ANALYSIS OF THE INTERACTIVITY IN A TEACHING AND LEARNING SEQUENCE WITH NOVICE RUGBY PLAYERS: THE TRANSFER OF LEARNING RESPONSIBILITY AND CONTROL

Bernat Llobet Martí

Universitat de Girona

DOCTORAL THESIS

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Dr. VÍCTOR LÓPEZ ROS and Dr. JOSE IGNACIO VILA MENDIBURU, of the Universitat de Girona,

WE DECLARE:

That the thesis ANALYSIS OF THE INTERACTIVITY IN A TEACHING AND LEARNING SEQUENCE WITH NOVICE RUGBY PLAYERS: THE TRANSFER OF LEARNING RESPONSIBILITY AND CONTROL, presented by Bernat Llobet Martí to obtain a doctoral degree, has been completed under our supervision and meets the requirements to opt for an International Doctorate.

For all intents and purposes, we hereby sign this document.

Signatures:

Dr. Víctor López Ros   Dr. Jose Ignacio Vila Mendiburu

Bernat Llobet Martí

A la memòria de l'Albert Pascual, per sempre el meu capità.

Als meus pares, Rafel i Maria Lluïsa.

Le niveau de la décision tactique reste toujours le niveau premier, la source de tout, d'où certaines conséquences dans la façon de travailler tant en initiation qu'en perfectionnement.

[...]

Dans ce fondement de toute l'action de jeu, que constitue la succession des décisions d'action au cours d'une situation qui évolue, et qui évolue précisément à partir des décisions successives, et en réponse les unes aux autres, que prennent les antagonistes à tour de rôle, ce qui est le plus caractéristique dans la situation de jeu, comme dans « l'environnement » (à la fois physique et humain) correspondant pour le joueur, c'est la transformation des situations momentanées l'une dans l'autre, le fait qu'elle s'engendrent l'une l'autre.

René Deleplace (1979: 11-12)

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ABSTRACT

The aim of the thesis is to analyse and describe the mechanism of cession and transfer of learning control and responsibility from coach to novice players in a 12-session unit of rugby union. To achieve this aim, firstly we designed and validated an assessment instrument specific to rugby, to assess tactical behaviours of players in accordance with the objectives of the learning sequence. We also applied this instrument at the beginning of the process, during and at the end of it, reporting the learning outcomes in macro- and micro-levels of analysis. To study the learning transfer responsibility, we apply the interactivity analysis model, taking data from the transcription of videoed sessions and audio recorded.

The theoretical perspective of the thesis is consistent with the postulates of social constructivism (Vygotsky, 1978). Learning is understood as a process of self-construction of knowledge in a specific sociocultural context, and we focus our research on this process. It happens in the zone of proximal development (ZPD) with the support of a more expert person who scaffolds learners during the process. Scaffolding of learners is based on a contingent help and a progressive fading in order to transfer learning control and responsibility to learners. The coach, the learners and the content form an interactivity triangle with bidirectional relationships among them. This mechanism of learning transfer happening in the ZPD and subsequent links with the scaffolding delivered by the coach are the main foci of the thesis.

This research mainly has a qualitative approach and is a single-case study based on an interpretative and constructivist paradigm carried out in a naturalistic environment. However, we use a quantitative methodology in the first study to validate the assessment instrument used. To report the learning outcomes of the teaching and learning sequence we use both quantitative and qualitative approaches. We test significant measures of the performance scores, and we use descriptive method to perform a deeper analysis of these results. The main study focusing on the mechanism of learning transfer is based on the interactivity analysis model that describes the joint activity by analysing interactivity among participants. The structure of this interactivity is configured by the different ways in which the joint activity is constructed.

Participants of the study are 10 male novice rugby players aged 17-19 with four months of experience, and the coach-researcher, author of the thesis. They were members of a rugby club from a rural area of northeast Catalonia. The teaching and learning unit of rugby involved 12 sessions of 90 minutes each during six weeks. The coaching approach used over the course of the unit was the integrated technique-tactical model (IT-TM). Therefore, this thesis is based on three complementary studies that are described in the three articles of this compilation.

The aim of the first study was to create and validate an assessment instrument specific to rugby that was consistent with the coaching approach used during the learning sequence, the IT-TM. This approach is coherent with the main features of game centred approaches (GCA) since uses game-like situations to teach technique and tactics, among other traits of the model. For this purpose, we created the Rugby Attack Assessment Instrument (RAAI), which provides an index of performance (IP) that measures team's game performance. We performed content and construct validity tests, inter- and intra-observers reliability tests, and test-retest reliability. Results show that RAAI is a valid and reliable assessment instrument, as explained in the first article of this thesis.

The second study focuses on exploring and reporting the learning outcomes of the players after the unit of rugby. We explain the basis of the IT-TM and its application during the teaching and learning process. This coaching model emphasises the balanced teaching of both techniques and tactics worked simultaneously with problem-solving situations involving different degrees of decision-making. We report the use of the RAAI to assess learning progression of participants in a macro- and a micro-level. Macro-level analysis reports changes of the IP during the coaching sequence. Micro-level analysis describes changes of individual specific behaviours obtained with the application of the RAAI and not shown on the IP. Results in a macro-level, taking into account the IP evolution in 4 assessment times, show no significant linear trend. The micro-level analysis of the IP reveals that the frequency of some relevant tactical behaviours increases over the course of the unit. These tactical behaviours are relative to solving situations of superiority (2vs1), and giving continuity to the game, and they are related to the learning objectives of the unit. The second article explains and discusses the results of this study in the context of GCA.

