Improvement in game performance and adherence after an aligned TGfU floorball unit in physical education

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Background: Although a great deal of research has been undertaken from 1982 on TGfU, teachers consider its implementation to be complex and are reluctant to integrate it into their teaching practice. Furthermore, some TGfU literature does not suggest how it might be implemented and how problems might be overcome. On the other hand, a review of TGfU studies showed three shortcomings. First, most of them only compared TGfU with a technique-based approach in the school setting. Second, the studies did not follow the fidelity guidelines for models-based practice research and it is therefore difficult to contrast their results. Third, lesson design was not aligned on the principles of play. Thus, this study provide additional support for going forward from comparative studies in educational settings, and enacting an aligned TGfU unit of floorball contextualized in the principles of play.

Purpose: To verify whether pupils improved in variables related to performance and adherence after the enactment of an aligned TGfU unit.

Method: An eight lessons unit was designed, validated, and enacted using a mixed-methods quasi-experimental pre-test and post-test design. Participants were 41 pupils (23 boys and 18 girls; $M = 11.73$, $SD = .66$ years old) from two regular physical education classes with the same teacher. The teacher was trained in the TGfU approach. In pre-test and post-test assessments, data from decision-making, technical execution, cover, support, game performance, game involvement, enjoyment, perceived competence, and intention to be physically active were collected, using the Game Performance Assessment Instrument, two psychological scales, and two focus groups interviews with the pupils and the teacher. We analysed quantitative data using *t*-tests and qualitative data following an open and axial coding based on the pre-existing categories.

Results: Pupils improved in decision-making, technical execution, cover, support, game performance, game involvement, enjoyment, perceived competence, and intention to be physically active after implementation of the TGfU unit. The pupils and the teacher perceived improvement in all the variables analysed as a consequence of the intervention.

Conclusion: After the implementation of the aligned TGfU floorball unit, pupils improved in the variables related to performance and adherence. Based on participants' key comments, four aspects appeared to be essential for the success of the unit: (a) the lesson design; (b) collaboration from planning to teaching the unit between the

researcher and the teacher; (c) the inclusion of learning tasks linked with cover and support; and (d) the use of two reflective periods that helped pupils to understand and apply new knowledge.

Keywords: Teaching Games for Understanding, Game Performance Assessment Instrument, sport pedagogy, tactics, PETE

Bunker and Thorpe (1982) initiated the Teaching Games for Understanding (TGfU) approach as a response to their perceived dissatisfaction with a technique-based approach to teaching games in secondary schools. Whereas the technique-based approach's aim was to learn the technical execution before playing the game, the TGfU approach suggests that game understanding should be introduced through modified games before technical execution. This means that in order to participate with awareness, pupils must explicitly know when, where, and why to use the techniques in the game and not just mere technical execution. For that purpose, the standard lesson of TGfU is organized in five segments following the diagram of the structure of TGfU from Bunker and Thorpe's (1982). In the first and fourth segments (game form and return to game form, respectively), pupils' autonomously experiment the modified game form where game structures are adapted to the success of the player, accommodating a wider range of ability (Hopper 2011). In the second and fifth segments (teaching for understanding and review and closure, respectively), they reflect to understand what they did, what they should have done, and why. And in the third segment (drills for skill), they learn the technical execution. Thus, the TGfU approach seems appropriate for teaching and learning invasion games, as it was designed so that learners explore environments to discover their own solutions to game related problems (Holt, Strean, and García-Bengoechea 2002).

Although a great deal of research has been undertaken from 1982 on TGfU, teachers consider its implementation to be complex and are reluctant to integrate it into their teaching practice (Light and Butler 2005; Randall 2008). Furthermore, some TGfU literature does not suggest how it might be implemented and how problems might be overcome. On the other hand, a review of TGfU studies showed three boundaries. First, most TGfU studies to date showed benefits regarding pupils' decision-making (Morales-Belando and Arias-Estero 2017b, b; Robinson and Foran 2011; Turner and Martinek 1999), technical execution (Morales-

Belando and Arias-Estero 2017b, c; Olosová and Zapletalová 2015; Robinson and Foran 2011; Turner and Martinek 1999; Yang and Lu 2013), support (Yang and Lu 2013), cover (Yang and Lu 2013), game performance (Morales-Belando and Arias-Estero 2017c; Olosová and Zapletalová 2015), game involvement (Morales-Belando and Arias-Estero 2017c; Harvey, Cushion, Wegis, and Massa-González 2010), enjoyment (Jones, Marshall, and Peters 2010) or perceived competence (Jones et al. 2010). However, most of those studies traditionally compared TGfU with the technique-based approach in school settings. Moreover, to compare two teaching approaches seems inappropriate because each approach promotes different types of engagement, stated outcomes, and pupils' experiences (Metzler 2005a) and most of the studies did not evaluate support and cover of attacker-off-the ball and defenders, respectively. Support and cover contents are crucial, especially when teachers must get the pupils to understand the game and the changes of roles between attack and defence.

Second, although Hastie and Casey (2014) proposed a fidelity guideline for models-based practice research and Harvey and Jarrett (2014) and Miller (2015) established some methodological recommendations for research on game-centred approaches, most of studies in TGfU are not following them, with some exceptions (e.g., Harvey et al. 2010). Both guidelines agreed that this type of studies should report: (a) pupils' and teachers' previous experience in the approach; (b) the number of pupils differentiated by sex; (c) the total number of lessons, their length, content, and distribution per week; (d) the changes made in the unit during its implementation; (e) the treatment verification; (f) information about the teacher training in the approach and the game; (g) the pupils' perception.

Finally, interventions with TGfU were not based on the principles of play: (a) maintaining possession of the ball; (b) winning the ball; (c) shooting on goal; (d) defending the goal; (e) attacking the goal; (f) challenging the opponents' progression (e.g. for exceptions, Harvey, Wegis, Beets, Brian, Massa-Gonzalez, and Van der Mars 2009; Harvey et al. 2010).

