Abstract

This study examined the effectiveness of two approaches for basketball instruction, the Invasion Games Competence Model (IGCM) and the Traditional Approach (TRAD) on the actual game performance of primary school children (10-11 yrs). Data were collected by means of video-analysis of 3 on 3 and 3 on 1 game play conditions. Actual game performance of two groups of 13 participants was assessed by coding cognitive decision-making (DM), motor skill execution efficiency (MSEfficiency), and motor skill execution efficacy (MSEfficacy). All three components improved in both groups, but the learning profile was different, with the IGCM group showing a major increase in game performance from pre-test to post-test, while the traditional group caught up at the retention test. Game performance was always better in the 3 on 1 condition compared to the 3 on 3 condition. This study shows the beneficial short-term effects of the IGCM instructional method on actual game performance.

Key words:

Invasion game, primary school, physical education, decision-making, motor skill execution, video-analysis

Do alternative instructional approaches result in different game performance learning outcomes? Authentic assessment in varying game conditions.

Introduction and general research problem

In physical education curricula, game play traditionally occupies a major part of the timetable. The traditional way of teaching games focuses on teaching skills as a means for improving game performance (Bunker & Thorpe, 1982), meaning that these skills are taught and learned in isolation, at the expense of the acquisition of tactical knowledge (Turner & Martinek, 1995). Turner & Martinek (1992) stated that if pupils perceive a task as meaningless or undesirable, then learning from it will probably be minimal. This might be the case in the traditional instructional approach, in which the relation between an isolated skill / technique and the game play is not always clear to the pupils at the time they learn the motor skill. Given that tactical knowledge is an essential prerequisite for participation in game play, several authors have questioned the effectiveness of these traditional skill-based approaches for improving game performance (Mitchell, Griffin, & Oslin, 1994). Consequently, tactical approaches, such as "Teaching Games for Understanding" (Werner, Thorpe, and Bunker, 1996) have gained much attention. In these approaches, opportunities for an integrated development of motor and cognitive skills are created. Capel (2000) noted that analysis of successful game players shows that good motor skill is only one part of effective performance. The better game players also understand the need for the skill and when it is appropriate to use it. However, the results of these studies are inconclusive and often the research methodologies are not reported clearly (Rink et al., 1996). Further, these new approaches require methods to assess game performance during actual game play and thus including assessment of both decision-making and skill execution (French, Werner, Rink, Taylor, and Hussey, 1996; Gréhaigne, Godbout and Bouthier, 1995; Mitchell, Oslin, and

Griffin, 1995; Nevett, Rovegno, and Babiarz, 2001; Oslin, Mitchell, and Griffin, 1998; Turner and Martinek, 1992; Turner and Martinek, 1999). A dualistic view which contrasts skill and knowledge is not in line with the intimate interrelation and interdependence of cognitive function and physical action (Brooker, Kirk, & Braiuka, 2000). Light and Fawns (2003) correctly noted that research on teaching games that takes into account the interdependence of perception, cognition, and movement execution is scarce.

A traditional versus a tactical approach for teaching games

The present study is part of a larger study, which investigated the impact of two instructional approaches on cognitive learning patterns (decision-making and recognition ability) as measured by two video-based basketball tests, and on the pupils' actual game performance during 3 on 1 and 3 on 3 game play sessions. The description of the video-based tests and their results were published in Tallir et al. (2005), while the present paper focuses on the analysis of actual game performance. The general learning objective of both instructional approaches was to develop competencies to play a half court 3 on 3 basketball game. Within both instructional approaches different methods were used to accomplish this. In this paragraph the theoretical foundations of both approaches are briefly described, followed by the respective characteristics in the paragraph thereafter. The traditional instructional approach reflects a cognitivist approach to learning and instruction characterised by a bottom-up process for learning. Simple motor skills are presented and practiced first in isolation and incorporated in game situations only later (Harrison et al., 1999). However, pupils are not really able to improve their decision-making ability during these game activities, since the focus is still on the execution of the motor skills. Further, the traditional instructional approach is characterised by teacher control, break-down of the knowledge (procedural, declarative and strategic) (Thomas & Thomas, 1994) into smaller units (chunks) of

knowledge, and motor skills that are being practised independently before they are combined in a gradually more complex game setting (Anderson, 1985; Rumelhart & Norman, 1981; Shank & Abelson, 1977; Winn & Snyder, 1996). The IGCM approach on the other hand reflects a social-constructivist perspective towards learning and instruction. The authentic learning situations are simplified by adjusting the number of players (from five to three), the structure of the game, the game components comparable to the TGfU modification – representation – exaggeration principles (Holt, Strean, & Bengoechea, 2002). In the IGCM decisions about what, when, where and how have to be made during games (Mitchell, Oslin, & Griffin, 2003).