The third study approaches the main purpose of this thesis focusing on the mechanism of learning responsibility and control transfer from the coach to the players. After designing and validating an assessment tool and explaining the learning effects of the coaching model applied, we were able to research the joint activity built among the players and the coach around the content of rugby. We used the segments of interactivity (SI) as the inductive units of analysis that emerge from the analysis of the videoed and audio recorded sessions. We found six SI: SI of Activity Organisation, SI of Guided Practice, SI of Autonomous Practice, SI of Discussion, SI of Recapitulation and SI of Transition. The description of the SI evolution over the course of the unit gave as some clues about the way in which learning transfer occurred. Firstly, there is a slight decreasing of the segmentation. Specifically the number of segments of activity organisation and guided practice decreases by the end of the learning sequence. Secondly, interactivity is mainly built around the guided practice, which is strongly linked with the activity organisation. Thirdly, the discussion involving mainly tactical aspects of the game is progressively transferred from specific segments of discussion to the guided practice where the coach creates short debates about actions occurring during this SI. The study of the learning transfer mechanism is developed in the third article of the thesis.

In conclusion, the main contributions of this thesis are relative to: (a) the design and validation of a new assessment instrument, the RAAI; (b) the application of the RAAI to report learning outcomes using the IT-TM; (c) the study of the interactivity of a rugby coaching sequence in a club context. The compilation of the three articles and the following chapters of this dissertation explain with further detail these contributions.

Key words: evaluation, tactical behaviour, team performance, game centred approaches, rugby union, decision-making, scaffolding, interactivity, social constructivism.

RESUM

L'objectiu de la tesi és analitzar i descriure el mecanisme de cessió i traspàs del control i la responsabilitat de l'aprenentatge de l'entrenador als jugadors novells en una unitat didàctica de 12 sessions de rugbi. Per assolir aquest objectiu, en primer lloc hem dissenyat i validat un instrument d'avaluació específic de rugbi per avaluar els comportaments tàctics dels jugadors d'acord amb els objectius de la unitat didàctica. També hem aplicat aquest instrument a l'inici del procés, durant el mateix, i al final explicant els resultats de l'aprenentatge en relació a dos nivells d'anàlisi: macro i micro. Per explicar la cessió i traspàs de la responsabilitat de l'aprenentatge, hem aplicat el model d'anàlisi de la interactivitat, utilitzant les dades provinents de les transcripcions de les sessions gravades en vídeo i àudio.

La perspectiva teòrica d'aquesta tesi és coherent amb els postulats del socio-constructivisme (Vygotsky, 1978). Entenem l'aprenentatge com un procés d'auto-construcció del coneixement esdevingut en un entorn socio-cultural específic, i focalitzem la nostra recerca en aquest procés. Aquest s'esdevé en la zona de desenvolupament proper (ZDP) amb l'ajuda d'una persona més experta que ajusta l'ajuda proporcionada als aprenents durant el procés. El *scaffolding* proporcionat als aprenents es basa en l'ajuda contingent i la progressiva retirada d'aquesta ajuda per traspassar la responsabilitat de l'aprenentatge de l'entrenador als aprenents. L'entrenador, els jugadors novells i el contingut formen el triangle d'interactivitat que conté relacions bidireccionals entre aquests tres elements. Aquest mecanisme de cessió i traspàs de la responsabilitat de l'aprenentatge, que s'esdevé en la ZDP i té lligams directes amb l'ajust de l'ajuda (*scaffolding*), és el principal centre d'atenció d'aquesta tesi.

Aquesta recerca és principalment qualitativa i és un estudi de cas únic basat en el paradigma interpretatiu i constructivista, i dut a terme en un entorn d'entrenament real. De tota manera, en el primer treball, per validar l'instrument d'avaluació utilitzem metodologia quantitativa. Igualment, en el segon estudi, on expliquem els resultats d'aprenentatge de la unitat didàctica, utilitzem ambdues aproximacions metodològiques. Hem fet proves de significativitat del rendiment dels jugadors, i hem utilitzat mètodes descriptius per explicar determinats resultats de l'aprenentatge amb més profunditat. La

principal recerca relativa al mecanisme de cessió i traspàs de la responsabilitat de l'aprenentatge es basa en el model d'anàlisi de la interactivitat que descriu l'activitat conjunta entre els participants. L'estructura d'aquesta interactivitat està configurada per les diferents maneres amb les quals es construeix i s'organitza l'activitat conjunta.

Els participants d'aquesta recerca són 10 jugadors novells de rugbi d'edats compreses entre els 17 i els 19 anys, els quals tenien quatre mesos d'experiència com a jugadors de rugbi, i l'entrenador-investigador, autor d'aquesta tesi. Tots ells pertanyien a un club de rugbi d'una zona rural del nord-est de Catalunya. La unitat didàctica de rugbi fou de 12 sessions de 90 minuts dutes a terme durant sis setmanes. El model d'entrenament utilitzat durant la seqüència didàctica fou el model integrat tècnic-tàctic (MIT-T). Així doncs, aquesta tesi es basa en tres estudis complementaris descrits en la compilació dels tres articles.

L'objectiu del primer estudi era crear i validar un instrument d'avaluació específic de rugbi coherent amb el model d'ensenyament utilitzat durant la unitat didàctica (MIT-T). Aquest model és consistent amb les principals característiques dels models basats en el joc (GCA), donat que utilitza situacions de joc per ensenyar la tècnica i la tàctica, entre d'altres trets del model. Amb aquest objectiu vàrem crear el *Rugby Attack Assessment Instrument* (RAAI), el qual permet obtenir un índex de rendiment (IP) del joc de l'equip. En aquest estudi expliquem les proves de validesa de contingut i de constructe, així com les proves de fiabilitat inter- i intra-observadors i també la fiabilitat test-retest. Els resultats obtinguts mostren que el RAAI és una eina d'avaluació vàlida i fiable, tal i com hem explicat en el primer article de la tesi.