The principles of play are the general key general strategies for tactical elements of play, whereas tactics are the specific decisions that players have to make in each specific game situation. In other words, the players should make appropriate tactical decision according to the principles of play. Additionally, although Bunker and Thorpe (1982) proposed to change teachers' tendency to teach *how*? before *why*? so that pupils could execute the technique based on the right decision, investigations have forgotten that tactical decisions must be based on the principles that are present in the play. This may difficult the pupils' understanding of game play.

Our study provide additional support for going forward from comparative studies in educational settings, and enacting an aligned TGfU unit of floorball contextualized in the principles of play (Bayer 1986). Accordingly, the objective of the present study was to verify whether pupils improved in variables related to performance and adherence after the enactment of an aligned TGfU unit. The hypothesis was that the pupils would improve in the components that determine game performance (decision-making, technical execution, cover, support, game performance, and game involvement, Oslin, Mitchell, and Griffin 1998). Consequently, the second hypothesis was that the variables related to adherence (perceived competence, enjoyment, and intention to be physically active) would improve following the implementation of the unit.

Method

Research design

The study followed a mixed-methods quasi-experimental pre-test and post-test design. A TGfU floorball unit was carried out between pre- and post-test. In both assessments, quantitative data from decision-making, technical execution, cover, support, game performance, game involvement, enjoyment, perceived competence, and intention to be

physically active were collected. Qualitative data were evaluated with the pupils and the teacher upon completion of the study to record their perception of the variables we had previously evaluated quantitatively.

Research context

The school, located in Spain, was coeducational, public, urban, bilingual and non-religious. The department of physical education ethos is aligned with the school ethos and promotes inclusive pupil centre pedagogy and the holistic formation of the pupils through different strands (e.g., physical activity and health, games, sport, etc.).

Participants

Two classes consisting of 41 pupils took part in the study with the same teacher (23 boys and 18 girls, $M_{age} \pm$ SD 11.73 ± .66 years; 20-21 from each class, respectively). All pupils took part in all the floorball lessons. The teacher was 40 years old. He had 17 years' experience teaching physical education at the same school using a technique or traditional approach. Before the intervention, the teacher implemented the technique-based approach in the following way: (a) explaining technical execution; (b) showing how to do the technical execution; and (c) expecting pupils to copy the technical execution. Pupils and teacher were selected because they had no prior experience with TGfU or with floorball.

Procedure

Design of the aligned TGfU Unit

We designed the unit in collaboration with the teacher, according to the principles of play, and following the sections proposed by Metzler (2005b). An example regarding the principle of maintaining possession of the ball was the following: (a) in the "game form" section, the pupils would practice the tactical aspect similar to the real game (e.g., 5 vs. 4 in which the

value of the goal is four times higher if the attacker on-the-ball passes to a teammate, then progress to goal, and finally get back the ball for a shot to the goal); (b) in the "teaching for understanding" section, the pupils would reflect on what they had to do and why (e.g., What should I do after passing to a teammate? Should I stand still or should I move? Why?); (c) in the "drills for skill development" section, the pupils would improve their technical execution (e.g., holding the stick with both hands, the dominant hand closer to the ball); (d) in the "return to game form" section, the pupils would perform a task very similar to the initial task (e.g., 5 vs. 5 with individual defence, in which the value of the goal is double if the attacker on-the-ball passes to a teammate, then progress to goal, and finally get back the ball for a shot to the goal); (e) in the "review and closure" section, the pupils would reflect on the integration and understanding of decision-making and technical execution (e.g., What should I do after passing to a teammate? What can I gain if I move? In which direction should I move? How should I hold the stick so that the pass is more accurate? Why?). Instructional alignment of goals, technical and tactical contents and their distribution across the unit, the modifications made, the number of players, feedback, and practice area, was followed (Figure 1). In addition, the intervention followed the fidelity guideline of the models-based practice research in sport pedagogy (Hastie and Casey 2014) and the methodological recommendations of Harvey and Jarrett (2014) and Miller (2015).

Teacher's Instruction in TGfU

TGfU trainers, who have nine years' experience in the approach research and practice, trained the teacher in TGfU two hours per week for nine weeks (a total of 18 hours). The training consisted of five procedures (Morales-Belando and Arias-Estero 2017a). First, we explained the pedagogical features of TGfU. For this purpose, teacher and researchers discussed about: (a) the main game elements (participants, space, time, and equipment), (b) Almond's (1986) game classification (invasion, net-wall, striking and fielding, and target games), and (c) the

teaching strategies of the game for understanding (modified games, feedback, rules, routines, and expectations). Second, we explained the expected teacher behaviours during the intervention. That is, the teacher had to ask questions, pose problems, set exploratory and discovery tasks (tasks in which children choose from and perform a range of movement patterns), help children become independent learners, enable all the children to be successful, develop skilfulness, and foster understanding. Third, we explained the expected pupils' behaviours. That is, pupils had to play an active role, wrestle with problems, propose solutions, explore, answer questions, and carry out ideas. Fourth, together with the teacher, we designed a pilot unit of six 55-minutes lessons in floorball with an alignment among: (a) goals; (b) technical and tactical contents and their distribution across the unit; (c) modifications made; (d) number of players; (e) feedback; and (f) practice area. Fifth, the teacher conducted the pilot unit with a group of 25 pupils at the same class level (not the study participants), and we filmed it. Subsequently, we checked the teacher and pupils' behaviours, comparing them with the expected behaviours, to improve the intervention. Finally, together with the teacher, we analysed the causes of the teacher detected mistakes (i.e., in segment "teaching for understanding" teacher did not give feedback related to the previous tasks segment). In order to address the teacher misunderstandings, he had a list of questions and answers to be followed. In addition, the teacher had to design the lessons with the researchers support.

