Original Article

EFFECTS OF IMPLICIT, EXPLICIT AND SEQUENTIAL LEARNING IN THE ACQUISITION OF THE BASKETBALL SHOOTING SKILL IN NOVICES

EFEITOS DA APRENDIZAGEM IMPLÍCITA, EXPLÍCITA E SEQUENCIAL NA AQUISIÇÃO DA TÉCNICA DE ARREMESSO EM NOVATOS NO BASQUETEBOL

Mariana Calábria Lopes[1], **Maicon Rodrigues Albuquerque**[2] and **Markus Raab**[3,4]

[1]Universidade Federal de Viçosa, Viçosa-MG, Brasil.
[2]Universidade Federal de Minas Gerais, Belo Horizonte-MG, Brasil.
[3]German Sport University, Köln, Germany.
[4]School of Applied Sciences, London Southbank University, London, United Kingdom.

ABSTRACT

This study aims to examine the effect of explicit and implicit learning in children, as well as a sequential application of learning modes, in the acquisition of the basketball shooting skill in an ecological setting. Participants (n=80) were novices in basketball, ages 9 to 12 years old. The experimental groups followed one of the three different methods of training, which combined technical and tactical aspects: (a) explicit, (b) implicit, or (c) sequential (implicit first and then explicit). The control group participated only in the measurements. A pre-test and a post-test measured the performance of basketball shooting skills in isolation. A transfer test in a 3-on-3 game condition was also applied. Results indicate that all intervention groups improved in a similar manner as a consequence of practice and there was no difference between the groups in the performance of the basketball shooting skill in isolation and under game condition. The sequential group obtained a performance drop similar to the explicit group in the transfer test, which may be due to the amount of explicit knowledge accumulated by them. The current findings indicate similar effects of implicit and explicit motor learning when they are applied in complex environments with children.

Keywords: Motor skills. Learning. Child. Basketball.

RESUMO

O objetivo do presente estudo foi verificar os efeitos da aprendizagem explícita e implícita em crianças, assim como a aplicação da aprendizagem sequencial, na aquisição da técnica de arremesso do basquetebol em um contexto ecológico. Os sujeitos (n=80) eram novatos no basquetebol, entre 9 e 12 anos. Os grupos experimentais seguiram um dos três diferentes métodos de treinamento, os quais combinaram aspectos técnicos e táticos: (a) explícito, (b) implícito, ou (c) sequencial (primeiro implícito e depois explícito). O grupo controle participou somente das fases de testes. Realizou-se um pré-teste e um pós-teste para avaliar o desempenho da técnica do arremesso de forma isolada. Também aplicou-se um teste de transferência no formato de um jogo de 3 vs. 3. Os resultados indicaram que todos os grupos experimentais melhoraram de forma semelhante como consequência do treinamento, não diferindo no desempenho da técnica do arremesso do basquete no teste de forma isolada ou no jogo. O grupo sequencial obteve uma queda de desempenho semelhante ao grupo explícito no teste de transferência, o que pode ser devido a quantidade de conhecimento explícito acumulado por eles. Conclui-se que os efeitos da aprendizagem motora implícita e explícita são semelhantes quando realizadas em ambientes complexos com crianças.

Palavras-chave: Habilidades motora. Aprendizagem. Criança. Basquetebol.

Introduction

A child can learn sports skills as a weekend player or a high-level athlete, which are very different things[1]. For the athlete, skill learning is usually done explicitly, through testing of hypotheses and trainers' instructions, to establish the best way to reach the expected level of performance. When children play one-on-one basketball, for fun, in a driveway for some hours, the implicit learning may be more likely to occur[2]., i.e., the child does not even intend to learn and cannot verbalize how to perform the learned movement.

This distinction shows that motor learning can be supported by two cognitive pathways that operate in parallel: an explicit and an implicit path[3]. Recently in a consensus

paper, Kleynen et al.[4] defined explicit learning as *"learning which generates verbal knowledge of movement performance (e.g., facts and rules), involves cognitive stages within the learning process and is dependent on working memory involvement."* In contrast, implicit learning involves unintentional and automatic acquisition of knowledge[5], with little or no increase in verbal knowledge of movement performance[4].