El segon estudi explora i descriu els resultats d'aprenentatge dels jugadors després de la unitat didàctica de rugbi. Expliquem els principis del MIT-T i la seva aplicació durant el procés d'ensenyament-aprenentatge. Aquest model d'ensenyament propicia el treball simultani i equilibrat de la tècnica i la tàctica utilitzant situacions-problema en les quals els jugadors han de prendre decisions de diversa complexitat. Expliquem l'ús del RAAI per avaluar la progressió de l'aprenentatge dels participants a nivell macro i micro. L'anàlisi a nivell macro explica els canvis en l'IP durant la seqüència d'entrenament. L'anàlisi a nivell micro descriu els canvis de comportaments específics individuals que s'han obtingut amb l'aplicació del RAAI i que no recull l'IP. Els resultats a nivell

macro, que tenen en compte l'evolució de l'IP en els quatre moments de l'avaluació, ens mostren que la tendència lineal dels quatre IPs no és significativa. Amb l'anàlisi a nivell micro, observem que hi ha un augment progressiu de la freqüència de determinats comportaments tàctics dels jugadors al llarg de la unitat didàctica. Aquests comportaments tàctics es refereixen a resoldre situacions simples de superioritat numèrica (2x1), i també accions que afavoreixen la continuïtat del joc, que estan lligades als objectius d'aprenentatge. El segon article explica i discuteix sobre els resultats d'aquest estudi en el context dels GCA.

El tercer treball aborda el propòsit principal d'aquesta tesi, centrat en el mecanisme de cessió i traspàs de la responsabilitat i el control de l'aprenentatge de l'entrenador als jugadors. Després de dissenyar i validar l'eina d'avaluació i explicar els resultats de l'aprenentatge del model d'entrenament aplicat en la unitat didàctica, estem en disposició d'investigar l'activitat conjunta construïda pels jugadors i l'entrenador al voltant del contingut del rugbi. Les unitats d'anàlisi utilitzades són els segments d'interactivitat (SI) que emergeixen de forma inductiva amb l'anàlisi de les gravacions audio-visuals. Hem trobat sis SI: SI de l'Organització de l'Activitat, SI de Pràctica Guiada, SI de Pràctica Autònoma, SI de Discussió, SI de Recapitulació i SI de Transició. La descripció de l'evolució dels SI al llarg de la unitat didàctica ens ha aportat indicis sobre com s'ha manifestat el traspàs de l'aprenentatge. En primer lloc, hi ha una lleugera disminució de la segmentació a mesura que el procés avança, concretament disminueix el nombre de segments d'organització de l'activitat i de pràctica guiada vers el final de la seqüència d'aprenentatge. En segon lloc, la interactivitat es construeix principalment al voltant de la pràctica guiada, la qual està molt lligada a l'organització de les activitats d'ensenyament i aprenentatge. En tercer lloc, observem que la discussió que s'estableix entre els participants, i que és fonamentalment sobre elements tàctics, es transfereix des de segments específics de discussió vers moments de pràctica guiada en els quals l'entrenador introdueix determinats debats relacionats amb aspectes concrets d'aquesta pràctica. L'estudi del mecanisme de cessió i traspàs de l'aprenentatge està explicat en el tercer article de la tesi.

Per concloure, les contribucions més destacades d'aquesta tesi es refereixen a: (a) el disseny i validació d'un nou instrument d'avaluació, el RAAI; (b) l'aplicació del RAAI

per explicar els resultats de l'aprenentatge de la unitat didàctica que ha aplicat el MIT-T; i (c) l'estudi de la interactivitat en una seqüència d'entrenament de rugbi en el context d'un club. La compilació dels tres articles i els capítols següents d'aquest treball expliquen amb més detall aquestes contribucions.

Paraules clau: avaluació, comportament tàctic, rendiment d'equip, models basats en el joc, rugbi, presa de decisions, *scaffolding*, interactivitat, socio-constructivisme.

RESUMEN

El objetivo de la tesis es analizar y describir el mecanismo de cesión y traspaso del control y la responsabilidad del aprendizaje del entrenador a los jugadores noveles en una unidad didáctica de 12 sesiones de rugby. Para conseguir este objetivo, en primer lugar hemos diseñado y validado un instrumento de evaluación específico de rugby, para evaluar los comportamientos tácticos de los jugadores de acuerdo con los objetivos de la unidad didáctica. También hemos aplicado este instrumento al inicio del proceso, durante el mismo, y al final explicando los resultados del aprendizaje en dos niveles de análisis: macro y micro. Para explicar la cesión y traspaso de la responsabilidad del aprendizaje, hemos aplicado el modelo de análisis de la interactividad, utilizando los datos provenientes de las transcripciones de las sesiones gravadas en audio y video.

La perspectiva teórica de esta tesis es coherente con los postulados del socio-constructivismo (Vygotsky, 1978). Entendemos el aprendizaje como un proceso de auto-construcción de conocimiento que ocurre en un entorno socio-cultural específico, y centramos nuestra investigación en este proceso. Éste tiene lugar en la zona de desarrollo próximo (ZDP) con la ayuda de una persona más experta que ajusta la ayuda proporcionada a los aprendices. El *scaffolding* proporcionado a los aprendices se basa en la ayuda contingente y la progresiva retirada de esta ayuda para traspasar la responsabilidad del aprendizaje del entrenador a los aprendices. El entrenador, los jugadores noveles y el contenido forman el triángulo de interactividad que contiene las relaciones bidireccionales entre los tres elementos. Este mecanismo de traspaso de la responsabilidad del aprendizaje, que ocurre en la ZDP y está directamente relacionado con el ajuste de la ayuda (*scaffolding*), es el principal centro de atención de esta tesis.

Esta investigación es principalmente cualitativa y es un estudio de caso único basado en el paradigma interpretativo y constructivista, y realizado en un entorno de entrenamiento real. De todas formas, en el primer estudio, para validar el instrumento de evaluación utilizamos metodología cuantitativa. En el segundo estudio, donde explicamos los resultados de aprendizaje de la unidad didáctica, utilizamos ambas aproximaciones metodológicas. Hemos realizado la prueba de significatividad del rendimiento de los jugadores, y hemos utilizado métodos más descriptivos para explicar determinados resultados de aprendizaje con más profundidad. La investigación principal

relativa al mecanismo de cesión y traspaso de la responsabilidad del aprendizaje se basa en el modelo de análisis de la interactividad que describe la actividad conjunta entre los participantes. La estructura de esta interactividad está configurada por las distintas maneras con las que se construye y organiza la actividad conjunta.