The Aligned Intervention Unit

The teacher conducted a floorball unit. Floorball is an indoor invasion game where participants hold a stick, are in two teams of five players plus a goalkeeper. The aim of the game is to score the ball in the opposite goal. The players can not touch the ball with any part of the body. The unit had eight lessons, of which two were pre-test and post-test assessment. The initial unit plan did not change during the intervention. The intervention lasted four weeks. Each week, there were two 55-minutes lessons. Each lesson was contextualized in one

189 principle of play, which made it possible to establish the lesson goal (Bayer 1986). Based on
190 the lesson goals, the pupils performed on a tactical content and the related technical content.
191 For example, in lesson 2, the principle of play was maintaining possession of the ball.
192 According to this, the pupils had to understand why and for what purpose maintaining
193 possession of the ball (tactical content) is important. Then, they had to learn how to execute
194 the technique to pass the ball as the key technique for maintaining possession (technical
195 content). Consequently, we designed the game forms, with the number of pupils, the practice
196 area, and the changes made to achieve the objective of each lesson (Figure 1). In this
197 intervention, the pupils practiced in heterogeneous groups (by gender and skill ability). In
198 addition, the teacher adapted the complexity of the questions in the segments "teaching for
199 understanding" and "review and closure" according to the pupils' level of understanding.

200 *Verifying the Treatment*

201 First, four TGfU experts were asked to determine whether the unit was designed in accordance
202 with TGfU core features: (a) the learners played an active role; (b) struggled with problems;
203 and (c) explored and proposed solutions. The TGfU experts were authors of renowned prestige
204 with a publication record on TGfU in an international context. The experts rated the
205 quantitative (on a scale from 1 to 5) and qualitative adequacy of the unit to the TGfU core
206 features. We scored the experts' quantitative values to verify that (a) each TGfU feature was
207 allocated a mean minimum rating of three; and (b) at least three of the four experts rated each
208 TGfU feature as three or higher. In addition, we read and contrasted the experts' suggestions
209 about the TGfU core features. The four experts rated all the features as higher than three.
210 Second, we designed an ad hoc checklist based on Butler's (2014) TGfU benchmarks and we
211 asked two independent and blinded observers to identify whether the critical premises of the
212 approach were present in the lessons. The observers were holding a Ph.D. related to physical
213 education and sport and were authors of renowned prestige of more than eight years at an

international level in the implementation and research of TGfU. They observed the recordings of all the lessons and we calculated the percentage of TGfU benchmarks achieved by the teacher in each lesson according to the two external evaluators. The observers reported that the teacher implemented the intervention following 90% of the TGfU approach premises in each lesson. Third, we followed the fidelity guideline suggested by Hastie and Casey (2014) because it is showed: (a) treatment verification; (b) teacher's experience with the model; (c) students' previous experience, number of pupils, and sex; and (d) length and content of the lessons, total number of lessons, and the weekly nature of the lessons.

Data Collection

Performance

Each pupil was recorded for 10 minutes both in pre-test and post-test lessons, playing a game of 5 vs.5 on a 28x15 m practice area. We used the Game Performance Assessment Instrument (GPAI; Oslin et al. 1998). Assessment means that each observer classified each child's game action as appropriate or inappropriate, as a function of our definitions of what was appropriate for each component (Figure 2). GPAI was selected because it was designed to assess the attacker on-the-ball, attacker off-the-ball, and defence according to seven game components (decision-making, technical execution, adjust, cover, support, guard, and base), using quantifiable indexes. The observers added the number of appropriate and inappropriate decision-making, technical execution, cover, and support. Each observer watched 21 pupils. The observers were physical education teachers with three years' experience implementing TGfU units. Observation was systematic because the observers assessed all the pupils' actions in which any of the game components occurred. The observers watched the video focused on one pupil, rewind and then code. The same procedure was followed with each pupil. Before each observation it was compulsory at least half an hour of rest. Each day each observer could

not observe more than three hours of continue work to avoid the fatigue effect and improve the observers' reliability.

We obtained the decision-making index (DMI), technical execution index (TEI), cover index (CI), and support index (SI) through the following formula: number of appropriate actions / number of inappropriate actions. We obtained the game performance from the formula: [DMI + TEI + CI + SI] / 4. We obtained game involvement as the sum of the appropriate and inappropriate decision-making, technical execution, cover, and support (Metzler 2005b). To collect the data from the filming, we trained the two observers for 20 hours in the analysis and viewing of videos. We obtained the observation reliability from the same five pupils (12.20% of the pupils) observed by both observers. Using the intraclass correlation coefficient, reliability reached values between .80 and .99; using the Kappa index, between .79 and .97; and using the percentage of agreement, between 86.5% and 97.3%.

Enjoyment and Perceived Competence

Pupils completed the enjoyment and perceived competence scale (Arias-Estero, Alonso, and Yuste 2013) adapted from the physical activity enjoyment scale (Kendzierirski and DeCarlo 1991). This instrument had seven items referring to enjoying this game (Cronbach's $\alpha = .97$): (a) I enjoyed practicing floorball very much; (b) practicing floorball was fun; and (c) I would describe this sport as very interesting; and feeling or considering oneself to be good at practicing floorball (Cronbach's $\alpha = .96$): (a) after practicing floorball, I felt pretty competent; (b) I think I am pretty good practicing floorball; (c) I am satisfied with my performance in floorball; and (d) I am pretty skilled practicing floorball. Agreement with the items was rated on a 5-point Likert-type scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The pupils responded for five minutes.

Intention to be Physically Active

Pupils completed the intentionality of being physically active scale (Arias-Estero, Castejón, and Yuste 2013) adapted from the original version (Hein, Müür, and Koka 2004). This instrument had five items referring to the intention to continue performing floorball in the future (Cronbach's $\alpha = .96$): (a) I am interested in developing my physical fitness by practicing floorball to feel good; (b) outside of the lessons, I like to practice floorball; (c) after I finish the present unit, I would like to take part in floorball club training; (d) after I finish the present unit, I would like to be physically active practicing floorball; and (e) I often practice floorball in my free time. Agreement with the items was rated on a 5-point Likert-type scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The pupils responded for five minutes.

