psychological training loads should also be taken into account, so studies and analyses need to be carried out on the most appropriate moment for use during the training session: the beginning, the middle or the end. The athlete's fatigue diminishes his or her capacity to pay attention and if these multimedia resources are used late in the

session the positive effects pursued with their application may be reduced (Parlebas, 2001).

## **CONCLUSIONS**

Technological and multimedia resources (ICTs) used as an aid to the explanations of the coach have a significant and positive influence on play perception analysis capacity and, to a lesser extent, on motivation in handball players in their sports training phase.

Traditional teaching resources also have a positive but limited effect for improving play perception analysis capacity in an intensive training period, as they do not achieve a significant increase in the handball player's motivation.

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