Los participantes de esta investigación son 10 jugadores noveles de rugby de entre 17 y 19 años de edad, los cuales tenían cuatro meses de experiencia como jugadores de rugby, y el entrenador-investigador, autor de esta tesis. Todos ellos pertenecían a un club de rugby de una zona rural del nordeste de Cataluña. La unidad didáctica de rugby fue de 12 sesiones de 90 minutos realizadas durante seis semanas. El modelo de entrenamiento utilizado durante la secuencia didáctica fue el modelo integrado técnico-táctico (MIT-T). Así pues, esta tesis se basa en tres estudios complementarios que se detallan en los tres artículos de esta compilación.

El objetivo del primer estudio es crear y validar un instrumento de evaluación específico de rugby coherente con el modelo de enseñanza utilizado durante la unidad didáctica (MIT-T). Este modelo es consistente con las principales características de los modelos basados en el juego (GCA) puesto que utiliza situaciones de juego para enseñar la técnica y la táctica, entre otras características. Con este objetivo hemos creado el *Rugby Attack Assessment Instrument* (RAAI), el cual permite obtener un índice de rendimiento (IP) del juego del equipo. En este estudio explicamos las pruebas de validez de contenido y de constructo, y las pruebas de fiabilidad inter- e intra-observadores, así como la fiabilidad del test-retest. El resultado obtenido muestra que el RAAI es una herramienta de evaluación válida y fiable, tal y como explicamos en el primer artículo de la tesis.

El segundo estudio explora y describe los resultados de aprendizaje de los jugadores después de la unidad didáctica de rugby. Explicamos los principios del MIT-T y su aplicación durante el proceso de enseñanza-aprendizaje. Este modelo de enseñanza propicia el trabajo simultáneo y equilibrado de la técnica y la táctica utilizando situaciones problema en las que el jugador tiene que tomar decisiones de diversa complejidad. Explicamos el uso del RAAI para evaluar la progresión del aprendizaje de los participantes a nivel macro y micro. El análisis a nivel macro explica los cambios en el IP durante la secuencia de entrenamiento. El análisis a nivel micro describe los

cambios de determinados comportamientos individuales que se han obtenido con la aplicación del RAAI y que no recoge el IP. Los resultados a nivel macro, que tienen en cuenta la evolución del IP en los cuatro momentos de la evaluación, muestran que la tendencia lineal de los cuatro IPs no es significativa. Con el análisis a nivel micro, observamos que hay un aumento progresivo de la frecuencia de determinados comportamientos tácticos de los jugadores a lo largo de la unidad didáctica. Estos comportamientos tácticos se refieren a resolver situaciones simples de superioridad numérica (2x1), y también a acciones que favorecen la continuidad del juego, que están relacionadas con los objetivos de aprendizaje. El segundo artículo explica y discute los resultados de este estudio en el contexto de los GCA.

El tercer trabajo aborda el objetivo principal de esta tesis, centrado en el mecanismo de cesión y traspaso de la responsabilidad y el control del aprendizaje del entrenador a los jugadores. Después de diseñar y validar el instrumento de evaluación y explicar los resultados del aprendizaje del modelo de entrenamiento aplicado en la unidad didáctica, estamos en disposición de investigar la actividad conjunta construida por los jugadores y el entrenador alrededor del contenido de rugby. Las unidades de análisis utilizadas son los segmentos de interactividad (SI) que emergen de forma inductiva con el análisis de las grabaciones audio-visuales. Hemos encontrado seis SI: SI de Organización de la Actividad, SI de Práctica Guiada, SI de Práctica Autónoma, SI de Discusión, SI de Recapitulación y SI de Transición. La descripción de la evolución de los SI a lo largo de la unidad didáctica nos ha aportado indicios sobre cómo se ha manifestado el proceso de cesión y traspaso del aprendizaje. En primer lugar, hay una ligera disminución de la segmentación a medida que el proceso avanza, concretamente disminuye el número de segmentos de organización de la actividad y de práctica guiada al final de la secuencia de aprendizaje. En segundo lugar, la interactividad se construye principalmente alrededor de la práctica guiada, la cual está muy ligada a la organización de las actividades de enseñanza y aprendizaje. En tercer lugar, observamos que la discusión que se establece entre los participantes, y que fundamentalmente es sobre elementos tácticos, se transfiere desde los segmentos específicos de discusión hacia momentos de práctica guiada dónde el entrenador introduce determinados debates relacionados con aspectos concretos de esta práctica. El estudio del mecanismo de cesión y traspaso del aprendizaje está explicado en el tercer artículo de la tesis.

En conclusión, las contribuciones más destacadas de esta tesis se refieren a: (a) el diseño y validación de un nuevo instrumento de evaluación, el RAAI; (b) la aplicación del RAAI para explicar los resultados del aprendizaje de la unidad didáctica que ha aplicado el MIT-T; i (c) el estudio de la interactividad en una secuencia de entrenamiento de rugby en el contexto de un club. La compilación de los tres artículos y los capítulos siguientes de este trabajo explican con más detalle estas contribuciones.

Palabras clave: evaluación, comportamiento táctico, rendimiento de equipo, modelos basados en el juego, rugby, toma de decisiones, *scaffolding*, interactividad, socio-constructivismo.

1. GENERAL INTRODUCTION

My professional development has always been linked to teaching, in order to improve the motor competence of learners in different contexts. My job as a physical education teacher in several high schools has been the main motivation for improving my teaching skills applied to young learners. I have also shared this job with my passion for rugby union, first as a player and later as a coach. Therefore, the main motivation for researching the teaching and learning process, in the context of physical education and sports (PES), is closely linked to my professional career as a teacher and coach. This thesis is the product of hundreds of teaching and coaching hours and the many questions that have frequently arisen on how students and players learn and how I could better support them to facilitate their knowledge construction. As a rugby player, I was fortunate to have a coach who was not only concerned about coaching us to be better players, but also about helping us understand the game and the reasons why we made some decisions and not others. This was probably the main reason I became interested in wanting to build better decision-makers along with skilled players when I started coaching. The comprehensive teaching and coaching of team sports seemed a good way of teaching sports to young learners. With my professional background, I determined that research in the field of teaching and coaching would be a good way to better understand how learners build their knowledge, and I could contribute to, and deepen, knowledge in this area.