Although the two pathways to learning (implicit and explicit) can occur separately, they can also take place in combination or sequentially (sequential or hybrid learning). Poolton, Masters, and Maxwell[6], for example, showed that brief initial periods of implicit motor learning during the early stages of learning in laboratory seem to have provided learners with the advantage of stability under pressure or dual tasking, even after an explicit instruction presentation about the movement of golf putting. This finding has practical relevance, given that it is impossible to restrict a learner to an entirely implicit learning environment[1].

In team sports like basketball, ball skills are assumed to be complex motor skills because they are generally practiced in a dynamic sports setting, which demands fast and effective decisions[7]. Thus, for a novice, it is important to develop technical and tactical skills. Although this statement is widely accepted and technical and tactical training usually occur in conjunction, the trend has been for research to deal separately with motor and cognitive learning in sports in order to reduce the complexity of the learning situation. One exception found in the literature is the work of Schlapkohl, Hohmann, and Raab[8]. This study was designed to analyze the effects of implicit and explicit learning in the acquisition of topspin forehand shot in table tennis when the teaching process involves motor and tactical aspects at the same time. The results revealed that the implicit group both performed better at the end of the learning phase and had a more stable performance when a decision-making task was added compared to the explicit group.

Furthermore, it is important to note that the majority of the studies on implicit learning has been conducted with adults[9,10]. If a major goal of motor learning research is to support the practice in physical education classes and sport settings involving children and adolescents, it is precipitate to generalize the findings from adult populations[11]. Some few exceptions are the studies from Capio and colleagues[9,12,13], which found support to use the errorless paradigm to promote the learning of fundamental motor ability (e.g., throwing) and sport specific closed skill (e.g., golf-putting) in children, with particular advantage for low-ability children. Nevertheless, it is not yet clear how well these findings generalize to the sport context in an open ability, like the shooting in basketball. The shooting is a fundamental skill of basketball, that players enjoy and practice most, even novices[14].

In sum, in the present study, the effects of implicit and explicit learning in the acquisition of the basketball shooting skill will be investigated in children with an integrated training (technical and tactical), in order to increase the ecological validity of the approach. Implicit and explicit motor and perceptual learning used to be investigated in laboratory conditions[15], which allows great control over the variables involved, but does not necessarily transfer to real situations, especially to team sports[16].

We based the following hypotheses on the integration of effects of different learning types to promote generalization to developing basketball shooters: Hypothese 1 - the implicit group and a sequential group will demonstrate higher performance of basketball shooting after an intervention phase compared with an explicit group and a control group[8]. Although the work of Schaplakohl et al.[8] did not investigate sequential learning, Poolton, Masters and Maxwell[6] research has shown that the effects of sequential learning are similar to implicit learning; Hypothese 2 - When the technical skill of shooting a basketball has to be performed simultaneously with a decision-making task, the performance of the implicit and sequential

groups will remain stable, whereas the performance of the explicit group and the control group will be reduced[8,17,18]; Hypothese 3 - the explicit and sequential groups will be able to verbalize a larger number of movement rules regarding shooting a basketball after the intervention in comparison to the implicit and control groups[3].

Thus, we predict that differences between implicit and explicit learning may be more or less pronounced depending on the age and domain. Given that findings regarding complex movements and sports in children are lacking, we thought to first test the generalization of implicit and explicit learning. At a more exploratory level, from the developmental perspective we examined whether implicit and explicit motor learning replicate effects found earlier in adults or in fundamental movement and closed skills, which is poor explored in the literature, specially in ecological settings.

Methods

Participants

A total of 80 participants (25 girls and 55 boys; 9–12 years old; M_{age} = 10.61 years, *SD* = 0.85) took part voluntarily in this study. They were assigned through convenience sampling according to the period of the intervention to one of three experimental groups (implicit group: *n* = 18, explicit group: *n* = 20; sequential group: *n* = 19) or a control group (*n* = 23).

All participants were novices in basketball and had no previous experience outside physical education classes at school. They were recruited through notice boards and flyers distributed at schools and sports clubs in Germany. The participant assent was obtained with parental/guardian consent. The Institutional Review Board approved the study.

Measures

Participants each completed three tests designed to measure the effect of the learning procedure on (a) basketball shooting, (b) basketball shooting under game conditions, and (c) declarative knowledge. All skill tests occurred on a court with official baskets and dimensions according to the rules of the FIBA. The balls were smaller and lighter than for adults (Molten N. 5) to facilitate ball handling and provide more enjoyable experiences for the children[19].