The different theoretical foundations of both instructional approaches have some practical implications. The traditional approach (TRAD) used in this research is characterised by a focus on the acquisition of motor skills required for 3 on 3 half court game play. The acquisition of these skills was mainly pursued by game isolated drills. Each lesson started with (1) an introductory activity, followed by (2) the practice of one or more skills (technique practice) and ended with (3) a game (not necessarily related to the 3 on 3 game play). Skills studied and practiced during the learning phase were shooting, basic dribbling, passing and catching, holding the ball, one on one, even numbered and majority situations (e.g. 3 on 1 and 3 on 2 situations). In the approach based on the Invasion Games Competence Model (IGCM) (Musch et al., 1988; Musch et al., 2002), the focus was on the decision-making component of game performance. Each lesson started with a game situation related to the core of the lesson and the learning activities were always game related. The IGCM instructional approach focused on the improvement of the decision-making abilities related to scoring, creating shooting opportunities and setting up an attack. During the entire lesson the pupils' decision-making was monitored by the teacher. Freezing the game and reflective questioning

encouraged the pupils to focus on their decisions. Only when the pupils were able to understand that they needed new skills in a game situation dribbling, shooting and passing skills were introduced and practiced. For example, when pupils experienced a game situation where a bounce pass appeared to be the most appropriate action, but they were not able to execute this motor skill, then this motor skill was learned in a simplified or modified game situation.

Tallir et al. (2005) already found different decision-making and recognition abilities between both instructional groups as measured with two video-based basketball tests. The content and procedure of these video-based tests was explained in Tallir et al. (2005). The results showed no differential impact of the two instructional approaches on the retention test scores of the decision-making or recognition test. However, these two approaches gave rise to different learning patterns. In relation to the decision-making test, pupils in the traditional group improved linearly in decision-making, while the IGCM group resulted in better decision-making at the first test after 2 weeks already. For the recognition test, a different learning pattern was found. Here, the traditional group scored better at the first intermediate test after 2 weeks, while the IGCM group echoed a linear and gradual improvement in recognition. Tallir et al. (2005) concluded that the IGCM is a more efficient approach for decision-making abilty, as measured by the video-based decision-making test, while the traditional instructional approach is more efficient on the video-based recognition test.

Instruments for the assessment of game performance

If the primary goal of games teaching is enhancing pupils' game playing ability, then it is necessary to select an appropriate instructional approach as well as authentic assessment tools if the lesson objectives and the measurement of student learning need to be related (Kirk, 2005; Metzler, 2000). Traditionally, skill tests are used to evaluate the skill execution,

but these tests fail to assess game play since they are not performed in a game-related context. On the contrary, authentic assessment includes the assessment of a decision-making component as well as a motor skill execution component during game play. French & Thomas (1987) noted that decision-making should be measured as a separate entity from motor skill execution since many novice players will develop decision-making abilities far in advance of skill acquisition. Further, the assessment of game playing ability should include the decisions players make about what to do with the ball and the actions they execute when they do not have the ball because both on-the-ball skills and off-the-ball movements are vital components of becoming competent game players (Mitchell, Oslin, and Griffin, 2003).

In the following paragraph two instruments for the assessment of game performance are discussed, followed by a presentation of the instrument used in this study. The Game Performance Assessment Instrument (GPAI; Mitchell, Oslin, & Griffin, 1995) focuses on tactical problems and was originally developed from a 'Teaching Games for Understanding' approach. It provides teachers and researchers with a means of observing and coding decision-making and motor skill execution. The GPAI is an observation instrument to be used across different game categories, and considers a decision-making component and a skill execution component of both offensive and defensive actions. Game performance and game involvement can be calculated after the observation. The latter recognizes that lower ability players, who may not make appropriate decisions or execute skills efficiently, can still be highly involved in a game (Griffin, Mitchell & Oslin, 1997). Another procedure was developed by Gréhaigne, Godbout, and Bouthier (1997). This Team Sport Performance Assessment Procedure (TSPAP) quantifies an individual's overall offensive performance in selected invasion and net team sports, reflecting both technical and tactical aspects of game play. The TSPAP only considers the events or actions related either to the attack or offensive

aspect of the game. The observation instrument allows one to assess how a player gained possession of the ball and how a player disposed of the ball. With the TSPAP a player is observed in order to establish two complementary performance indices: the efficiency index and the volume of play. The assessment relies on quantitative data based on the frequency of various events that occur during game play (Gréhaigne et al., 1997).

The coding instrument used in this study was based on the GPAI. It differs from the latter in the more detailed definition of the decisions and motor skill executions instead of putting them in one category. The GPAI assesses all "decisions made" as one game component, which makes it possible to identify whether a decision is related to dribbling, passing or shooting. The coding instrument used in this study assesses these decisions as separate categories. Further, next to a decision-making and a motor skill execution efficiency component the efficacy of the motor skill executions was also assessed. So, in contrast to the TSPAP, in which only the number of various actions was used, the new instrument assesses both the decision-making and the skill execution component (efficiency and effectivity) of every observable offensive action, on and off-the-ball. The rationale to assess both the decision-making component and the quality of the execution of this decision builds on the critique of Thomas & Thomas (1994) who noted that a player can have an expert declarative knowledge base and yet be inept as a performer. French and Thomas (1987) defined declarative knowledge as knowledge of factual information. Anderson (1982) and Chi & Rees (1983) suggested that one must first develop a declarative knowledge base within a given sport in advance of the development of procedural knowledge. The structure of procedural knowledge is usually conceptualized in terms of production systems. Each production consists of a condition side and an action side an may be viewed as if = then pairs

(Anderson, 1982; Chi & Rees, 1983). The coding instrument used in this study is described in detail in the methods section.

