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ORIGINAL

Assessment of primary school students' decision-making related to tactical contexts

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ABSTRACT

The purpose of this study was to assess and understand prior tactical knowledge and game performance as well as the relationship between the different components of game performance in invasion games. The participants (N = 22; girls: 13; boys: 9) were Physical Education students (ages: 11-12) with a low expertise in invasion games (they were selected among those with no other background in invasion games than PE lessons). Their game performance was videotaped, after which measures of motor execution and cognitive components were developed from observational analysis. Decision- making was measured on two levels: a) decision-making restricted to the performance of technical-tactical skills; and b) decision-making focused on adapting to the offensive tactical contexts of the game. Participants played an eight-minute-long 4-versus-4 generic invasion game. The latter was designed to meet both developmental needs and previous learning, so interference between motor execution ability and decision-making performance was minimized. The findings revealed that these students already had a basic concept of offensive and defensive game situations, both on-the-ball and off-the-ball. No significant differences were found between players' performance in penetrating-the-defense contexts and in those where they kept ball possession. The findings additionally highlighted the existence of significant relationships between decision-making and skill execution in getting open, tackling, marking off-ball and double teaming. Other links between game performance components are discussed throughout the paper. The importance of assessing game performance taking into account tactical contexts is also supported (Gutiérrez, González, García-López, & Mitchell, 2011), as well as some of the GCA pedagogical principles, e.g. the use of modified games (Oslin & Mitchell, 2006).

KEYWORDS: EVALUATION METHODS; PERFORMANCE BASED ASSESSMENT; PRIOR LEARNING; PHYSICAL EDUCATION; TEAM SPORTS.

1 INTRODUCTION

Important changes have happened in instructional theories during the last decades. These theories have moved from being based on behavioural theories to being based on constructivist theories, and from associative learning to constructivist learning. In games teaching, the traditional and still most widespread approach is the technical model based on the acquisition of isolated skills. Following the changes that have taken place in most curricular areas, including Physical Education, this traditional approach should be replaced by approaches founded on constructivism, the ecological paradigm and a situated learning perspective. Although this change has been taking place for several years, it is still more evident in the published literature than in real practice (Robles, Giménez, & Abad, 2011). Alternative teaching games methodology has been gathered by Oslin and Mitchell (2006) under the denomination of Game-Centered Approaches (GCAs). GCAs comprise the original and most well-known model: Teaching Games for Understanding (Bunker & Thorpe, 1982, 1986) and the following evolutions such as the Tactical Game Model (Griffin, Mitchell, & Oslin, 1997) or Play Practice (Launder, 2001). The description made of GCAs by Oslin and Mitchell (2006) is very close to that used in Spain to designate alternative approaches. In Spain GCAs are gathered under the name *Enseñanza Comprensiva del Deporte*.

Game-centered approaches contain features that make these models superior to the traditional model. Oslin and Mitchell (2006) summarized them in four main features: (1) children are motivated by games; (2) potential transfer based on tactical similarities (García-López, Contreras, Penney, & Chandler, 2009); (3) development of decision-making component, and (4) development of decision makers through a problem solving approach. To make the most of the formative potential of GCAs, the observation of three features is of great importance: 1) authentic assessment, 2) teaching progressions based on tactical aspects; and 3) importance of previous learning on the selection of contents and on the design of progressions. As stated below, the second and third features aforementioned have not been sufficiently linked by critical studies. The main reason for this gap is the lack of research data about previous learning on which to base learning progressions. The aim of this paper is to contribute to lessen this limitation.

In comparison to the traditional approaches, in GCAs more pedagogical importance has been given to the assessment process. There is evidence of the importance given to assessment in GCAs in the development of observational instruments to assess game performance during actual game play. Examples of these instruments are Game Performance Assessment Instruments (GPAI) (Oslin, Mitchell, & Griffin, 1998), Team Sport Assessment Procedures (TSAP) (Gréhaigne, Godbout, & Boutier, 1997) and those designed by Blomqvist, Vänttinen, and Luhtanen (2005) or French and Thomas (1987). Most of these instruments have been used in both research and physical

education settings. Through these instruments, game performance components, decision making and skill execution are evaluated separately. As GCAs have as their central premises the game and the decision-making component (Oslin & Mitchell, 2006), this kind of assessment provides researchers and teachers with very valuable and useful information to improve the learning process. In this sense, when the assessment procedure links what is taught to how it is taught, it helps to regulate the teaching and the learning process. This kind of assessment is generally known as authentic assessment (Memmert & Harvey, 2008).