(a) Basketball shooting test

Participants were required to throw the ball in the basket from a distance of 2.80 m from the projected line of the backboard[20]. Participants performed two blocks of 10 trials and shooting performance was assessed using a 6-point scale developed by Hardy and Parfitt[21]: 5 for a ''clean'' basket (i.e., ''swish''); 4 for rim and in; 3 for backboard and in; 2 for rim and out; 1 for backboard and out; and 0 for a complete miss. A trained rater evaluated each shooting attempt in loco. To prevent excessive physical stress in the participants, blocks were separated by an interval of at least one minute. All participants were allowed to perform two practice trials in both test phases. Only the best block (the sum of the 10 trials) of each test phase was used for analysis to reduce the intra-individual variance. The maximal score was 50 points per block.

(b) Basketball shooting test under game conditions

Participants played on a basketball half-court between two teams of three players and lasted 8 min. Assessment of the performance of the basketball shooting skill under decision-making constraints was made using the Skill Execution Index (SEI) of the Game Performance Assessment Instrument – GPAI[22], which has been previously validated in basketball[23]. Each time the observed participant shoot the ball to the basket, the rater evaluated his action as either "efficient" (one point) or "inefficient" (zero point) in the context of the game situation. The participants' performance was recorded using a Sony digital video camera (model DCR-

TRV900E) and was further analyzed by two independent raters (national C-license basketball trainers). Intra-class correlation coefficients (ICCs) showed significant correlations between the raters in their scoring of skills in the pre-test (efficient skill execution, ICC = .91, p < .001; inefficient skill execution, ICC = .81, p < .001) and post-test (efficient skill execution, ICC = .92, p < .001; inefficient skill execution, ICC = .83, p < .001). So, the performance indicators were calculated according to the protocol of Mitchell et al.[22] with the changes proposed by Memmert and Harvey[24], which considers the assessment of all the raters (k=1 to n) for efficient actions (ae) and inefficient actions (ai) and creates values from zero to two for each coder (equation 1). All results above one indicate that the player is successful and has shown more efficient than inefficient actions.

$$SEI = 2x \; \frac{\sum\limits_{k=1}^{n} (a_e + 1)}{\sum\limits_{k=1}^{n} (a_e + a_i + 2)}$$

(c) Declarative knowledge

The aim of this analysis was to check the instruction manipulation of the groups and to ensure that they learned through an implicit or explicit process. All participants were asked to fill out the Declarative Knowledge Questionnaire[3], before and after the learning phase, regarding all the rules, coaching tips, and strategies they felt were important for the execution of the shooting skill in basketball. They did not receive any feedback about their results regarding the rules between both test phases. Explicit rules were measured by comparing the number of written rules related to the position and/or movement of the feet, leg, body, arm, and the ball to a list of set instructions[25]. Two independent raters counted the number of explicit rules reported by each participant relating to motor skill execution (e.g., ''I keep my forearm vertical'' or "I extend my elbow when I shoot"). Statements that were irrelevant to technical performance such as "I bounce the ball two times before shooting" were not included according the test protocol[3] and adopted in the work of Lam, Maxwell, and Masters[26] with basketball shooting. ICCs were computed and significant correlations were shown for both pre-test (ICC = .80, p < .001) and post-test (ICC = .94, p < .001), so means were calculated from the combined scores of the independent raters.

Procedures

The experiment comprised two distinct phases: (a)a learning phase and (b) a test phase.

(a) Learning phase

The learning phase was presented as a "basketball camp" for the intervention groups (explicit, implicit, and sequential). Basketball Camps are a regular way of training and a great introduction to the sport for children[27]. Three "basketball camps" were organized, one for each intervention group, which received different instructions according the learning process. The order of the type of learning to be used in each of the camps was drawn, adopting the following sequence: implicit, explicit and sequential. For each camp, we recruited and trained two basketball coaches for their respective protocol. The learning phase took place over five consecutive days, during distinct school holidays. A total of eight units of 2.5 hours each were performed in the learning phase, one unit on the first and last day of the camp and two units on each of the other days. In each unit one tactical problem and one technical skill were taught through implicit or explicit method, depending on the group in which the participant

had been placed. About 30 min were spent practicing the technique and about 2 hours were spent performing tactical tasks that also required the execution of technical movements. The shooting was the main focus of three different units. The training schedule is depicted in Table 1. The time for each activity was controlled and equal for all interventions groups.