In sum, the current status of knowledge on the efficacy of teaching methods in game play is somewhat ambiguous, especially due to the fragmented assessment of technical and tactical skills, an approach that does not take into account the close interdependence of these components of proficient game play. Therefore, the general purpose of the present study was to investigate the effectiveness of two instructional approaches on pupils' actual offensive game performance through authentic assessment using video-analysis of decision-making, motor skill efficiency, and motor skill efficacy. These game performance components are described in the testing procedure section of this paper. In this study, the pupils are observed in 3 on 3 as well as in 3 on 1 game conditions. The 3 on 3 condition is included because it is put forward as a standard in the primary school curriculum for the PE program. Such small-sided games provide more opportunities to each pupil to be involved in the play, to try things out and to develop skills (Capel, 2000). Bernaerdt and Guns (2006) used the GPAI to compare 3 on 3 and 5 on 5 basketball game situations and found higher game involvement, better decision-making and more support with a lower number of players on court. Metzler (2000) noted that modified games should reflect students' developmental readiness and should allow certain aspects of the game to come into play more often so that pupils get more in-game repetitions on key tactics and motor skills. In order to evaluate to what extent the 3 on 3 findings can be generalized to other situations, a 3 on 1 situation was included as well. A 3 on 1 situation is featured by different time and space constraints as compared to a 3 on 3 situation. In the former situation, it might be easier for novice basketball players to acquire, develop and integrate specific game related decision-making and motor skill execution.

Research questions

The first hypothesis of this study was that the pupils in the IGCM group would outperform participants receiving a traditional program with respect to decision-making since the IGCM approach provides more opportunities to learn and develop these skills. On the other hand, the ability to execute motor skills (efficiency and efficacy component) should be significantly better for the pupils who received the traditional, more skill-oriented instructional approach. The second hypothesis was that the game performance of both instructional groups would be better in the 3 on 1 condition compared to the 3 on 3 condition since the 3 on,1 situations provide the pupils more time and space to take decisions and to execute the required motor skills. Third, the relation between the video-test decision-making test and the actual game performance scores was also investigated to test Thomas & Thomas (1994) hypothesis that one can have an expert knowledge base and yet be inept as a performer.

Methods

Participants.

The effectiveness of the two game teaching approaches was tested in a quasi-experimental research involving four fifth-grade classes (26, 25, 26, and 20 pupils of 10-11 years old, respectively, 97 pupils in total). All pupils had little or no experience in basketball. The experimental classes belonged to two elementary schools that are representative for the neighbourhood of the city of Ronse (Belgium). Both schools adopted the same PE curriculum. The schools were contacted at random and asked for their willingness to participate in the study with one or more fifth-grade classes. Two experimental classes were assigned at random to the traditional game teaching condition (TRAD) and two classes received the experimental treatment based on the Invasion Game Competence Model (IGCM). Because complete naturally constituted classes were assigned to the conditions, the

research took place in an ecologically valid setting. This setting provides a more stringent test for the effectiveness of the game teaching approaches than studies where tactical knowledge is taught in tightly controlled laboratory settings, whose results cannot be directly transferred to the context of real-life classrooms. If the results show that the game teaching approaches are effective in the quasi-experimental context, they will strengthen their applicability and effectiveness in natural classroom settings. Informed consent was obtained from all participants and their parents or guardians. No extra control group - not receiving basketball instruction - was considered in the research design because of ethical and practical reasons. The study was approved by the Ethics Committee of the Ghent University Hospital.

Procedure

The study lasted twelve weeks, during which all classes received 12 basketball lessons. All lessons were given by the researcher herself to prevent interference with teacher expertise. Table 1 provides an overview of the total intervention period. In view of controlling for potential differences in instructor behaviour, all lessons and tests were led by the researcher within the normal school settings and during the PE classes.

Insert Table 1

Testing procedure

As shown in Table 2, the game play tests were administered 5 times. At each assessment moment each class-group was divided in subgroups that played approximately 26 minutes 3 on 3 and 3 on 1 game play. During one assessment moment pupils remained in their original subgroup, but had to play against different opponents. Assignment of the pupils to a subgroup occurred at random on each assessment moment. In view of the analysis all sessions were videotaped. In order to analyse students' game performance during 3 on 3 and 3 on 1 game play in an authentic manner, a specific coding instrument was developed. More

specifically, the analysis focused on the cognitive decision-making component (DM) as well as the motor skill execution component (efficiency (MSEfficiency) and efficacy (MSEfficacy) component). The decision-making component involves both what to do and how to do it. Players have to decide what to do in a game situation, predict possible outcomes, decide the best way to do it, and select an appropriate response. Skill execution is being able to produce the required movement. It includes mechanical efficiency of the movement (motor skill efficiency component), while the motor skill execution efficacy component is the observed outcome of the action. The entire coding instrument is presented in appendix 1.