This thesis explores the teaching and learning process in the field of sports coaching from a socio-constructivist perspective. We intend to deeply understand what is going on when a group of 10 players, led by a coach, start a process of knowledge

construction around the content of rugby during 12 sessions in the context of a rugby club. We are particularly interested in researching the educational influence exerted by the coach in order to adjust the help delivered to the players so that learning can be optimized. The educational influence mechanism studied here is related to the progressive transfer of responsibility and control of learning from the coach to the players. Coll, Colomina, Onrubia and Rochera (1992) researched this mechanism in relation to teaching diverse fields of knowledge (i.e. language studies and computer studies). In the field of PES, López-Ros (2001) and Pradas (2012) studied this educational influence mechanism in sport initiation in the context of two primary schools. The present thesis focuses on this research topic in an extracurricular context of sports coaching in a rugby club. This club was created four months before the intervention and the players started to play rugby here. It is located in a small town in a rural area of northern Catalonia. Most of the players and staff have a Catalan origin and the language spoken was mainly Catalan, and occasionally Spanish. We aim to collect data that may lead to a better understanding of the teaching and learning process in sports initiation through studying how the coach adjusts help, and how learners appropriate control. Consequently, the research question is posed in the following terms:

- How does the process of transferring the responsibility and control of learning from coach to players happen in a teaching and learning process of rugby initiation?

In the following chapter we explain the research question and the objectives of our study in more detail. The thesis is organised as a compilation of three articles, where we

show the results of the analysis of interactivity among the research participants. Additionally, we report the design and validation of an assessment instrument used to assess how players' learning evolves. We also explain the application of a comprehensive coaching approach consistent with our theoretical framework, as well as discussing the learning outcomes of the learning sequence using the assessment tool designed.

In this introduction we expound the key features of the theoretical basis that give sense to and guide our work. The articles presented in this thesis follow a chronological order of completion coherent with the requirements of our work. However, in this introduction we invert the order, as we give more importance to the research question specifically dealt with in the third paper. The first two articles explain previous aspects of the study that were required in order to answer the main research question in the third article. Therefore, we first present the socio-constructivist perspective of learning and the most relevant elements of the educational influence in the teaching and learning processes. Secondly, we focus on the basis of the game-centred approaches (GCA) of teaching team sports, as a model consistent with the socio-constructivist perspective. Thirdly, we explore the assessment of game performance in the context of GCA. Lastly, we explain the relevance of our research and its most significant contributions in our field of knowledge.

The socio-constructivist perspective and the educational influence

The main focus of this dissertation is to understand how the teaching and learning process of a specific content evolves in a naturalistic setting. We understand a

naturalistic setting as a real coaching situation occurred in its real context and not created specifically for the research. The analysis of this process is based on the socio-constructivist perspective and the postulates of Vigotsky (Cole, 1996; Coll, 2001; Cubero, 2005; Daniels, 2001; Vila, 1998; Vygotsky, 1978; Wertsch, 1985). According to this perspective, learning occurs as a shared process of co-construction and re-construction of knowledge between the expert -the coach or the teacher[1]- and the learners -players or students- around a specific content (Coll, 2001). During this process, understood as a joint activity, participants progressively build a system of shared meanings in relation to the content learnt. Cole (1996) emphasises the importance of mediation during the development process of learners, through the use of cultural artefacts such as language and various conventional signs. The author depicted this mediation process through the interactivity triangle, in which the object to be learnt, the teacher and the learner are in the three vertexes with bidirectional relationships. A learner's knowledge construction is based on the relationship between the constructive mental activity of the learner, the contents, and the teacher's role as a guide supporting this mental activity. The learner is considered an active element during the teaching and learning process and his/her contribution to this knowledge construction is crucial. Therefore, the concept of the interactivity triangle does not conceive of a teacher who possesses all knowledge and transfers it to the learners. Instead, teacher's role is to "make sure that there is a proper link between the constructive mental activity of the learner and the social and cultural meanings of the contents" (Coll, 2001: 179). The contents are social and cultural products and the constructive mental activity of learners is guided around them.

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[1] We are going to use the word *teacher* in the broad sense as the person who teaches.

The socio-cultural perspective of constructivism brings us to the context in which this process takes place. One interpretation of the context assumes that it represents the cultural environment in which the teaching and learning process develops and is an independent variable that surrounds the organisation of joint activity in concentric circles (Daniels, 2001). However, we understand the notion of context in the way Cole (1996) explains it. He related cognition to the context in action that participants create during the teaching and learning process through their interactions. Hence, this context is built through what the subjects do, where they do it and how they do it (Erikson & Shultz, 1977). As suggested by the cultural psychology (see Cole, 1996), there are different definitions and perspectives about the notion of *context*. Cole (1994) defines this context as 'which weaves together' (p. 92) to underline the active construction of the context in action and its learning implications. The context is created during the negotiation processes in order to maintain and facilitate the evolution of communication and, therefore, the interaction that makes learning possible (Potrac, Nelson & Groom, 2016). To ensure communication it is necessary to negotiate meanings and the roles of participants during the whole process. Negotiation is set up with a minimum of common and shared meanings, but if they do not exist, they have to be built (Vila, 1998). It is not relevant the non-existence of differences between participants during interaction, but what is really important is the presence of a shared knowledge in order to make interaction and communication possible (Frankel, 2012). All this process may happen through intersubjectivity, a concept defined by cultural psychology as the capacity of understanding other's mind through language, gesture or other means (Bruner, 1996). Intersubjectivity appears implicitly to know the learners needs, and may become the central characteristic of effective interaction, either between peers or with adults involved in a joint problem solving activity, building a learning context with negotiation