Table 1. Example of a Training Schedule of One Unit for All Intervention Groups

Time	Activity
20 min	Warm-up activity + stretching
20 min	3 on 3 game (tactical problem)
30 min	Technical training (pass, drible or shooting)
20 min	Small game
20 min	3 on 3 game (same tactical problem)
20 min	5 on 5 game
20 min	Pause (water break, explanations, etc.)

Source: Own source

The learning content and training structure were the same for all intervention groups. The training session was adapted from the book *Teaching Sport Concepts and Skills*[22] and included the tactical level of complexity I and II in basketball and the technical skills of chest pass, dribbling, and shooting. The three intervention groups differed only in terms of instruction, as showed below.

Explicit learning group - The instructions about the tactical skills were taught through "guided discovery learning"[28], i.e., the coach asked questions to guide the solution to the tactical problem presented in the game. The questions were based on the suggestions made by Mitchell et al.[22] and emphasized tactical awareness. Motor learning was introduced with a step-by-step method in which the movement rules outlined by Schroeder and Bauer[25] was read by the coaches before and after the technical training (Table 2). In addition, they repeated the main skill rules at the start and end of the day with all the children of the group together. In terms of feedback, the coaches do not corrected the children in relation to skill execution.

Table 2. Instructions given in the explicit condition for basketball shooting

Explicit instructions
Keep your feet shoulder-width apart and knees slightly bent.
Point your feet point toward the basket.
Support the ball with the hand of your non-shooting arm.
Elbow of your shooting arm should be under the ball.
Stretch your body fully from the bottom up (toward the roof).
During shooting, the throwing arm stretches vertically upward.
Release the ball with your fingertips.
Follow through by snapping the wrist toward the basket, so that the shooting hand is facing downward.

Source: Adapted from Schroeder and Bauer [25]

Implicit learning group - In the implicit group, the children did not receive instructions in terms of tactics or technique execution. The tactical skills were taught through the "non-

guided learning" method, where players have to find unique solutions to movement problems through exploration and discovery. The errorless approach was used to promote the implicit motor learning, such that participants started closer to the basket and slowly increased the distance from the basket. The "errorless" method was preferred to promote implicit motor learning, rather than analogy learning ("cookie jar analogy") used on previous work[26]. The main focus of the "cookie jar analogy" is the movement of the arms and the hands to imitate a movement into a cookie jar, while leg movements are not emphasized. As in this study, the whole body movement was important this analogy seems insufficient. The implicit group did not get any feedback about skill execution.

Sequential learning group - The participants in this group followed the implicit learning protocol for the first four units and the explicit learning protocol for the four subsequent units.

Control group - The control group completed only the test phase (pre-test and post-test). They did not have any kind of systematized intervention.

(b) Test Phase

The test phase comprised the pre-test, the post-test, and a transfer test. The pre-test and post-test consisted of identical experimental procedures and conditions (e.g., period of the day, balls, etc.) and the tests were counterbalanced across each condition for all groups. The pre-test was conducted prior to the start of the learning phase and the post-test and the transfer test on the day after the last training unit. The transfer test was a basketball game, in a 3-on-3 condition, on a half-court.

Statistical analysis

The data were checked for normality and outliers (values representing more than two standard deviations). A two-way analysis of variance (ANOVA; 4 Groups × 2 Tests) with repeated measures on the last factor was used to compare the performance of the basketball shooting (isolate) and basketball shooting under game conditions among the four groups (Hypotheses 1 and 2, respectively). To test Hypothesis 1 we used the score of basketball shooting on the pre-test und post-test. To investigate the Hypothesis 2 we used the score on post-test of the basketball shooting (isolate) and the score on the transfer test (basketball shooting under game conditions). A Scheffé post hoc test was used to explore significant ANOVA results further. The effect sizes were calculated as partial eta squared (η_p^2). To test Hypothesis 3, concerning declarative knowledge, we conducted a Kruskal-Wallis Test to compare the four groups in the pre-test and post-test. The alpha level was .05. The statistical procedures were calculated with SPSS, version 20.

Results

The descriptive statistics for the dependent variables for each group are displayed in Table 3. The results section is structured following the sequence of the hypotheses.