Content validity was assured by the consultation of a basketball expert to guarantee a clear link between the categories of the instrument and the overt actions to be measured by the instrument. Reliability was determined by recoding of a randomly selected part of the game play sessions (5%). This resulted in test-retest reliability coefficients of 0.95, 0.98 and 0.99 for the decision-making, motor skill execution efficiency and motor skill execution efficacy component, respectively. Inter-observer reliability coefficients were also calculated and resulted in Cronbach's α of 1.0, 0.73 and 0.96.

Data analysis

The offensive game performance of 26, randomly selected pupils ($N_{IGCM} = 13$, $N_{TRAD} = 13$), were coded entirely using the software "Catmovie", which enabled us to code the game performance on screen. The coding instrument included three broad components for each action: a decision-making component, a motor skill execution efficiency component and a motor skill execution efficacy component. The decision-making component was coded positive/negative when a player took a correct/incorrect decision in a particular game situation. For the motor skill execution component the different aspects of the executed skill

(efficiency component) were coded positive/negative when the skill was executed technically correct/incorrect, respectively. The motor skill execution efficacy component was coded positive/negative if the action had a successful/unsuccessful outcome. It should be noted that the coding instrument monitored both on-the-ball and off-the-ball actions and for each action the three components were always assessed. In total, the coding instrument included 95 categories (cat).

The coding procedure took place in several phases. Each game play session was initially divided into fixed successive five seconds intervals or sequences. After segmenting, all sequences were coded by the experimenter using the aforementioned coding instrument. During each game play session all actions of one player were coded before moving on to the assessment of the actions of the next player. The allocated codes were automatically stored in an SPSS-data file. On every assessment moment an average only 50 sequences on a total of on average 312 sequences per player was coded. A sequence was not coded when the player was off the picture, when he was defending of when he was not participating in the game.

Dependent variables

It should be noted that the scores of the three components of game performance are proportional values, meaning that the sum of the positive and negative scores for each component is always 1. It was necessary to calculate the components this way because the amount of time the participants were playing differed between assessment moments and between participants. First, the positive and negative scores were separated (e.g. sum of positive DM scores, sum of negative DM scores,…). Afterwards for each component of game performance a proportional value was calculated (e.g. sum of positive DM scores/sum of DM scores, sum of positive MSEfficiency scores/sum of MSEfficiency scores, sum of positive MSEfficacy scores/sum of MSEfficacy scores).

Statistical analysis

A 3 (time: pretest vs. post-test vs. retention test) x 2 (condition: 3 on 3 vs. 3 on 1) x 2 (group: IGCM vs. TRAD) ANOVA with repeated measures on the first two factors was applied for each of the three dependent variables. Post hoc LSD tests were used to further analyse the retrieved main effects. Interactions were further elucidated by separate ANOVAs and LSD tests. Further, Pearson correlations were computed for both instructional groups between the learning outcomes on the video-based decision-making test and the decision-making ability scores during game play. An alpha level of .05 was put forward for interpretation of the results. Effect sizes were based on the calculation of Eta squared (η_p^2).

General results

All means and standard deviations of the decision-making, motor skill execution efficiency and motor skill execution efficacy components are reported in Table 2.

Decision-making component

A significant main effect for time was found for the decision-making component $F(2,48) = 31.62$, $p < .001$, $\eta_p^2 = .57$. Test scores increased significantly from the pre-test to the post-test (pre-post, $p < .001$) and remained stable at the retention test (post-ret, ns; pre-ret, $p<.001$). Decision-making scores were better in the 3 on 1 condition than in the 3 on 3 condition $F(1,24) = 6.99$, $p < .02$, $\eta_p^2 = .23$. Overall, the IGCM group outperformed the traditional group $F(1,24) = 7.56$, $p = .02$, $\eta_p^2 = .24$. However, and this is a critical finding, an interaction effect between time and group (see Figure 1) was found $F(2,48) = 4.29$, $p = .02$, $\eta_p^2 = .15$, indicating that while the IGCM group attained higher decision-making scores at the post-test (pre-post, $p<.001$) as compared to the traditional group (pre-post, $p < .05$) scores of both groups converged at the retention test ($IGCM_{post\text{-}ret}$, p = ns and $TRAD_{post\text{-}ret}$, $p < .05$). A second order interaction between time x group x condition occurred $F(2,48) = 3.53$, $p = .05$,

η_p^2 = .13. The decision-making scores of the IGCM group increased between pre-test and post-test, but for the 3 on 1 condition (from 0.62 to 0.81) a larger increase was found in comparison to the 3 on 3 condition. For the traditional group a small increase was found between pre-test and post-test for the 3 on 1 condition, while for the 3 on 3 condition scores for the decision-making component increased to a larger extent.