and mutual understanding among participants (Daniels, 2001). There is evidence of how this process of shared knowledge construction is developed in the study of interactions in different settings (i.e. schools) (Edwards & Mercer, 1987; Mercer, 1995), as well as in the sports teaching and learning field (e.g. López-Ros, 2003; Harvey & Light, 2015; Harvey, Cope & Jones, 2016). All these concerns are paramount in the initial postulates of Vygotsky when considering that psychological functions appear first at inter-psychological level and subsequently at intra-psychological level. Similarly, Vygotsky highlighted the importance of interactive processes in the zone of proximal development. Subsequent studies about scaffolding have shown the need of permanent negotiation (and, therefore, the permanent creation of contexts) to facilitate learning. In a similar way that happens in our study, the presence of negotiation does not mean that relationship among participant is necessarily symmetric. In this sense, the context that was created during the learning sequence of our study was built around the game situations proposed by the coach and the guided practice derived from them, but evolved in relation to the responses of players partially unpredictable. The coach's plans included in the second and third article of this thesis, as well as in the appendixes, were a flexible guide of what the coach planned to teach. This dynamic notion of the context is in accordance with the idea that it is partially created without planning (Durand, 2001). It is not given completely in advance, and evolves throughout the organization of the joint activity. Although this joint activity progresses and develops along the way, it is nevertheless intentional, and aims to favour and boost learning.

From the socio-constructivist perspective, learning occurs in the zone of proximal development (ZPD) (Vygotsky, 1978). This refers to the distance between what learners are able to do by themselves and what they are able to do with the help of a more expert

educational agent. According to Vygotsky (1978), learning takes place in the zone where learners progressively take control and responsibility of their knowledge acquisition. The presence of an expert is crucial in the Vygotskyan notion of learning, since the expert not only helps the learner to do a task, but he/she also provides the learners with new tools which allow them to construct new and useful psychological functions for their development (Vila & Álvarez, 1997). Therefore, we understand that the teaching and learning process occurs in the ZPD, an area where the teacher provides the learners with relevant pedagogical support in order to help them to solve tasks and co-construct their knowledge around specific content knowledge.

The pedagogical help in the context of the ZPD has been depicted using the concept of *scaffolding* used by Wood, Bruner and Ross (1976) to exemplify the process of adjusting the help that a learner gets from an adult in relation to the notion of knowledge construction. Thus, Maybin, Mercer and Stierer (1992) stressed that scaffolding represents the help that learners need to accomplish a task they are not able to do on their own. They also emphasised that the aim of this help is to enable learners to become autonomous. Different authors outline three key features of scaffolding, namely, contingency, fading and transfer of responsibility (van de Pol, Volman, & Beishuizen, 2010). Contingency refers to adapting the support given to students to their level of learning, or to a slightly higher level. Fading indicates the progressive withdrawal of the initial support provided by the teacher. Transfer of responsibility implies an increase in learners' control over the task performance, linked to fading. In this sense, teaching contingently implies adapting the support according to students' understanding, and fading this support to gradually transfer the responsibility of learning to the students. Therefore, we understand the teaching and learning process as a

guided participative activity under constant mediation, and around a specific content (Mercer, 1995; Rogoff, 1990). This process is considered a joint activity that has been planned in advance, but it develops unpredictably, therefore implying a constant readjustment and negotiation. In PES, few studies have approached the notion of scaffolding in relation to teaching and learning (Chen & Cone, 2003; Chen, Rovegno, Cone, & Cone, 2012; Goodyear & Dudley, 2015; Wibowo, Bähr & Groben, 2014).

In order to understand the teaching and learning process, we focus our research analysis on *educational influence mechanisms* (Coll et al., 1992). These mechanisms may occur in the ZPD when there is a teaching and learning process in which a coach scaffolds his players' learning to guide their knowledge construction around the content of rugby. In this context, we understand a *mechanism* as the means by which a teaching and learning situation, created by a teacher, may cause a knowledge construction effect on learners. *Devices*, on the other hand, are the tools or instruments that participants use during this teaching and learning process. The two educational influence mechanisms, described so far, are (a) the progressive cession and transfer of responsibility and control of learning from the coach to the learners, and (b) the progressive construction of a shared meanings system in relation to the tasks, situations, or contents present in the way participants organise the joint activity (Coll et al, 1992). The first mechanism relates to the scaffolding and the teacher's adjustment of the help. It refers to the way in which the teacher acts contingently with the learners during the joint activity of an intentional educational process. The present study explores how this mechanism appears and evolves in a teaching and learning setting of an extracurricular sport in young learners. In relation to the second mechanism, at the beginning of a learning sequence, the teacher and learners share small spaces of meanings regarding the tasks and contents.

As this process progresses, shared meanings become wider, richer and more complex. In this sense, Vygotsky understands consciousness as something that organises the structure of human behaviour, and the meanings as the essential unit of the human consciousness (Daniels, 2001; Veresov, 1998). An important contribution of Vygotsky is the idea that consciousness is mediated semiotically and, therefore, in origin, it is social and cultural. What makes us humans, according to Vygotsky, is the development of higher psychological processes. These processes take place due to the semiotic mediation of mind (Daniel, 2001; Kozulin, 1994; Vila, 1987; Wertsch, 1985). From this perspective, interaction with others, signs and symbols mediation and other semiotic resources are fundamental for learners to carry out the internalisation process and, in the end, give sense to their actions. As Kozulin (2003: 19) affirmed, "the role of the human mediator is defined in Vygotsky's (1978) theory through the notion that each psychological function appears twice in development, once in the form of actual interaction between people, and the second time as an inner internalized form of this function". Therefore, all the periods of interaction, specifically the periods of reflection used during the coaching process may contribute to the creation of shared meanings among participants. Both mechanisms are directly related, and some studies (Coll & Rochera, 2000; Coll et al., 1992; Colomina, Onrubia & Rochera, 2001) point out the need to consider them together. However, other studies show that it is possible to analyse one of these mechanisms in depth, even though they admit the interrelationship between them (e.g. López-Ros, 2001; Pradas, 2012). In this thesis, this second mechanism is not specifically studied, although some issues related to this system are explored in relation to the transfer of learning.