The pupils completed the two above questionnaires individually and anonymously at the pre-test and post-test assessments. The principal investigator explained that they were not tests, and that the pupils should complete them in the teacher's absence, but in the presence of the principal investigator.

Pupils and Teacher's Perception

We designed two ad hoc semistructured interviews at the end of the post-test assessment, one targeting the pupils in groups of five and the other targeting the teacher. The broad categories were decision-making, technical execution, cover, support, game performance, game involvement, enjoyment, perceived competence, and intention to be physically active (Figure 3). Ten pupils randomly selected from each class participated in two focus groups. These interviews were designed to corroborate the information obtained from the variables at the post-test assessment. The principal researcher asked questions and digital audio recorded the interviewees' perception and the reason for it. Although all interviews addressed the same variables, the focus of questions and the language differed depending on the interviewee. The duration of the pupils' interview was 40 minutes, and of the teacher's interview, 20 minutes.

Data Analysis

Statistical analysis of the quantitative data (decision-making, technical execution, cover, support, game performance, game involvement, enjoyment, perceived competence, and intention to be physically active) was conducted using SPSS v. 22.0 for Windows (SPSS, Inc., Chicago, IL). We determined the normality of the data through the Kolmogorov-Smirnov test, finding that the data were parametric. We used *t*-tests for related samples to assess possible pre-test and post-test differences in each variable. Statistical significance was set at $p < .05$. Effect sizes (*ES*) for significant differences between the pre-test and post-test of each variable were also determined.

Qualitative data were analyzed with an open and axial coding based on the pre-existing targeted categories (decision-making, technical execution, cover, support, game performance, game involvement enjoyment, perceived competence, and intention to be physically active) in two phases. First, the two main researchers coded the data line-by-line and incident-to-incident in a descriptive manner considering the pre-existing categories. In addition, they both were engaged in a reflective dialogue with an independent researcher looking for accuracy and reliability (Braun and Clarke 2006). After that, the three researchers completed a second analysis were the most representative codes were selected and linked with the pre-existing categories.

Ethical consideration

Pupils' parents and the teacher completed informed consent forms (giving right to withdraw and confidentiality), and pupils and the teacher provided their assent. The authors University's Research Ethics Committee approved the study and it was performed according to the Helsinki Declaration.

Results

The results showed statistically significant post-test improvement in all the variables (Table 1), that is, the pupils increased the number of appropriate game actions. In addition, statistically significant differences were ratified by the high *ES*: decision-making = 2.04, technical execution = 1.29, cover = 1.68, support = 1.54, GP = 2.71, GI = 1.07, enjoyment = .05, perceived competence = .77, and intention to be physically active = .86. However, the improvements were higher in GP and decision-making, and lower in enjoyment, perceived competence, and intention to be physically active. Furthermore, the perception of the pupils and the teacher ratified the quantitative results because the pupils and the teacher perceived improvement in all the variables analysed (see comments in Figure 4). Generally speaking, they linked the improvement as a consequence of the TGfU intervention. In other words, according to the qualitative data (Figure 4), there was strong evidence that the pupils improved in all the dependent variables, mainly, due to: (a) the enactment of an aligned TGfU unit; (b) the mentoring process before, during, and after the intervention; (c) the inclusion of cover and support contents in the unit; and (d) the implementation of two reflective lesson segments. The high practical difference between pre-test and post-test, together with the participants' perceptions in the interview, support the use of TGfU in physical education context.

Discussion

The objective of the present study was to verify whether pupils improved in variables related to performance and adherence after the enactment of an aligned TGfU unit. The hypothesis was that the pupils would improve in the components that determine game performance (decision-making, technical execution, cover, support, game performance, and game involvement). Consequently, the second hypothesis was that the variables related to adherence (perceived competence, enjoyment, and intention to be physically active) would improve

following the implementation of the unit. The two hypotheses were confirmed, as all the variables analysed improved to a great extent at post-test. Main findings from this study were consistent with those of previous studies because the pupils also improved in: (a) decision-making (Morales-Belando and Arias-Estero 2017b, c – $p < .05$; Robinson and Foran 2011 – $p = .001$; Turner and Martinek 1999 – $p = .001$); (b) technical execution (Harvey et al. 2010 – $p = .013$; Morales-Belando and Arias-Estero 2017b, c – $p < .01$; Robinson and Foran 2011 – $p = .006$; Yang and Lu 2013 – $p = .000$); (c) cover (Harvey et al. 2010 – $p = .003$; Yang and Lu 2013 – $p = .003$); (d) support (Yang and Lu 2013 – $p = .001$); (e) game involvement (Harvey et al. 2010 – $p = .044$; Morales-Belando and Arias-Estero 2017c – $p = .02$); (f) enjoyment (Jones et al. 2010 – $p = .001$); and (g) perceived competence (Jones et al. 2010 – $p = .05$). These results obtained were expected because TGfU was designed to promote improvement in performance and adherence variables (Bunker and Thorpe 1982; Harvey and Jarrett 2014). In contrast, they differed largely in GI and enjoyment due to the instrument employed and the type of design (Harvey et al. 2009 – $p < .05$). Nevertheless, this was the first study that assessed variables related to performance and adherence in the school setting, finding large improvement in all of them in comparison to previous studies.