Motor skill execution efficiency component

Significant main effects for time $F(2,48) = 67.31$, $p < .001$, $\eta_p^2 = .74$ and for condition $F(1,24) = 37.29$, $p < .001$, $\eta_p^2 = .61$ were found. The scores for the motor skill execution efficiency component of both groups improved from 0.58 to 0.77. Scores in the 3 on 1 condition were higher ($M = 0.74$, $SD = 0.01$) than the scores for the 3 on 3 condition ($M = 0.64$, $SD = 0.02$). Further, a significant interaction effect between time and group (see Figure 1) was found $F(2,48) = 6.66$, $p < .005$, $\eta_p^2 = .22$. The IGCM group improved to a larger extent over time (from 0.57 to 0.79) (pre-post, p < .001 and post-ret, p = ns) as compared to the traditional group (from 0.59 to .74) (pre-post, p < .05 and post-ret, p < .005). A second order interaction between time x group x condition was found $F(2,48) = 6.63$, $p = .005$, $\eta_p^2 = .22$. For the IGCM group scores increased between pre-test and post-test, but for the 3 on 1 condition (from 0.59 to 0.83) a larger increase was found in comparison to the 3 on 3 condition (from 0.54 to 0.71). Between post-test and retention test a fractional increase was found for both conditions. For the traditional group a minor increase is found between pre-test and post-test for the 3 on 1 condition (from 0.67 to 0.73), while for the 3 on 3 condition scores for the motor skill execution efficiency component increased to a larger extent (from 0.50 to 0.60). Between post-test and retention test scores increased more for the 3 on 3 condition (from 0.60 to 0.73) in comparison to the 3 on 1 condition (from 0.73 to 0.76).

Motor skill execution efficacy component

For the motor skill execution efficacy component a significant main effect for time was found $F(2,48) = 12.73$, $p<.001$, $\eta_p^2 = .35$. Both groups improved from 0.62 to 0.72 between the pre-test and the retention test. A significant main effect for condition was also found $F(1.24) = 69.06$, $p<.001$, $\eta_p^2 = .74$, indicating that in the 3 on 1 condition scores were higher ($M = 0.77$, $SD = 0.02$) than in the 3 on 3 condition ($M = 0.58$, $SD = 0.03$). Further, there was a tendency to an interaction effect between time and group $F(2,48) = 2.62$, $p = .08$, $\eta_p^2 = .35$. Both groups improved over time, but the IGCM group improved to a larger extent between pre-test and post-test (from 0.62 to 0.72) as compared to the traditional group (from 0.63 to 0.65). At the time of the administration of the retention test, scores of both groups converged.

To check if there is a relationship between decision-making ability during game play and the cognitive learning outcomes from the video-based decision-making test (Tallir et al., 2005) Pearson correlations at the pretest, post-test and retention test were computed. No correlations were found between decision-making ability during game play and the cognitive learning outcomes. No significant correlations were found, all r-values being lower than 0.23 with p-values above 0.25.

Insert Figure 1 and Table 2

Discussion

The general purpose of this study was to compare the effectiveness of two instructional approaches on pupils' actual game performance through video-analysis of their behaviour in the actual game play. This study combined a detailed assessment of the decision-making ability and the motor skill execution (efficiency and effectivity) ability of both on and off-the-ball offensive actions, which is a step forward in the assessment of the overall game performance. The GPAI ((Mitchell et al., 1995) only assesses decision-making

and motor skill executions, whereas the TSPAP (Gréhaigne et al., 1997) is an assessment instrument that provides us a quantitative measure of the frequency of events or actions related to the attack. The instrument used in this study was based on the GPAI, but it is more detailed. Further, next to decision-making and motor skill execution efficiency, the efficacy of the actions players make during game play is also assessed. Efficacy is an important aspect of game performance, since this component shows whether an action has a successful of unsuccessful outcome. It is important to note that all findings apply to 10-11 year old pupils with little or no experience in basketball.

The higher scores of the IGCM group on the three game performance components on the post-test indicated that this instructional approach resulted in better short-term learning effects. Although the IGCM approach does not emphasize the motor skill execution component of game performance to the same extent as the traditional approach, the former instructional approach resulted in higher scores for decision-making as well as for motor skill execution. The IGCM approach seems to allow a faster acquisition of both decision-making and motor execution skills than the traditional approach. The latter effect was not expected given the content of the lessons in the IGCM group. This indicates that improvement in technical skills can be realized by means of a tactical approach. In the IGCM approach, the game situations are modified so that frequent in-game repetitions of motor skills are realized without loosing the focus on practising decision-making skills. This finding confirmed the statement from Turner & Martinek (1992), that pupils learn more if they perceive a task as meaningfull or desirable. In the IGCM instructional approach, this is an important characteristic of the learning tasks, while in the traditional instructional approach the motor skill are often practiced in game isolated drill. Still, it should be mentioned that both instructional approaches resulted in clear positive effects on game performance, since the

scores of each game play component of both groups converged at the retention test. In spite of the differences found in this study, there is not necessarily one single most appropriate way to teach games to achieve a range of objectives. Different approaches must not be seen as alternatives, but they may be selected at different times in order to achieve certain objectives in a lesson or a unit of work. Thus, teachers should look to retain the benefits of each approach in achieving the specific objectives of games lessons in physical education in the curriculum. Further, it is important to choose for the most efficient approach, since the number op hours to be spent on invasion games is limited in most countries.