Both cognitive and motor components are equally important in developing sport performance (French & Thomas, 1987; Griffin, Dodds, Placek, & Tremino, 2001), and therefore they should have the same importance in the assessment process. Furthermore, these components are highly difficult to separate during game play. As Nevett, Rovegno, Babiarz, and McCaughtry (2001) suggest, a player's motor coordination is determined by individual, environmental and task constrains, so skill and tactics should not be separated. Consequently, in further discussions about skills such as passing, getting open, or marking, we will refer to them as technical-tactical skills.

Furthermore, GCAs use structural features (rules, space, materials, etc.) and tactical problems to design task and learning progressions. Previous literature has suggested different proposals to classify tactical problems. Probably the most widespread are those made by Griffin, Mitchell, and Oslin (Griffin et al., 1997 for specific games such as football, basketball, etc.; and Mitchell, Oslin, & Griffin, 2003 for game categories such as invasion games, net games, etc.). These authors establish the different tactical goals and problems to guide the teaching and learning process. For invasion games, the tactical goals and problems proposed are: a) within offensive and scoring: keeping possession, penetrating and attacking, and transition; b) within defense and preventing scoring: defending space, defending the goal, and winning the ball; and c) within starting and restarting play: beginning the game, restarting from the sideline and endline, and restarting from violations. Another tactical problem classification is that inspired on the action principles described by Bayer (1986). This author considers three action principles in attack (maintaining possession of the ball, penetrating the defense, and attacking the goal) and three in defense (recovering possesion of the ball, defending space and defending the goal). Bayer does not describe these action principles as tactical problems, but as game context. Nevertheless they have been used as tactical problems in the design of activities books (e.g. Contreras, García-López, Gutiérrez, del Valle, & Aceña, 2007; Contreras, de la Torre, & Velázquez, 2001) and in research works (e.g. González, García-López, Gutiérrez, & Contreras, 2010; Gutiérrez et al., 2011).

The third feature that should observe GCAs to maximize their pedagogical potential is to base learning tasks and progressions in the learners' previous knowledge. As learners bring with them previous experiences and knowledge to the lessons, they base and negotiate the meaning of the learning experiences from their existing schema by revising and creating understanding out of existing ones (Applefield, Huber, & Moallem, 2001). Different studies have addressed this issue (e.g. Nevett et al., 2001, Blomqvist et al., 2005), using in most cases a knowledge-based information-processing perspective as their theoretical framework.

This study has the aim to add valuable information to reduce the aforementioned limitations. A coding instrument was designed and used to assess decision making components in the two levels described. Therefore, the purpose of the study is twofold: to devise and implement a "game context" approach to assess the game performance components and, doing so, to provide information that could be used to design suitable learning progressions linked with tactical teaching approaches.

2 METHODOLOGY

2.1 Participants and procedure

This research has been carried out within a collaborative project between the University of Castilla-La Mancha and the educational government of this region. The sample included 22 elementary school Physical Education students (girls: 13; boys: 9; ages: 11-12 years). Participants were selected from among students with no formal training in invasion games and without any experience in official competition. Participants were evaluated through a 4 versus 4 invasion game, where the technical and rules requirements were minimized. The game form was selected following the developmental abilities and previous experience in such a way that students would be able to reach their maximum achievement in the decision making component. Selection of the number of players per team was based on the proposal made by Mitchell et al. (2003).

The design of the modified invasion game was inspired by those used in similar research made in educational contexts (Contreras, García-López, & Cervelló, 2005; Blomqvist et al., 2005; Nevett et al., 2001). All games lasted 8 minutes and were divided into two halves. All games were recorded with a video camera located behind and above the court and were analysed afterwards using the G-PET (Game Performance Evaluation Tool).

2.2 Coding Instrument: G-PET (Game Performance Evaluation Tool)

A coding instrument was used to examine the components of game performance and game play features. The design for G-PET (Gutiérrez, 2008) was based on the instruments designed by French and Thomas (1987) and Nevett et al. (2001). Most relevant variations from these instruments were the analysis of defensive actions and the tactical-context adaptation. Content validity was established by a panel of experts. Instrument reliability was established through test-retest procedures, with correlation coefficients higher than .80. Intra- and inter-observer correlations among the observers in all categories ranged from .77 to 1.00.