Table 3. Descriptive statistics for all dependent variables by group

Dependent variables	Explicit		Implicit		Sequential		Control	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Basketball shooting								
Pre-test	26.40	4.29	23.94	5.70	22.32	4.02	22.83	6.44
Post-test	27.60	5.30	24.89	6.12	26.05	6.11	22.39	6.48
Basketball shooting under game conditions								
Post-test[a]	0.58	0.91	0.12	1.05	0.32	1.05	-0.29	1.14
Transfer-test[a]	0.27	0.81	0.18	0.91	0.08	1.16	-0.36	0.96
Declarative knowledge								
Pre-test	0.44	0.46	0.14	0.28	0.26	0.45	0.17	0.48
Post-test	1.66	1.15	0.28	0.46	1.58	2.11	0.20	0.47

Note: [a]Z score. *SD* = Standard deviation
Source: Own source

Basketball shooting (Hypothesis 1)

Initial performance was assessed using a one-way ANOVA with the score of the pre-test. No initial significant differences were found between the groups, $F(3,76) = 2.40$, $p = .075$. A Group × Test repeated-measures ANOVA, with number of scored points in the free-throw shooting test as a dependent measure, revealed significant main effects of test, $F(1,76) = 4.82$, $p = .031$, $\eta_p^2 = .06$, and Group, $F(3,76) = 2.86$, $p = .042$, $\eta_p^2 = .10$. Post hoc analysis indicated that the explicit group had a higher performance of basketball shooting than the control group ($p=.005$). No significant interactions, $F(3,76) = 2.01$, $p = .119$, $\eta_p^2 = .07$, were found, meaning that all interventions groups improved in a similar manner as a consequence of practice (Figure 1). So, Hypothesis 1 was not supported.
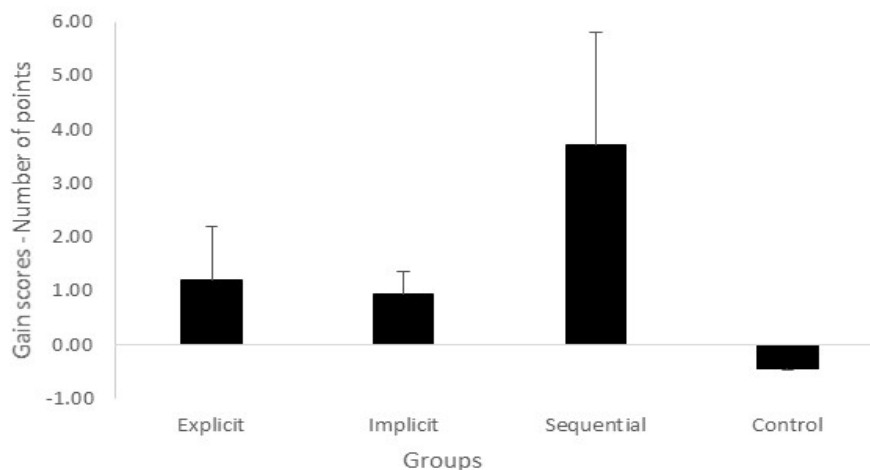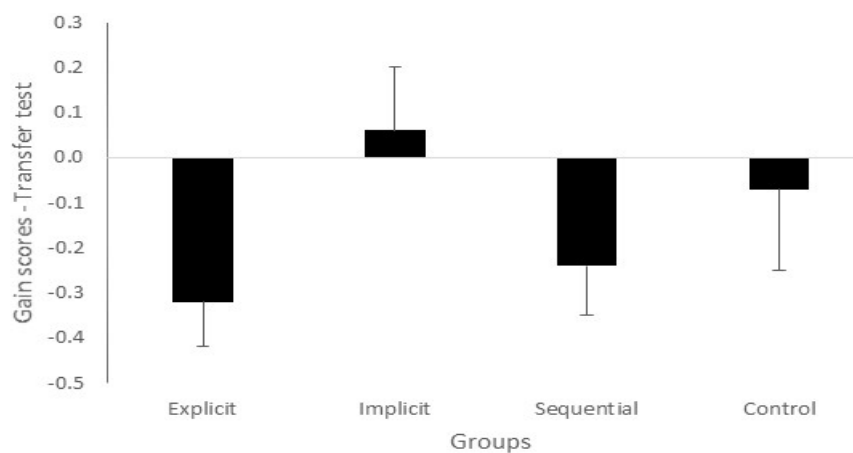

Figure 1. Gain scores between post-test and pre-test of the basketball shooting test by group. Error bars represent standard deviation
Source: Own source

Basketball shooting under game conditions (Hypothesis 2)