In general, it was found that for both instructional approaches the 3 on 1 condition resulted in higher scores on the three components of game performance as compared to the 3 on 3 condition. Capel (2000) noted that small-sided games provide more learning opportunities compared to the full game. In this experiment it was not possible to compare the amount of learning opportunities between the full game and a small-sided game, since the full game was not used as an assessment condition. However, the amount of decisions made during an average of 10 minutes game play was significantly higher in the 3 on 1 condition (Mean = 60 decisions) compared to the amount of decisions made in the 3 on 3 condition (Mean = 36 decisions) ($t(143.635) = - 8.10$, $p<.001$). This is in line with the results of Guns and Bernaerdt (2006) who found higher game involvement, better decision-making and more support in the 3 on 3 situations compared to the 5 on 5 situations. This may be, perhaps in combination with motivational aspects, an interesting topic for future research.

Although not the main focus of this paper, our data provide the opportunity to compare the actual in-field and video-based decision-making ability. This might elucidate some of the ambiguity in research outcomes in the literature. From the original dataset of the Tallir et al. (2005) study, we calculated the correlation between the scores on the video-based

decision-making test and the scores of the decision-making component of actual game performance of the same 26 pupils. Tallir et al. (2005) concluded that the IGCM is a more efficient instructional approach for decision-making abilty as measured by the video-based decision-making test, while the traditional instructional approach is more efficient on the video-based recognition test. No correlations were found between decision-making ability during game play and the cognitive learning outcomes on the video-based test in any of the assessment moments (pretest, post-test and retention test). Turner and Martinek (1999) stated that the knowledge component of game performance contains both declarative and procedural knowledge. It is possible that the proportion of both types of knowledge needed for the different tasks differed. The twofold measurement of the decision-making ability used here provided an illustration of the difference between decision-making during game play and while watching a video-fragment. In the video-based test declarative and procedural knowledge are used (Turner & Martinek, 1999). Tallir et al. (2005) explained the more efficient learning process in the IGCM approach on the video-based decision-making test by the fact that the pupils nearly always deal with more complex game settings in this instructional approach. The traditional instructional approach on the other hand favoured the structured storage of sport-specific knowledge in memory because of the step-by-step approach in dealing with isolated basketball-elements. This way the pupils of the IGCM group are enticed to reflect on their game performance right from the start, whereas the traditional instructional group experienced this at a later stage. However, in the absence of the 'normal' coupling between what the player perceives and his/her corresponding actions the ecological validity of such a video-based test is jeopardized (see Gibson, 1979). In the 3 on 3 and 3 on 1 game play tests on the other hand the perception-action coupling can fully be exploited. Another possible explanation is the fact that in the latter test decisions had to be

made within time constraints (Thomas & Thomas, 1994). Further, it is important to note that one's abilities to execute the different motor skills is also a factor that influences the decision-making process during game play, while this it not the case with the video-based decision-making test. It is obvious that more research is needed to draw firm conclusions on this topic.

Conclusions

Considering the results in relation to the three game performance components, it was found that the IGCM group showed more short-term improvement on all game performance components. So, the first hypothesis can only partially be accepted. For the decision-making component and the motor skill execution efficiency component the increase between pre-test and post-test the IGCM group outperformed the traditional group. For the motor skill execution efficacy component a similar difference between both groups, although not significant, was found. This means that the impact of specific characteristics of the two instructional approaches is differential. More specific, it can be concluded that the IGCM instructional approach has beneficial effects, since here the efficiency in reaching learning outcomes is higher on the short-term compared to the traditional approach. From a teachers' point of view, given the limited number of lessons to be spent on PE in most countries, an efficient approach is what one needs to improve pupils' game performance. Further, the hypothesis can be accepted that – independent of the instructional intervention - all game performance component test scores are significantly higher in the 3 on 1 condition as compared to the test scores in the 3 on 3 condition. Finally, a relation between the video-tests and the actual game performance scores was not found, which indicates that both tests are not interchangeable. Moreover, if we want an overall picture of pupils' game performance, assessment of the actual game performance is necessary. A video-based test gives only a limited amount of information, and does not fully reflect the skills that are aimed at during

448 PE classes.

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Table 1

Overview of the instruction content of the traditional instructional approach and the IGCM instructional approach

		Traditonal instructional approach	IGCM instructional approach
Week	Lesson	Lesson content	Lesson content
1		Pretest (video-based and game play tests)	Pretest (video-based and game play tests)
2	1	Shooting technique	Basic Game Form 1: 3 on 3
	2	Shooting technique in combination with dribble or passing	Basic Game Form 1: 3 on 3
3	3	Dribbling technique	Basic Game Form 1: 3 on 3
	4	Dribbling technique	Partial Game Form aimed at shooting
4		Intermediate test 1 (video-based and game play tests)	Intermediate test 1 (video-based and game play tests)
5	5	Passing and catching	Partial Game Form aimed at shooting (shot selection, shot execution)
	6	Passing and catching	Partial Game Form aimed at creating shooting opportunities
6	7	Jumpstop and pivotting	Partial Game Form aimed at creating shooting opportunities
	8	In and out / 1 on 1	Partial Game Form aimed at creating shooting opportunities
7		Intermediate test 2 (video-based and game play tests)	Intermediate test 2 (video-based and game play tests)
9	9	2 on 2 and 3 on 3 game play	Partial Game Form aimed at creating shooting opportunities
10	10	1 on 1, 2 on 2 and 3 on 3 game play	Partial Game Form aimed at setting up an attack
	11	3 on 3 game play	Partial Game Form aimed at setting up an attack
11	12	3 on 3 game play	Basic Game Form 1: 3 on 3
12		Post-test (video-based and game play tests)	Post-test (video-based and game play tests)
17		Retention test (video-based and game play tests)	Retention test (video-based and game play tests)