As suggested by the pupils and the teacher, decision-making improved because the tasks designed in "game form" and "return to game form" based on the principles of exaggeration and representation allowed more space for the attackers and limited certain actions of the defenders. One pupil said "we had to take advantage of the game restrictions of the defenders; the practice area was big and we could move about without the opponents defending us. In line with that, the teacher commented "the strategy of increasing the practice area space and limiting the game actions of the defending team has helped a lot in the attacking". As a result, the attackers had more time and less spatial constraints and could make more appropriate decisions (Metzler 2005a). In other words, the environment was made easier

for players allowing them the time and space to think and execute their decision using their technique. That is, having opportunities for decision making developed their decision-making ability. Invasion games have a high tactical demand, because the players must know what to do in every game situation, mainly due to the number of teammates, opponents and, especially, to the common practice area. Allowing more game space so the attackers do not feel pressured by the defenders while limiting the defenders' actions seem to be suitable strategies for the design of game forms that can favour the improvement of decision-making. This is because decision-making improves when reducing the temporal requirements that constrain players' decisions. In addition, reflection on the lesson segments "teaching for understanding" and "review and closure" could help pupils to understand and integrate what happened in the game. The complexity for the teacher lies in knowing the game dynamics based on the principles of play and in designing game forms adapted to the pupils' characteristics, expanding the possibilities of modification by adaptation where game structures adapt to the success of the players, accommodating a wider range of ability (Hopper 2011).

According to the teacher, the pupils improved technical execution due to the "drills for skill development" task and the meaning that technique acquires when contextualized in the game ("after the reflections on the first lesson segment, lesson segments number three of each lesson were very important because I could give the pupils guidelines about the technique that made sense from what we had reflected on previously, what we did in the game, and we had reflected on at the end of the lesson"). This is important as students practiced in a game-like context allowing for the best opportunity for their skills to transfer. The improvement obtained in the present study could be a result of the fact that the approach allows technical execution to acquire meaning in the various game forms. In the unit designed for this study, we stressed that the teacher should realize that the pupils must understand why they should perform

technical execution in the segment "review and closure", as admitted by the teacher "I think that, through questions, the pupils understood why to do the technical execution, as you taught me". As suggested by Yang and Lu (2013), the improvement of technical execution could be due to the fact that the pupils consciously applied technical execution in the game. To achieve this, in the present study, the lessons integrated technical execution, first from a more directed approach ("drills for skill development"); second, in a game form very similar to the real game in which the pupils performed autonomously ("return to game form"); and third, from the relationship established in the final reflection on the decision-making component ("review and closure").

The improvement found in cover could be due to the fact that TGfU considers that practice should be contextualized in the game to be learnt so that the pupils will act with awareness (Butler 2014). Having to defend in order to recover the ball forces them to make decisions and acquire experiences when they play the role of defence (Mitchell 2005). Nevertheless, defence usually does not receive much attention when teachers and coaches teaching invasion games. Unlike the technique-based approach, with TGfU, teachers can comprehensively integrate the attack and defence in the game. The inclusion of attack and defence in the unit might be another relevant reason for such positive results. One pupil highlighted "It was what we had to do when we didn't have the ball; we coordinate ourselves to recover the ball and win." Along the same lines, the teacher mentioned "I found worthwhile that the pupils improved defence and their space distribution so that no attacker was without a defender even when the defending teammate was taken on; improvement were made because, in the game forms we played, we performed on contents focused on defence; they know how to differentiate between an attacking or defending situation". It is the teachers' responsibility to propose learning tasks of both game phases in their interventions so that the pupils' training will be much more comprehensive in relation to game dynamics.

With regard to support, the teacher comments were consistent with the pupils ones in that they improved in occupying free practice areas and getting away from the defence ("I had to get away from the defender to receive the ball; and the teacher: "I noted that with TGfU, they improved actions such as knowing how to occupy space, which is vital for invasion games; pupils now seek to go to the free space to receive a pass and get away"). From the quantitative and qualitative results, the real demand of the game in attack, the adaptations of the game forms, and the pupils' reflection during "teaching for understanding" and "review and closure" (especially in lessons two and six) might cause the attacker on-the-ball to decide to rely on teammates, and the teammates to be adequately placed to receive the ball (Mitchell 2005). A key aspect for the attackers off-the-ball was to realize that their practice was extremely important to generate imbalances in the defence. For this purpose, through feedback, the teacher made the pupils understand that, after passing the ball, they could not stand still. As indicated by the teacher, the "pupils did not stand still when they did not have the ball", but instead, after passing the ball, they moved to a new position to receive it. This is a tactic to generate imbalance in the defence, applied when the pupils understand the game dynamics (Rovegno, Nevett, Brock, and Babiarz 2001). However, only Yang and Lu (2013) analyzed support. Hence, other TGfU studies are ignoring the assessment of the players off-the-ball. The analysis of the players' off-the-ball behaviour is extremely important in TGfU because the players spend most of their time in that role (Rovegno et al. 2001). For this purpose, it is also necessary for teachers using the TGfU instead of the traditional technique-based approach (Gutiérrez, Fisette, García-López, and Contreras 2014; Oslin et al. 1998).

The positive result in game performance was due to pupils' improvement in decision-making, technical execution, cover, and support (Oslin et al. 1998). The results of this study showed that the TGfU intervention was effective, and this could be due firstly, to the fact that different aspects of the unit (Figure 1) were designed based on the tactical objectives present

in the game and secondly, to the training in which the teacher was involved to understand the game and the principles of play, as the teacher recognised ("I believe that the instructional alignment was key for the students' achievement"). These are not irrelevant issues in the design and implementation of interventions with TGfU. That is, the contents covered in the present intervention required performing in very specific tactical situations that occur normally in the game because they were contextualized in a principle of play, as required by TGfU (Gutiérrez et al. 2014; Mitchell, Oslin, and Griffin 2013). For example, in the first lesson, what mattered was to learn to maintain possession of the ball and, for this purpose, the pupils also had to learn to pass and receive. That is, they practiced technical execution contextualized in the game to solve the tactical problem. With regard to the conceptual, political, pedagogical, and cultural dilemmas presented by Harvey, Cushion, and Sammon (2015), we should encourage teachers to truly change the way they teach games. This requires training them so that they will be aware of the reality of each category of game, understanding the game and the principles of play (Harvey and Pill 2016; Memmert et al. 2015). The change in teachers' education would enable them to plan teaching games so that the pupils would really transfer tactical knowledge among those games, as proposed by Bunker and Thorpe (1982) when devising TGfU.