Skill execution was judged as successful (1) or unsuccessful (0) in every execution. Decision-making was analysed into two levels. In both levels right decision-making was coded as (1), and wrong as (0). The first level evaluated decision-making related to the execution of a specific skill or movement (e.g. a correct decision-making (1) would be to pass the ball to a playmate who is free, and a wrong one (0) would be to move trying to get free to a space where one opponent is standing). The second level analysed the tactical-context adaptation trough the evaluation of players' tactical intention with regard to the tactical context in which the action is located. This level was established only for offensive actions. Based on Bayer action principles (1986), G-PET includes three offensive tactical contexts: maintaining possession of the ball (1A), penetrating the defense (2A), and attacking the goal (3A). For coding purposes, tactical contexts were coded respectively as 1A, 2A or 3A. These abbreviations will be used throughout the paper.

When an action was analysed, researchers first evaluated in which tactical context the action took place, or the situated principle (it could be coded as 1A, 2A or 3A and written down in first place), and then they evaluated the intention of the player or the applied principle (it could be coded as well as 1A, 2A or 3A and written down in the second place). When the situated principle and the applied principle match, the tactical-context adaptation is correct. An example of correct adaptation to the tactical context would be: the player is trying to keep possession (by passing or moving with the ball) in a maintaining-possession-of-the-ball context. This action would be coded as 1A1A. An example of wrong adaptation could be: the player is trying to attack the goal (by shooting) in a penetrating-the-defense context. This second action (2A3A) would be coded as wrong. The actions in which the player showed neither tactical intention nor involvement on the game were also coded as wrong. This behaviour was coded as "watcher player".

Table 1 summarizes and describes the coding categories. Both first level decision-making and skill execution were evaluated in the technical-tactical skills included in the first column. These variables are presented by game roles. In order to get a clearer comparison of different game aspects, variables related to technical-tactical skills were grouped in global variables (defense; attack; on the ball; and off the ball). The second column includes variables related to the second level of decision making: tactical-context adaptation. Tactical-context-adaptation performance was grouped in a single variable (global-context-adaptation performance) and also analysed by the three offensive tactical contexts aforementioned.

Table 1: Description of the dependent variables to measure decision-making

Skill execution and Level 1 Decision-making: Technical-tactical skill selection	**Level 2 Decision-making: Tactical-context adaptation**
On-the-ball attacker Pass Shoot Moving with the ball	Global-context-adaptation performance (Global efficiency during the whole game in adapting the actions to the tactical context)
Off-the-ball attacker Get free	1A1A. Tactical-context-adaptation performance to keep the ball contexts (efficiency in selecting actions to keep the ball when the tactical context is coded as "keeping the ball context")
On-the-ball defender Mark (on-the-ball) Blocked shot Tackle Double team (on-the-ball)	2A2A. Tactical-context-adaptation performance to penetrating-the-defense contexts (efficiency in selecting actions to penetrate the defense when the tactical context is coded as "penetrating-the-defense")
Off-the-ball defender Mark (off-the-ball) Interception Double team (off-the ball)	3A3A. Tactical-context-adaptation performance to attacking the goal contexts (efficiency in selecting actions to try to score when the tactical context is coded as "attacking the goal context")
Global variables Defense/attack On the ball / off the ball	Watcher player (a player is coded as "watcher player" when he or she does not show tactical intention nor involvement in the game)

For coding purposes, the playing time was divided into decision-making units of action (Nevett et al., 2001). The ending of a decision-making unit occurred in the following conditions: a) after four seconds of action; b) when the player performed a different technical-tactical skill; or c) when the offensive tactical context changed.

2.3 Statistical analysis

The mean and standard deviation were calculated for each variable. The Kolgomorov-Smirnov test for assumption of normality and the Levene test for homogeneity of variance or homoscedasticity showed that the sample did not meet these assumptions for all the variables in the study. Therefore and also due to a small sample size, a Mann-Whitney U test was conducted to analyse the differences between the two samples. Wilcoxon's test was conducted for the two dependent samples. Lastly, the relationships between decision-making and skill execution were examined by using Pearson's correlation coefficient (Vincent, 2005).

3 RESULTS

The results are presented in three sections. The first section of the results will focus on descriptive scores of game performance. The second section will include four intra-group data analyses: (a) comparison of tactical context adaptation performances; (b) comparison of offensive skills performance (pass, move with the ball and get free) in different tactical contexts; (c) study of the correlation between decision making and skill execution; and (d) comparison between global variables: attack/defense; on the ball/off the ball.

3.1 Descriptive scores of game performance

Descriptive scores of game performance are depicted in Table 2.