Research on educational influence mechanisms has been extensive in diverse fields (i.e. Bustos-Sánchez, 2011; Coll & Rochera, 2000; Colomina, 1996; De Gispert & Onrubia, 1997; Engel, 2008; Viladot, Gómez & Malagarriga, 2010). In the context of PES, we only find two relevant studies carried out by López-Ros (2001, 2013) and Pradas (2012). Both studies focus the attention on the transfer of learning responsibility mechanism. López-Ros (2001, 2013) conducted the study with 10 students aged 11-12 in a four-session teaching and learning sequence where the objective was to improve tactical cooperation in attack. Pradas' (2012) research combined the study of the transfer of learning mechanism with the study of the teacher's thoughts and decision-making during the teaching and learning process. 18 students aged 10-11 participated in a six-session learning sequence of indoor hockey. In the third article of this thesis we discuss the findings related to the analysis of the interactivity and the learning transfer mechanism.

The game-centred approaches

As mentioned previously, the content and its characteristics is one of the vertexes of the interactivity triangle that delimits and conditions the teaching process. This is the main reason why another focus of interest of our dissertation is the teaching approaches used in team sport initiation. In the second half of the last century, the studies of Mahlo (1969), Deleplace (1979), Bayer (1979) and Teodorescu (1965) in central Europe on the one hand, and Wade (1967), Mauldon and Redfern (1969), and Bunker and Thorpe (1982) in the UK on the other, among others, represented the beginning of a change in how to approach the teaching and learning of team sports in mainly educational settings (Gréhaigne & Nadeau, 2015; Gréhaigne, Wallian, & Godbout, 2005; Stolz & Pill,

2014). They were concerned about the dominant technique-led approach that did not take into account the game as a whole, but fragmented it into technical abilities and the full version of the game. This traditional approach started the teaching process by acquiring the former and evolved into the latter. Therefore, these authors proposed a tactical approach to teaching sports that put the learner in the centre of the process. With this approach, the game was considered a problem-solving situation that required the use of skills and cognition to solve these problems. This significant change in the way to address the teaching of team sports took diverse nuances, depending on the countries and cultures in which these approaches were developed (see Stolz & Pill, 2014 for an extended review).

The terminology used to name these new tactical approaches, which are based on teaching and learning tactical aspects of the game, has been somehow confusing and not always precise. In Anglo-Saxon literature, the English term, teaching games for understanding (TGfU) (Bunker & Thorpe, 1982) has been used, sometimes wrongly, as a generic name for tactical approaches in teaching sports. Game-based approaches (GBA) and game-centred approaches (GCA) have been mainly used in the last decade when talking about these teaching approaches (Harvey & Jarrett, 2014; Jarrett & Harvey, 2014; Stolz & Pill, 2014). Butler (2014) proposes using GCA to substitute TGfU in order "to provide a more inclusive term" (p. 3), and we follow her suggestion in our work. In the second article of this thesis we explain the application of the integrated technique-tactical model (IT-TM) (López-Ros, 2016; López-Ros & Avelar-Rosa, 2015; López-Ros & Castejón, 1998a, 1998b, 2005; López-Ros, Castejón, Bouthier & Llobet-Martí, 2015), a Spanish model that comes from the tradition of the comprehensive teaching of sports (*enseñanza comprensiva del deporte*) (Castejón,

2003; Devís-Devís & Peiró-Velert, 1992). We decided to use this pedagogical model in our study because we understand that IT-TM is a suitable approach in order to improve technical and tactical performance of players, in the context of the game in rugby initiation. In the second article we explain the characteristics of this model and the rational for its application in more detail. We also show the procedural learning outcomes of players after a learning sequence of 12 sessions of rugby.

Initially, research on GCA was mainly focused on comparing technical and tactical approaches of teaching team sports to find out which approach would be more effective. In this sense, we highlight the monograph published in the *Journal of Teaching in Physical Education* edited by Rink (1996). Since then, some research has continued to focus on this comparison paradigm. In this vein, Stolz and Pill (2014) point out "the meta-analysis (…) illustrates the contradictory nature of the claims on behalf of a TGfU approach" (p. 79). They also state the difficulty in comparing studies of this kind due to the different research designs applied.

In the field of rugby, some studies have researched on game sense, "the Australian derivative of TGfU" (Light & Evans, 2013; p. 409), and its understanding and application by elite rugby coaches in Australia and New Zealand (Evans, 2012; Evans & Light, 2008; Light & Evans, 2010; Light & Evans, 2013). They generally conclude that rugby coaches do not use pedagogical principles of game sense, although they use games in their coaching sessions, and player-centred pedagogy is far from being applied. In the French context there has been a profound methodological work on teaching and coaching rugby from a tactical approach. Deleplace (1966, 1979) claimed the need to teach technique within the attack-defence relationship. His work on rugby

represented one of the foundations of the *Pédagogie des Modèles de Décision Tactique* (Bouthier, 1984; Gréhaigne, Wallian et al., 2005; Stein, 1981), a tactical approach to teaching team sports that proposes the use of situations to promote the adaptation of players' decision-making to the changing constraints determined by the opposition (Ulrich & Eloi, 2016). Therefore, all learning situations should propose at least two possible solutions. Several studies have researched on rugby and specific subjects in this context. Reitchess (1986) carried out a research with 5-6 year-old children on 6vs6 game situations. Stein (1981) researched on ball carrier's actions in 1vs1 situations with participants aged 10-12. Bouthier (1984, 1986) compared novice players with experts applying 2vs2 and 2vs1-plus-1 tests. The author also proposed learning tasks for 2vs2 and 2vs1 situations in the context of rugby initiation. Mouchet (2003, 2008) and Mouchet and Bouthier (2006) stressed the need to take into account not only the internal logic of the game, but also the internal logic of the player and his/her subjectivity when analysing and teaching tactical decision-making in rugby (Bouthier, 2014).