Improvement in game involvement was expected because it was one of the main reasons for the emergence of TGfU (Bunker and Thorpe 1982). This could be due to the fact that, according to Holt et al. (2002), in TGfU, pupils are the centre of the learning and as a result, their participation increases, regardless of their level of game performance (Harvey et al. 2009). As expressed by the pupils in this study, the game forms designed demanded their involvement because they were fun ("I found it interesting and we had lots of fun"), and besides, it was imperative in order to participate ("my teammates passed me the ball much more than in other units; we could not get sidetracked even for a minute because we were

458 always playing"). Another reason for the improvement in game involvement may be the
459 autonomy afforded by TGfU to the pupils in the different lesson segments, as they stated in the
460 interview ("the floorball classes were a lot fun because I had to play, not like other previous
461 physical education when we didn't play a lot; the challenges of the tasks were difficult, but we
462 achieved them"). Finally, above all, the teacher stressed the changes introduced with regard to
463 the decrease of the number of players in each game form ("I think that they became more
464 engaged because we reduced the number of pupils"). Using TGfU, teachers should reflect on
465 the game forms they propose to enable game involvement for all pupils. Changing the number
466 of players on the teams may be a strategy that helps to increase game involvement. In the
467 present study, the pupils played in groups of between two and five players and the playing area
468 was adapted either for attack or defence purposes (larger when attacking and smaller when
469 defending, see Figure 1).

470 The pupils' greater game involvement, along with the improvement in all the game
471 components assessed, could be the reason for their increased enjoyment and perceived
472 competence, as reported by the pupils and the teacher ("I didn't know to play before and now I
473 know; I feel good because I have learned how to move in the practice area; I have seen that I
474 am a better player; "I feel good because I used to fail a lot."; and the teacher: "I think that my
475 pupils feel more competent in floorball because they have seen a remarkable improvement
476 from the beginning to the end of the intervention"). The increase of participation and
477 involvement in game forms generated more motivation towards sports practice (Mandigo and
478 Holt 2000). Chen and Darst (2002) claimed that improvement in skills and interest in a sport
479 influenced participants' enjoyment and perceived competence, as in the present study. In
480 general, this is a result of the fact that the pupils had to play game forms, and the game is
481 motivating. This improvement is justified because TGfU is a suitable approach for the
482 development of social skills, enjoyment, and perceived competence (Mandigo and Holt 2000;

Randall 2008). Therefore, it seems that the tasks designed in our study were suitable for the pupils' level, as expressed by the teacher ("we (the research team and me) worked hard to adapt the game forms to the students"). Thus, as suggested by Hopper (2011) it is essential to adapt the objectives and constraints of games to the pupils' level when designing a unit using TGfU so that the tasks are achievable challenges but not too easy or too complex.

The positive attitudes developed during the intervention with TGfU, reported both by the pupils and the teacher ("I'd like to keep practicing because I had a lot of fun; we are going to ask for the material to practice floorball in recess; I'm going to continue playing floorball with my teammates because, in this game, the boys are not always the best."; and the teacher: "the pupils are more interested in floorball; they are eager to keep practicing it at recess or as extracurricular activity; this is because they had fun"), influenced them by increasing their interest in continuing to practice in the future. According to the theory of planned behaviour, people with a positive attitude towards participating in physical activities tend to be more physically active (McEachan, Conner, Taylor, and Lawton 2011). Considering that one of the main goal of the educational curriculum in physical education is to get pupils to acquire habits of physical activity outside of school hours, with TGfU, the teachers are provided with a teaching approach of game play that could allow this (Kirk and Haerens 2014). However, this statement is only based on the results obtained in the present study and in Yang and Lu (2013). New studies are necessary that consider this variable and ratify the results, in view of its significance.

In summary, this study stands out because it was contextualized in the principles of play (Figure 1), as Harvey et al. (2009) suggested, and because it followed the methodological recommendations and fidelity guideline for models-based practice research in sport pedagogy (Harvey and Jarrett 2014; Hastie and Casey 2014; Miller 2015). Another novel aspect is that it was the first intervention within the school setting in floorball that included directions for the

attacker off-the-ball and the defender, evaluated from the cover and support components. In addition, it explored the psychological variables and the perception of pupils and teacher.

Conclusion

After the implementation of the aligned TGfU floorball unit designed following the guideline on fidelity for model-based research, pupils improved in the variables related to performance and adherence. To achieve this, 41 pupils (11-12 years old) and a teacher participated in a pre-test and post-test research design using a mixed-method approach. Data were collected using the GPAI, two psychological scales, and two focus groups interviews with the pupils and the teacher. Quantitative results showed improvements in DM, TE, C, S, GP, GI, enjoyment, perceived competence, and intention to be physically active. Based on participants' key comments, four aspects appeared to be essential for the success of the unit: (a) the lesson design; (b) collaboration from planning to teaching the unit between the researcher and the teacher; (c) the inclusion of learning tasks linked with cover and support; and (d) the use of two reflective periods that helped pupils to understand and applied new knowledge. From a practical viewpoint, teachers could find information in this study about how to implement the TGfU approach in floorball with regard to the lesson goals, tactical, and technical common contents for invasion games, as well as their distribution in each lesson, number of players, feedback, practice area, and modifications introduced in the game forms (Figure 1). Further studies are necessary to explore in depth issues related to the duration of interventions and lessons, content development, appropriateness of content for the different age groups, type of game, feedback, and assessment. This new knowledge could help teachers to learn how to implement TGfU and decide to use it in their classes. In addition, future studies should confirm the results of the present study with a control group and with other games.