To check the stability of the basketball shooting skill under cognitive constraints, the performance of this skill in isolation and in a game (3 on 3) were compared. Only the values

of the post-tests were used after they had been z transformed. The results of the 4×2 (Group $\times$ Test) ANOVA with repeated measures revealed a main effect of group, $F(3,76) = 3.50$, $p = .020$, $\eta_p^2 = .12$. Post hoc comparisons between the four groups showed the control group performed at a significantly lower level than the explicit group ($p = .026$), but this difference already existed in the base-line value (post-test of the skill in isolation - ANOVA, $F(3,76) = 2.86$, $p = .043$). As illustrated in Figure 2, it is apparent that the performance of the implicit group remained stable and the other groups' performance deteriorated under game conditions. Nevertheless no significant effect of test, $F(1,76) = .942$, $p = .335$, or Group $\times$ Test interaction, $F(3,76) = .342$, $p = .795$, was found. Thus, Hypothesis 2 was not supported.

Figure 2. Gain scores between transfer test and post-test of the basketball shooting under decision-making constraints task by group. Error bars represent standard deviations

Source: Own source

Declarative knowledge (Hypothesis 3)

To identify if the explicit method was successfully implemented, it was ran a Kruskal-Wallis test comparing the difference among explicit rules, before and after the intervention. The test showed a significant difference in the number of rules reported by the groups ($x^2(3) = 30.16$, $p < .001$). The post hoc analysis (pairwise comparisons) revealed that the explicit and sequential groups reported more rules than the implicit and control group ($p < .01$).

Discussion

In the present study, it was examined the effect of explicit and implicit learning, as well as a sequential application of learning modes, in the acquisition of the basketball shooting skill. The current study extended previous work by combining training in several technical and tactical skills in a learning phase in an ecological setting. Furthermore, it was tested the generalization of effects by testing a specific sports skill in children instead of adults. Finally, the learning phase lasted 25 hours, much more than standard laboratory testing provides.

As expected, the results show that all intervention groups improved performance in the basketball shooting task from pre-test to post-test whereas the control group did not improve. Taking into account the combination of technical and tactical training of several skills (additional load) and the results of previous studies[6,8], it was predicted that the implicit and sequential group would have a better shooting performance at the end of the learning

phase. Despite the apparent better performance over time of the sequential group compared with the other groups, it was not found a significant interaction effect. However, a significant main effect (Group) was found between the explicit and control groups, in that the latter scored fewer points. From the beginning, both groups performed quite differently compared to the other groups that almost reached significance. During the learning phase, the variation between these groups became larger and statistically significant.

It can also be argued that environmental complexity in the learning phase was too high, considering that several technical and tactical skills were taught and about 20 children participated in the intervention program at the same time. According to Lebed and Bar-Eli[29], a complex environment has a large number of elements, unpredictable behaviors, and many interactions of available information. Thus, in the sports context, the complexity of a situation increases when there is a small perceptual space–time relation (e.g., distance between players), when the number of options rises and their detectable differences decrease, and when the number of attributes used to define a situation and the relation between decisions and situations increases[28]. Raab[28] carried out four experiments with adults to investigate the interaction of implicit and explicit learning processes and complexity in the decision making of athletes in tactical team sports, including basketball. His results suggest that implicit learning is superior in low-complexity situations and explicit learning in high-complexity situations. Therefore, it is plausible that only the explicit learners in our study improved their performance by the end of the learning phase. However, because the focus in this study was more on motor learning and the participants were children, further studies are needed to test alternative explanations.

To replicate and extend the findings of several studies[8,17,18], the second aim of this study was to test the robustness of the basketball shooting performance under cognitive constraints. The performance level of the implicit group continued to rise during transfer, despite the imposition of the game condition, supporting the hypothesis that this group was not using working memory to control aspects of the shooting task. The explicit and control groups suffered a drop in performance while performing the skill under cognitive constraints, suggesting their dependence on working memory to control the primary task. However, these changes in performance were not statistically significant and did not confirm Hypothesis 2. Although the groups showed a similar performance in the transfer test, the analysis of declarative knowledge revealed that the sequential and explicit groups reported significantly more movement rules than the implicit and control groups. These results replicate previous work (see Masters & Maxwell[3] for a review), and provide a manipulation check.

Thus, counter to our original prediction, there was no clear relationship evident between the number of rules reported and performance on the transfer test. Here it is important to highlight that only in the study of Schlapkohl et al.[8] did the transfer test involve a decision-making task, while in the other works the secondary cognitive task was to count pitched tones[18] or to generate random letters[30]. The present study extends previous research by its use of an ecological setting (game situation), where motor and cognitive skills were required. Moreover, Schlapkohl et al.[8] used the analogy method to promote the implicit learning of a table tennis forehand in adults, whereas this study employed the errorless method to implicitly teach children how to shoot a basketball.