Tactical-context-adaptation performance. Participants achieved a global context-adaptation performance of 62.97% (*SD* = 17.15) of good decisions. The context in which participants achieved better performance was in penetrating-the-defense (*M* = 70.08, *SD* = 18.13), while the lowest performance was in attacking-the-goal (55.41, *SD* = 39.03). Participants did not show tactical intention nor involvement on the game (watcher players) in a 5.72% of the decision-making units.

Offensive technical-tactical skills. In decision making variables, highest scores were achieved in passing (*M* = 83.5, *SD* = 22.04) and shooting (*M* = 93.1, *SD* = 13.70), while the lowest result was found in moving with the ball (*M* = 49.42, *SD* = 25.91). In skill execution, highest scores were found in control (*M* = 88.49, *SD* = 20.27), and in moving with the ball (*M* = 89.41, *SD* = 13.97). The lowest results in skill execution were found in getting free (*M* = 59.72, *SD* = 18.14).

Defensive technical-tactical skills. In decision-making variables, highest scores were achieved in blocking (*M* = 94.16, *SD* = 15.05) and interceptions (*M* = 92.4, *SD* = 17.26). Very low scores were achieved in marking skill execution, both on the ball (*M* = 29.79, *SD* = 17.04) and off the ball (*M* = 31.05, *SD* = 19.05).

Table 2: Percentages of efficiency in game performance variables

Variable	*M*	*SD*
Tactical-context adaptation		
Tactical-context-adaptation performance to keep-the-ball context (1A1A)	62.97	17.15
Tactical-context-adaptation performance to penetrating-the-defense context (2A2A)	70.08	18.13
Tactical-context-adaptation performance to attacking-the-goal (3A3A)	55.41	39.03
Global-context-adaptation performance	66.81	11.08
Watcher player (% of decision making units)	5.42	7.39

Technical-tactical skills	**Skill execution**		**Decision-making**	
	M	***SD***	***M***	***SD***
On-the-ball attacker				
Control	88.49	20.27		
Pass	70.87	28.80	83.50	22.04
Pass 1A	64.77	39.26	79.22	26.11
Pass 2A	67.78	38.55	90.55	16.92
Moving with the ball	89.41	13.97	49.42	25.91
Moving with the ball 1A	90.48	14.11	72.96	31.54
Moving with the ball 2A	92.11	25.69	39.78	35.86
Shoot	83.12	20.80	93.12	13.70
Off-the-ball attacker				
Get free	59.72	18.14	71.54	15.57
Get free 1A	57.50	32.01	66.61	24.79
Get free 2A	58.91	22.30	72.39	19.03
On-the-ball defender				
Mark (on-the-ball)	29.79	17.04	62.27	24.55
Blocked shot	43.75	40.29	94.16	15.05
Tackle	50	50	55	49.72
Double team (on-the-ball)	71.42	48.79	85.71	37.79
On-the-ball defender				
Mark (off-the-ball)	31.05	19.05	44.41	23.80
Interception	71.66	37.60	92.42	17.26
Double team (off-the-ball)	48.14	24.95	64.92	20.21
Global variables				
Attack	76.40	10.57	74.71	11.43
Defense	51.15	8.04	71.44	8.41
On-the-ball	64.90	9.35	75.63	9.20
Off-the-ball	52.34	11.28	67.39	12.96

3.2 Intragroup analysis

Comparison of tactical-context-adaptation performances. No significant differences were found between tactical-context-adaptation performance to keep the ball, penetrating the defense and attacking the goal contexts.

Comparison of decision-making and motor execution performance of offensive technical-tactical skills (passing, moving with the ball and getting free) in different tactical contexts (keep-the-ball and penetrating-the-defense contexts). Game performance efficiency in passing, moving with the ball and getting clear was analysed separately in a maintaining-possession-of-the-ball context and penetrating-the-defense context. When comparing both scores, significant differences (at $p < .05$ level) were found only in moving-with-the-ball decision making where participants showed significant better performance in the maintaining-possession-of-the-ball context.

Study of the correlation between decision making and skill executions. Decision making and motor execution correlated significantly (at $p < .01$ level) in one offensive technical-tactical skill (getting free) and three defensive skills (stealing the ball, marking off the ball and double teaming by the defender off the ball).

Comparison between global variables: attack/defense; on-the-ball off-the-ball. Participants performed significantly better on-the-ball skills. These differences were at $p < .05$ level in decision making, and at $p < .01$ level in skill execution. Students performed better in both the decision-making and the skill execution ability while attacking, although these differences were only statistically significant in the skill execution ability ($p < .01$). Thus, participants found it more difficult to perform defensive actions than offensive ones, especially in relation to skill execution.