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652

653 Table 1. Means, standard deviations, and significant differences of the variables at the pre-test
654 and post-test assessments.

Variable	Pre-test		Post-test		*t*	*p*
	M	*SD*	*M*	*SD*		
Decision-making	1.54	1.40	7.90	5.81	6.84	.000
Technical execution	1.84	2.36	6.56	6.08	4.78	.000
Cover	1.05	.83	5.62	5.45	5.26	.000
Support	1.56	1.41	6.12	4.43	6.53	.000
Game performance	1.50	.82	6.54	3.47	8.96	.000
Game involvement	49.02	18.74	59.32	20.51	3.52	.001
Enjoyment	4.20	.58	4.65	.42	5.02	.000
Perceived competence	3.37	.99	3.96	.77	4.38	.000
Intention to be physically active	3.95	.72	4.41	.52	3.44	.001

655

656 Figure 1. Features of the TGfU unit.

Lesson & tactical principle (goal)	Tactical content	Technical content	Practice area (m)	Game form	Feedback	Game modification
1. Pre-test	-	-	28x15	5vs.5	-	-
2. Maintaining possession of the ball	Give priority to pass over driving. Game actions to perform after passing to unbalance the defence.	Technique to pass and receive.	28x15	5vs.4	Do you think it was better to run with the ball or to pass it? Why? What did you do after passing the ball? How can you support your teammate on-the-ball?	- Greater number of attackers. - Obligatory individual defence. - Defence cannot intercept passes.
3. Winning the ball	Distribution in the practice area to defend the passer and receiver. Change of defence-attack roles.	Technique to defend the passer and receiver.	23x10	4vs.5	What did you do to make it more difficult for the opponent to pass and receive? What place of the practice area was the most appropriate for it?	- Greater number of defenders. - Obligatory individual defence and defensive help from the attacker on-the-ball. - Forbidden to pass to the nearest player or to the one who just made the pass.
4. Shooting on goal	Give priority to shooting over passing and driving. Distribution in the practice area to favour the shot on goal.	Technique for shooting on goal.	20x11	3vs.2	Once you get the ball, what is the first game action to do? Which zone of the practice area made shooting on goal easier? Why?	- Greater number of attackers. - Obligatory individual defence for attacker on-the-ball. - Forbidden to defend the attacker on-the-ball on the centre.
5. Defending the goal	Distribution in the practice area to defend the shot on goal. Change of defence-attack roles.	Technique to defend the shot on goal.	20x11	3vs.3	How did you prevent the attacker from shooting? What game actions did you take into account for this?	- Obligatory individual defence. - Forbidden to pass to the player who just made the pass.
6. Attacking the goal	Distribution in the practice area to receive a pass that allows attacking the goal. Ways to get away from the defence.	Technique of holding and carrying the stick on movement to pass and receive.	25x14	4vs.3	What should you do when your teammate has the ball? Where in the practice area it is better? How can you get away from your defender?	- Greater number of attackers. - Obligatory individual defence. - Defence cannot intercept passes towards their goal.
7. Challenging the opponents' progression	Distribution in the practice area to defend from attacking the goal.	Technique to defend the opponents' progression.	20x9	3vs.4	How can you challenge the opponents' progression? How can you recover the ball?	- Greater number of defenders. - Obligatory individual defence and defensive help from the attacker on-the-ball.
8. Post-test	-	-	28x15	5vs.5	-	-

Figure 2. Criteria used to assess the decision-making, technical execution, cover, and support on the GPAI. Decision-making was appropriate when it met at least one of the criteria. In the rest of the game components, it was necessary to meet all the criteria in order to be considered appropriate/efficient.

Game component and game action		Criteria	
		Appropriate (decision-making, cover, support) or efficient (technical execution)	Inappropriate (decision-making, cover, support) or inefficient (technical execution)
Decision-Making	Pass	Finding a pass option. Allowing an advantage in the game (numerical superiority, proximity to the goal). Preventing them from getting the ball away.	Not seeking a pass option. Not passing to a teammate when this would give an advantage in the game (numerical superiority, proximity to the goal). Not passing in the presence of an opponent and having free teammates.
	Shoot	Shooting on the attacking area if the player is not defended (at least 1 m).	Shooting despite having an opponent nearby (less than 1 m away) or in the defending area.
	Drive	Scoring a goal without the presence of opponents. Attacking the goal without the presence of opponents. Taking on (beat) a defender. Getting a good passing and shooting position.	Not scoring a goal without presence of opponents. Not taking on (beating) a nearby opponent (less than 1 m). Not progressing towards the opposing goal with a defender nearby.
Technical execution	Pass and shoot	Holding the stick with both hands (the dominant hand closest to the ball). Moving the body in line with the ball. Shooting the ball with power and precision so it reaches the teammate or scores a goal. Not raising the stick above the knee.	Not holding the stick with both hands (the dominant hand closest to the ball). Not moving the body in line with the ball. Not shooting the ball with power and precision so that it reaches the partner or scores a goal. Raising the stick above the knee.
	Drive	Holding the stick with one or both hands. Not looking at the ball while driving. Not raising the stick above the knee.	Looking at the ball while driving. Raising the stick above the knee.
Cover	Player on-the-ball	Placing oneself between the goal and the opponent. Being close to the opponent when shooting and at a distance of 1 m when passing and driving.	Not placing self between the goal and the opponent. Not next to the opponent when shooting and at a distance greater or less than 1 m when passing and driving.
	Player off-the-ball	If on the side of the ball: trying to intercept the pass. If not on the side of the ball: not being close to the attacker, and attending to the opponent with the ball for possible defensive support.	If on the side of the ball: not trying to intercept the pass. If not on the side of the ball: not close to the attacker, and attending to the opponent with the ball for possible defensive support.
Support		Occupying a free space and getting into an open passing line. Generating free spaces by different actions either involving other teammates or not (moving).	Not occupying free space. Not generating support for the attacker on-the-ball through different actions either involving other teammates or not (being still).