However, some limitations of this study should be noted. First, the participants were not randomly assign to an intervention group or the control group because the basketball camps (learning phase) occurred at different times due to external and organizational factors. Second, to favor the ecological validity of the study, it was not possible to control the errors of each participant in the shooting skill during the learning phase in the basketball camps. Nevertheless, it can be argued that the implicit motor learning was appropriately implemented

due to the low numbers of movement rules reported by the participants in the implicit group. Another problem is related to the motivation of the participants in the learning phase and on the test day, especially in the post-test. After five consecutive days of basketball training, some children were tired and not fully motivated on the 6th day, in the post-test. This condition may have had an influence on the test results, but it applies to all the intervention groups. An alternative would be to insert one day of rest between the learning and the test phase and introducing a motivational test to determine if the various learning processes lead to different levels of motivation.

Conclusions

Despite these limitations, the present study provides further knowledge on implicit and explicit learning processes in the field and extends the current literature on this topic. It was adopted the novel approach of analyzing the effects of implicit and explicit learning in the acquisition of shooting in basketball in an ecological setting, where the children had to perform other actions besides shooting. The implicit learning showed to have similar effects when compared to explicit motor learning in complex environment. Moreover, the implicit learning was used for the first time with children to promote the learning of a sport specific open skill combined with tactical training. This results can provide a way to orient coaches' and teachers' training choices during child motor skill development, which is particularly important to their engagement in games and sports activities.

Continued research is required to determine how combined training (technical and tactical) in ecological settings, through implicit, explicit, or a combination of the two learning processes (sequential), can benefit motor learning of sports skills. To examine the influence of further acquisition of declarative knowledge, it was recommended that the participants of the sequential group should be tested for all dependent variables in the middle of the intervention, when the type of learning process changes.

References

1. Masters RSW. Practicing implicit motor learning In: Farrow D, Baker J, Macmahon C, editors. Developing sport expertise: researchers and coaches put theory into practice. London: Routledge; 2013, p. 154-174.
2. Côté J, Murphy-Mills J, Abernethy B. The development of skill in sport. In: Hodges NJ, Williams M, editors. Skill acquisition in sport: research, theory and practice. London: Routledge; 2012, p. 269-286.
3. Masters RSW, Maxwell JP. Implicit motor learning, reinvestment and movement disruption: What you don´t know won´t hurt you. In: Williams AM, Hodges NJ, editors. Skill acquisition in sport: Research, theory and practice. London: Routledge; 2004, p. 207-228.
4. Kleynen M, Braun SM, Bleijlevens MH, Lexis MA, Rasquin SM, Halfens J, et al. Using a Delphi Technique to Seek Consensus Regarding Definitions, Descriptions and Classification of Terms Related to Implicit and Explicit Forms of Motor Learning. Plos One 2014;9(6): e100227. DOI: 10.1371/journal.pone.0100227
5. Frensch PA. One concept, multiple meanings: on how to define the concept of implicit learning. In: Stadler MA, Frensch PA, editors. Handbook of implicit learning. Thousand Oaks: Sage; 1998, p. 47-104.
6. Poolton JM, Masters RSW, Maxwell JP. The relationship between initial errorless learning conditions and subsequent performance. Hum Movement Sci 2005;24:362-378. DOI: 10.1016/j.humov.2005.06.006
7. Correa UC, Vilar L, Davids K, Renshaw I. Informational constraints on the emergence of passing direction in the team sport of futsal. Eur J Sport Sci 2014;14:169-176. DOI: 10.1080/17461391.2012.730063
8. Schlapkohl N, Hohmann T, Raab M. Effects of instructions on performance outcome and movement patterns for novices and experts in table tennis. Int J Sport Psychol 2012;43:522-541. DOI: 10.7352/IJSP2012.43.053
9. Maxwell JP, Capio CM, Masters RS. Interaction between motor ability and skill learning in children: Application of implicit and explicit approaches. Eur J Sport Sci 2016;17(4):407-416. DOI: 10.1080/17461391.2016.1268211

10. Lola AC, Tzetzis GC, Zetou H. The effect of implicit and explicit practice in the development of decision making in volleyball serving. Percept Mot Skills 2012;114: 665-678. DOI: 10.2466/05.23.25.PMS.114.2.665-678