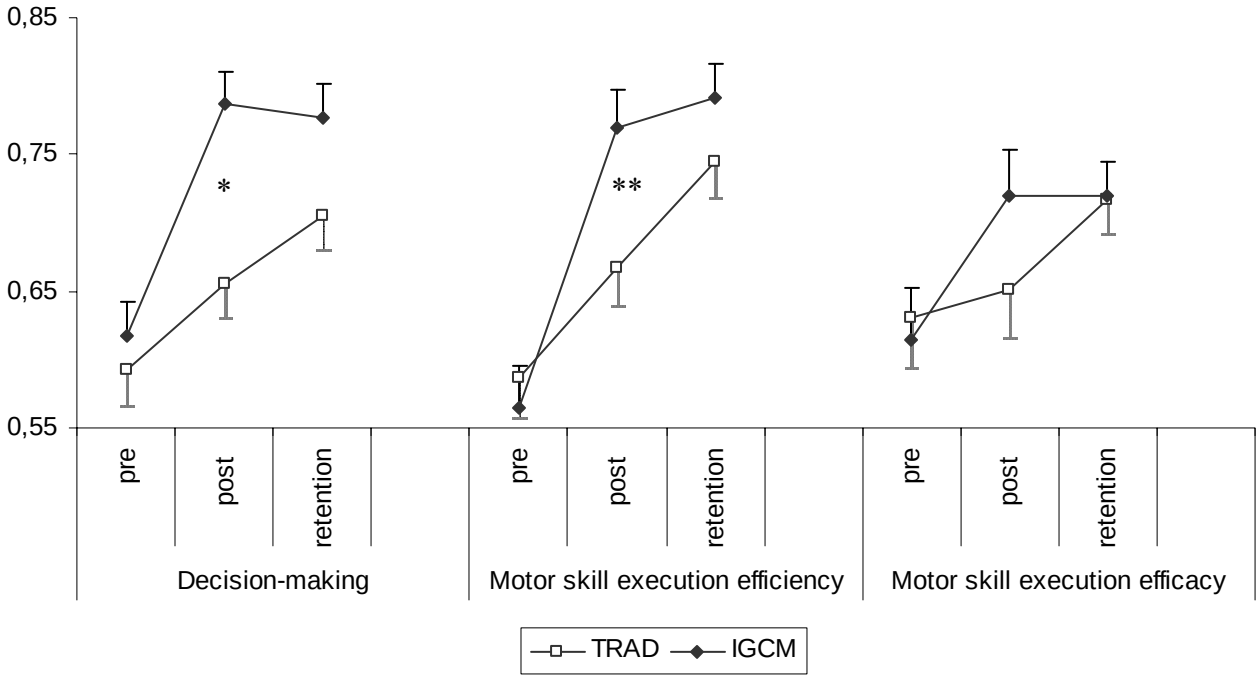
Table 2

Means ± SD for both instructional groups on the three components of game performance

Decision-making component				
	TRAD (n=13)		IGCM (n=13)	
	(3on3)	(3on1)	(3on3)	(3on1)
pre	0,52 ± 0.03	0,67 ± 0.03	0,62 ± 0.03	0,62 ± 0.03
post	0,63 ± 0.03	0,68 ± 0.02	0,76 ± 0.03	0,81 ± 0.02
retention	0,68 ± 0.04	0,73 ± 0.02	0,77 ± 0.04	0,79 ± 0.02
Motor skill execution efficiency component				
	TRAD (n=13)		IGCM (n=13)	
	(3on3)	(3on1)	(3on3)	(3on1)
pre	0,50 ± 0.05	0,67 ± 0,02	0,54 ± 0,05	0,59 ± 0,02
post	0,60 ± 0.04	0,73 ± 0,02	0,71 ± 0,04	0,83 ± 0,02
retention	0,73 ± 0.03	0,76 ± 0,02	0,74 ± 0,03	0,85 ± 0,02
Motor skill execution efficacy component				
	TRAD (n=13)		IGCM (n=13)	
	(3on3)	(3on1)	(3on3)	(3on1)
pre	0,54 ± 0.06	0,73 ± 0,03	0,54 ± 0,06	0,69 ± 0,03
post	0,56 ± 0.06	0,75 ± 0,02	0,60 ± 0,06	0,83 ± 0,02
retention	0,65 ± 0.03	0,78 ± 0,03	0,61 ± 0,03	0,84 ± 0,03

Figure Caption

Figure 1. Learning patterns for the three game performance components (decision-making component, motor skill execution efficiency component, motor skill execution efficacy component). Time x Condition effects are indicated with * (* $p < .05$, ** $p < .005$).