4 DISCUSSION

The purpose of our study was to assess and understand prior procedural knowledge in sixth graders with no previous training in invasion games, as well as the relationship among the different components of game performance in invasion games.

Results revealed that 6th grade students got the highest tactical context adaptation performance in penetrating-the-defense contexts, and the worst in attacking-the-goal contexts. This means that students were able to decide better in situations in which the best option was to move towards the goal, either by passing or moving with the ball. This result is partly consistent with those presented by Gutiérrez, García-López, González, and Contreras (2008). In that study, secondary PE students (13-14 years old) in a 5 versus 5 modified invasion game achieved better adaptation results in a penetrating-the-defense context than in a keeping-possession-of-the-ball context, but the higher context adaptation performance was in attacking-the-goal contexts. These results also partially coincide with those found by González et al. (2010) in the context adaptation performance shown by soccer players of the same age as the participants in this study. Participants of both studies showed their best performance in penetrating-the-defense contexts, and the weakest scores in attacking-the-goal contexts, although soccer players scored better than PE students in all tactical contexts (for further information on the comparison of these two studies see Gutiérrez et al., 2011).

Participant scores in technical-tactical skills were quite inconsistent both in the comparison between different technical-tactical skills, and in the comparison of decision-making and execution performance in the same technical-tactical skill. In most of the variables participants scored higher in decision-making than in skill execution. Highest scores were achieved in blocking and interceptions, both in the decision-making component. These two technical-tactical skills are highly related, both technically and tactically. Thus, similar scores support the idea of transfer. Biggest differences between decision-making and skill execution were found in marking and blocking. The only exception was moving-with-the-ball, in which participants executed much better than they decided. The successes in skill execution in technical-tactical skills as blocking and marking depend to a great extent on the performance of the opponent. Therefore, the origin of these differences could be in the relational nature of the technical-tactical skills (Gutiérrez, García-Lopez, & Contreras, 2009; MacPhail, Kirk, & Griffin, 2008). On the other hand, the success of moving with the ball was facilitated by the rules, because there were no rules such a doubles, and physical contact was not allowed. In this sense, it seems that decision-making is more conditioned than skill execution by structural features, like opponents or rules. This is consistent with the idea of the importance of the use of modified games in teaching games supported in GCAs (Memmert & Harvey, 2010; Oslin & Mitchell, 2006; Serra, J., García-López, L. M., & Sánchez-Mora, 2011).

Students got their best performance, both in decision-making and skill execution, in offensive and on-the-ball game actions. Same results were found by Blomqvist et al. (2005) who state that the origin of these results is that "instruction in physical education settings focuses mainly on motor skill execution, and thus, students' decision-making skills with-the-ball are more refined" (2005, p. 117).

In the comparison of decision-making and motor execution performance of offensive technical-tactical skills in different tactical contexts, participants showed a different performance just in moving with the ball. In this variable participants decided better in a keeping-possession-of-the-ball context than in a penetrating-the-defense context. These results indicate that when players were under pressure, they performed this skill adequately, and when they had to use it to penetrate the defense they did not make the right decision. Furthermore, in a penetrating-the-defense context they showed much more efficiency when passing (90.55%), than when they chose to move with the ball (39.78%). These results show that the tactical context in which the action takes place is important in the realization of the technical-tactical skill, and that tactical contexts have a higher influence over the decision making component.

These results are consistent with previous studies that used a tactical-context approach to assess game performance (e.g. Gonzalez et al., 2010; Gutiérrez et al., 2011).

The high correlation established between execution and decision-making and the low levels of efficiency in execution show the necessity of using modified games as a didactic resource. These results also show the suitability of proposing global teaching situations, as recommended in GCAs (Memmert & Harvey, 2010; Oslin & Mitchell, 2006).

Blomqvist et al. (2005) reported that their study had two limitations, the first was the skill heterogeneity of the participants, and the second was that all of them were boys. We tried to avoid these two limitations by selecting girls and boys and through the use of a questionnaire about previous experience, so that very skilful subjects were not assessed. However, high values in standard deviation were found in most of the variables, and therefore participants in our study had skill heterogeneity as well. In order to know the nature of these individual differences, more research is necessary in the line of that carried out by MacPhail et al. (2008) and Rovegno, Nevett, Brock, and Babiarz (2001), who applied a situated approach in order to know the influence of the social-interactive dimension in the teaching and learning of invasion games.

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