11. Perreault ME, French KE. External-Focus Feedback Benefits Free-Throw Learning in Children. Res Q Exerc Sport 2015;86:422-427. DOI: 10.1080/02701367.2015.1051613

12. Capio CM, Poolton JM, Sit CHP, Eguia KF, Masters RSW. Reduction of errors during practice facilitates fundamental movement skill learning in children with intellectual disabilities. J Intell Disabil Res 2013;57:295-305. DOI: 10.1111/j.1365-2788.2012.01535

13. Capio CM, Poolton JM, Sit CHP, Holmstrom M, Masters RSW. Reducing errors benefits the field-based learning of a fundamental movement skill in children. Scand J Med Sci Spor 2013;23:181-188. DOI: 10.1111/j.1600-0838.2011.01368

14. Krause JV, Meyer D, Meyer J. Basketball skills & drills. 3rd ed. Champaign, IL: Human Kinetics; 2008.

15. Kleynen M, Braun SM, Rasquin SMC, Bleijlevens MHC, Lexis MAS, Halfens J, et al. Multidisciplinary Views on Applying Explicit and Implicit Motor Learning in Practice: An International Survey. Plos One. 2015;10(8). DOI: 10.1371/journal.pone.0135522

16. Marasso D, Laborde S, Bardaglio G, Raab M. A developmental perspective on decision making in sports. Int Rev Sport Exer P 2014;7:251-273. DOI: 10.1080/1750984X.2014.932424

17. Masters RSW, Poolton JM, Maxwell JP, Raab M. Implicit motor learning and complex decision making in time-constrained environments. J Motor Behav 2008;40:71-79. DOI: 10.3200/JMBR.40.1.71-80

18. Poolton JM, Masters RSW, Maxwell JP. The influence of analogy learning on decision-making in table tennis: Evidence from behavioural data. Psychol Sport Exerc 2006;7:677-688. DOI: 10.1016/j.psychsport.2006.03.005

19. Arias JL, Argudo FM, Alonso JI. Effect of ball mass on dribble, pass, and pass reception in 9-11-year-old boys' basketball. Res Q Exerc Sport 2012;83: 407-412. DOI: 10.1080/02701367.2012.10599875

20. Showalter D. Coaching youth basketball.Champaign: Human Kinetics; 2007.

21. Hardy L, Parfitt G. A catastrophe model of anxiety and performance. The British Journal of Psychology 1991;82:163–178.

22. Mitchell SA, Oslin JL, Griffin LL. Teaching sports concepts and skills: A tactical games approach. 2nd ed. Champaign: Human Kinetics; 2006.

23. Oslin JL, Mitchell SA, Griffin LL. The Game Performance Assessment Instrument (GPAI): Development and preliminary validation. J Teach Phys Educ 1998;17:231-243. DOI: 10.1123/jtpe.17.2.231

24. Memmert D, Harvey S. The game performance assessment instrument (GPAI): some concerns and solutions for further development. J Teach Phys Educ 2008;27:220-240. DOI: 10.1123/jtpe.27.2.220

25. Schroeder J, Bauer C. Basketball: trainieren uns spielen [Basketball: training and play]. Reinbek: Rowohlt; 2001.

26. Lam WK, Maxwell JP, Masters RSW. Analogy versus explicit learning of a modified basketball shooting task: Performance and kinematic outcomes. J Sport Sci 2009;27:179-191. DOI: 10.1080/02640410802448764

27. LeMar B, Deutsch J. How to run a successful and educational basketball camp. International Journal of Human Sciences 2015;12:1182-1188.

28. Raab M. Implicit and explicit learning of decision making in sports is effected by complexity of situation. Int J Sport Psychol 2003;34:273-288.

29. Lebed F, Bar-Eli M. Complexity and control in team sports: Dialectics in contesting human systems. London: Routledge; 2013.

30. Masters RSW, Poolton JM, Maxwell JP. Stable implicit motor processes despite aerobic locomotor fatigue. Conscious Cogn 2008;17:335-338. DOI: 10.1016/j.concog.2007.03.009

Author address: Mariana Calábria Lopes. Universidade Federal de Viçosa - Departamento de Educação Física. Av. P.H. Rolfs, s.n., Campus UFV, Viçosa – MG, CEP:36570-000. E-mail: lopesm@gmail.com