0,85
0,75
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*
**
pre
post
retention
pre
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pre
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retention
Decision-making
Motor skill execution efficiency
Motor skill execution efficacy
TRAD
IGCM

Appendix : The 3 on 3 and 3 on 1 game performance coding instrument

Date Condition Participants' number			
Game performance	Decision-making component	Motor skill execution component	Effectiveness component
Control	Pivoting in the direction of the basket. (cat09) Not pivoting or not pivoting in the direction of the basket. (cat10)	Holding the ball with two hands. (cat25) Knees, hip and elbow bent. (cat26) Feet parallel and aimed at the basket. (cat27) Pivoting without travelling foul. (cat28) Pivoting according to the position of the defender. (cat29) Holding the ball with one hand or holding the ball with two hands but close to the floor. (cat30) Knees, hip and elbow not bent. (cat31)	Player stays in possession of the ball. (cat79) Player looses the ball. (cat80)

		Feet not parallel and not aimed at the basket. (cat32) Pivoting with travelling foul. (cat33) Pivoting without taken the position of the defender into account. (cat34)	
Scoring	Standing close to the basket and trying to score when there is no defender nearby. (cat11)	Feet parallel and aimed at the basket. (cat35) Holding the ball in shooting pocket. (cat36) Overhand shooting. (cat37) Bow in trajectory of the ball. (cat38) Clear flexion-extension movement. (cat39) Ball hits square on the basket or the ring. (cat40)	Ball ends in the basket. (cat81)
	Standing close to the basket and	Feet not parallel and not aimed at the	Ball misses the basket. (cat82)

		not trying to score when there is no defender nearby. Standing far away from the basket and trying to score while there was free space to dribble closer to the basket. Standing under the basket and trying to score. Trying to score while a team-mate was in a favourable position. Trying to score while there is close defence. (cat12)	basket. (cat41) No shooting pocket. (cat42) Not shooting overhand. (cat43) No bow trajectory of the ball. (cat44) Clear flexion-extension movement is missing. (cat45) Ball misses square on the basket or the ring. (cat46)	
Creating Shooting Opportunities	*Dribbling*	Dribbling to take the free space to the basket. Dribbling to create space. (cat13)	No travelling foul at the start of the dribble. (cat47) No travelling foul during the dribble.	Dribble ends in a scoring opportunity. Players stays in possession of the ball. (cat83)

		Dribbling on the spot. Not dribbling while there was free space to the basket. Dribbling while a team-mate stands free in a favourable scoring position. (cat16)	(cat48) No travelling foul at the end of the dribble. (cat49) Dribble with view on the game. (cat50) Travelling foul at the start of the dribble. (cat51) Travelling foul during the dribble. (cat52) Travelling foul at the end of the dribble. (cat53) Dribble with the back aimed at the game. (cat54) Not dribbling while moving with the ball. (cat55) Useless dribble (e.g. when catching a ball). (cat56)	Player looses the ball. (cat84)

	Passing	Pass to a team-mate who stands free and/or in a more favourable position. (cat14)	In the cutting direction. (cat57) Not too high, not to far. (cat58) Passing with two hands (chest or bounce pass). (cat59)	Ends in ball possession. (cat91)
		Pass while there was free space to dribble to the basket. Pass to a team-mate who does not stand free. Pass to a team-mate while there was a scoring opportunity. (cat17)	Not in the cutting direction. (cat60) Too high, to far, not far enough. (cat61) Not passing with two hands (no chest or bounce pass). (cat62)	Ball possession (after control with dribble). (cat92) Ball is lost. (cat93)
	Catching		In the running direction. (cat63) Not too high, not too far. (cat64) With two hands. (cat65)	Ends in ball possession. (cat91)
			Not in the running direction. (cat66) Too high, too far.(cat67) Not with two hands. (cat68)	Ball possession (after control with dribble). (cat92) Ball is lost. (cat93)

	Cutting	Cutting to the basket after giving a pass. Not cutting to the basket while the player with the ball undertakes an action to the basket. (cat15) Cutting to the basket while the player with the ball undertakes an action to the basket. Not cutting after giving a pass. Running behind the player with the ball. Cutting and returning immediately. (cat18)	Cutting immediately after giving a pass. Not cutting when there is an action to the basket. (cat69) Asking the ball while cutting. (cat70) Eye contact while cutting. (cat71) Not cutting immediately. Cutting while there is an action to the basket. (cat72) Not asking the ball while cutting. (cat73) No eye contact while cutting. (cat74)	Leads to a good passing opportunity. (cat85) Leads to ball possession. (cat86) Leads to a scoring opportunity. (cat87) Does not lead to a good passing opportunity. (cat88) Does not lead to ball possession. (cat89) Does not lead to a scoring opportunity. (cat90)
Setting up an attack		Moving to loose the defence. Player is free in the around the	Change of speed and direction. (cat75) Free, remain standing. (cat76)	Player can receive the ball. (cat94)

	spots. (cat19) Not moving when he can receive the ball. (cat20) Player can receive the ball left and right from the player with the ball. (cat21) Remain standing with defence in the passing lane. (cat22) Free but to far away from the player with the ball. (cat23) Free, but not remain standing. Two players on one side of the ball. (cat24)	No change of speed and direction. Remain standing in a useless position. (cat77) Free, but not remain standing. (cat78)	Player can not receive the ball. (cat95)