662 Figure 3. Categories of interview questions.

Decision-making	Pupils: "Did you do something different in those units? What? Did it help you to make your own decisions? Can you describe why?" Teacher: "Do you consider they improved in decision making? Why?"
Technical execution	Pupils: "Did you note an improvement in anything related to technical execution after the unit?" Could you describe what?" Teacher: "What is your opinion in terms of the introduction of technical execution in the unit?"
Cover	Pupils: "Did you do anything to recover the possession of the ball? (if so) Could you describe what?" Teacher: "Do you think the pupils improved in defence? Why?"
Support	Pupils: "Did you do anything to help your teammate to pass you the ball? Could you describe what?" Teacher: "Do you think they gave support to their teammates? Could you explain why?"
Game performance	Pupils: "Did you learn anything after the unit? Could you explain what?" Teacher: "Did you notice an improvement in general performance of the students along the unit? Could you explain why?"
Game involvement	Pupils: "Tell me about your participation in the lesson?" Teacher: "Do you think the pupils increased their involvement in lessons and real game? Could you explain why?"
Enjoyment	Pupils: "Did you enjoy in these lessons? Could you explain why?" Teacher: "Do you think they enjoyed in these lessons? Could you explain why?"
Perceived competence	Pupils: "Are you a better player now? Could you explain why?" Teacher: "Do you think they were more competent practicing floorball? Could you explain why?"
Intention to be physically active	Pupils: "Would you like to continue practicing floorball now that we have finished the unit? Any reason?" Teacher: "Do you think they would like to continue practicing floorball outside of the lessons? Could you explain why?"

663

Figure 4. Example of pupils' and teacher's responses on each variable in the interviews.

Decision-making	Pupils: (1) "Now I stop, look, and think whether it is better to shoot or to whom I can pass." (2) "We had to take advantage of the game restrictions of the defenders." (3) "The practice area was big and we could move about without the opponents defending us." Teacher: (4) "They have perfectly integrated the order of priorities in terms of what decisions to make." (5) "The strategy of increasing the practice area space and limiting the game actions of the defending team has helped a lot in the attacking." (6) "I wasn't expecting them to understand through questioning why to do some game actions."
Technical execution	Pupils: (7) "Now I hit with the stick better, I understand with which part to hit depending on where the pass should go." (8) "I know how to hold the stick and how to carry it when I run, receive, and pass the ball." (9) "We know how to do the technique because we discovered it with the questions from the teacher." Teacher: (10) "After the reflections on the first lesson segment, lesson segments number three of each lesson were very important because I could give the pupils guidelines about the technique that made sense from what we had reflected on previously, what we did in the game, and we had reflected on at the end of the lesson." (11) "I think that, through questions, the pupils understood why to do the technical execution, as you taught me."
Cover	Pupils: (12) "I think that I have defended better because I know how to place myself to steal the ball and challenge the opponents' progression." (13) "Even if we didn't win the competition, the other team scored fewer goals and we recovered the ball more often." (14) "It was what we had to do when we didn't have the ball." (15) "We coordinate ourselves to recover the ball and win." (16) "There were always learning tasks with defenders." Teacher: (17) "I found worthwhile that the pupils improved defence and their space distribution so that no attacker was without a defender even when the defending teammate was taken on." (18) "Improvements were made because, in the game forms we played, we performed on contents focused on defence." (19) "In the feedback segments, we also reflected on cover." (20) "They know how to differentiate between an attacking or defending situation."
Support	Pupils: (21) "I had to get away from the defender to receive the ball." (22) "When my team has the ball, the rest of the teammates should distribute themselves in the practice area to receive it and reach the goal faster." Teacher: (23) "I note that with TGfU, they improved actions such as knowing how to occupy space, which is vital for invasion games." (24) "Pupils now seek to go to the free space to receive a pass and get away." (25) "They did not stand still when they did not have the ball."
Game performance	Pupils: (26) "It was like in a game of floorball and the teacher asked us questions so we learned." (27) "I participated in all classes and I learned a lot about floorball." (28) "Now I know what to do and how to do it without the teacher telling me anything." Teacher: (29) "90% of the group did very well." (30) "I noticed an improvement in general skills throughout the unit." (31) "I believe that the instructional alignment was key for the students' achievement."
Game involvement	Pupils: (32) "My teammates passed me the ball much more than in other units." (33) "We could not get sidetracked even for a minute because we were always playing." Teacher: (34) "It was quite surprising that the pupils were very engaged and had an active participation. Even those pupils who are traditionally less involved are now active pupils." (35) "I think that they became more engaged because we reduced the number of pupils."
Enjoyment	Pupils: (36) "I found it interesting and we had lots of fun." (37) "The floorball classes were a lot fun because I had to play, not like other previous physical education when we didn't play a lot." (38) "The challenges of the tasks were difficult, but we achieved them." Teacher: (39) "I've seen that they had a good time during classes because they were always playing and were involved." (40) "They have welcomed this way of performing." (41) "They were willing to go out and play."
Perceived competence	Pupils: (42) "I didn't know to play before and now I know." (43) "I feel good because I have learned how to move in the practice area." (44) "I have seen that I am a better player." (45) "I feel good because I used to fail a lot." Teacher: (46) "I think that my pupils feel more competent in floorball because they have seen a remarkable improvement from the beginning to the end of the intervention." (47) "We (the research team and me) worked hard to adapt the game forms to the students."
Intention to be physically active	Pupils: (48) "I'd like to keep practicing because I had a lot of fun." (49) "We are going to ask for the material to practice floorball in recess." (50) "I'm going to continue playing floorball with my teammates because, in this game, the boys are not always the best." Teacher: (51) "The pupils are more interested in floorball." (52) "They are eager to keep practicing it at recess or as extracurricular activity." (53) "This is because they had fun."