In the first decade of this century, researchers began studying the teaching and learning of PES in naturalistic settings. Hence, the practice-referenced approach (Kirk, 2005, 2010) proposes the study of learning outcomes in real teaching and learning contexts. These studies report the use of teaching/coaching approaches during a learning sequence in relation to the achievement of the learning objectives of the unit. Our research is in accordance with this approach. In the second article we report the learning outcomes of the rugby unit in relation to the IT-TM principles and tasks. We also discuss some of the studies carried out on teaching invasion team sports in real educational settings (Harvey, Cushion, Wegis & Massa-Gonzalez, 2010 in a soccer club setting; Lee & Ward, 2009 in tag-rugby with secondary students; MacPhail, Kirk &

Griffin, 2008 in throwing and catching skills in primary PE; Mesquita, Farias & Hastie, 2012 in primary PE soccer).

Game performance assessment

The use of GCA in educational contexts implied the need to apply assessment tools consistent with the principles of these approaches. In our research, in order to analyse and understand the process of transfer of learning responsibility, we needed to have a valid and reliable instrument that could provide evidence of the players' learning progress. We were particularly interested in exploring changes in their procedural knowledge that could indicate their knowledge acquisition during the learning sequence.

The tactical and decision-making dimension of the game had to be assessed in authentic game situations. The first assessment tool designed for these purposes was the Game Performance Assessment Instrument (GPAI) (Mitchell, Griffin & Oslin, 1995; Oslin, Mitchell & Griffin, 1998). The GPAI was built in connection with the tactical games model of teaching team sports created by the same authors. The actions observed are coded as appropriate or inappropriate. Additionally, the game performance and the game involvement are two indexes that calculate the individual results of each component and the overall performance. All these actions are coded analyzing a small-sided game situation, and GPAI has been applied in other sports.

The other assessment tool used, but less frequently than the GPAI (Arias & Castejón 2012; Arias-Estero & Castejón, 2014), is the Team Sport Assessment Procedure (TSAP) (Gréhaigne, Godbout & Bouthier, 1997). This was conceived in the context of the

French tactical decision-learning model of teaching team sports (Gréhaigne, Richard & Griffin, 2005). The TSAP takes into account the actions of the ball carrier, and defensive actions used to conquer possession of the ball. It produces three scores: volume of play, efficiency index, and performance score. These results are also obtained observing a small-sided game situation, as in the GPAI.

However, in the context of the GCA, other studies report the use of other assessment instruments. Memmert (2007) mainly used the game-test situations to assess game creativity in young players. Gutiérrez and García-López (2012) applied the Game Performance Evaluation Tool (based on previous studies by French & Thomas, 1987, and Nevett, Rovegno, Babiarz, & McCaughtry, 2001) to assess technique-tactical skills and tactical context adaptation. Blomqvist, Vänttinen and Luhtanen (2005) created a coding instrument that analyses specific decision-making units of plays during small-sided games. Chen, Hendricks and Zhu (2013) introduced the Basketball Offensive Game Performance Instrument, which is used to assess pre-service teachers' game performance of basketball in attack. All of these evaluation tools have been used for specific research purposes, primarily by their authors, as they have a limited use in the field of PES. Finally, we highlight an observational instrument created to analyze ball possessions in rugby union that includes 99 behaviors. They can be observed during a rugby match to differentiate winning and losing technical and tactical performances (Villarejo, Ortega, Gómez, & Palao, 2014).

These assessment instruments value the actions of players as appropriate/good or inappropriate/bad. Moreover, this judgment is in the hands of the teacher or coach who is observing the learners' performance, becoming, then, a subjective measure to a certain

extent (Memmert & Harvey, 2008). We argue that tactical performance cannot be assessed as *black or white*, since some actions may have a certain degree of appropriateness, even though they could be coded as inappropriate. A continuum in the appropriateness of the actions coded needs to be considered, and subjectivity should also be avoided when possible. With these two concerns in mind, and with the objective of designing a rugby-specific assessment tool, in the first article we explain the Rugby Attack Assessment Instrument (RAAI) and report the validation process. In this sense, the RAAI is an assessment tool based on the previous codification of the possible actions performed by the ball carrier and immediate support players. These actions have a specific weight that is in accordance with their tactical value. We also take into account combined actions that have an added tactical value. Weights are either positive or negative, according to their positive or negative influence on the principles of the game. Construct and content validity is reported as well as reliability (Llobet-Martí, López-Ros, Barrera-Gómez & Comino-Ruiz, 2016).

Main contributions

This thesis aims to fill gaps related to research on interactivity in PES. There are only two studies that analyse both the joint activity organization of a teaching and learning process and the transfer of learning responsibility mechanism within the educational context of primary school PE (López-Ros, 2001, 2013; Pradas, 2012). As content plays a crucial role in the interactivity triangle, as well as in facilitating the learning transfer process, the study of interactivity in relation to different contents is paramount. It seems that the educational influence mechanisms appear and can be described in the teaching and learning of different kinds of contents. However, PES includes a group of contents,

which are strongly linked with the procedural knowledge that requires declarative knowledge, and have their own features. The connection between decision-making and motor action adds a specific characteristic that makes its study somehow different to other types of contents. Thus, the process of learning transfer may have specific connotations.

Our study analyses interactivity in an extracurricular sports setting, and we did not find previous studies in this context. This is a relevant issue as the teaching context has specific attributes that may condition the transfer process. Since the basic purpose of different settings may also be diverse and these purposes may partly define the ways in which the organisation of joint activity develops and evolves, the learning transfer process may have its own specific appearance and development. Thus, results give an insight into how learners take control of their own learning in this specific context. We stress the study of how the coach adjusts help during the learning tasks in the rugby unit. This is an important aspect of teaching from a socio-constructivist perspective, since players learn from the coach's guidance on scaffolding during the transfer of responsibility and control of learning.

In relation to the methodology, we introduce the in-depth study of some segments of interactivity. Sometimes the segments represent a wider source of data that, when analysed in more detail, provide deeper information about the learning transfer process. With this purpose, we provide the analysis of specific patterns of interactivity of certain segments that show some evidence relative to the evolution of the reflections among participants over the course of the learning unit.

Another significant contribution of our research relates to reporting the learning effects of applying the IT-TM in the context of a rugby club. We show that the IT-TM is an effective approach to teaching/coaching team sports, although it is not within our scope to claim that this model is the most appropriate for these purposes. Instead, we explain how this model is applied so as to provide teachers and coaches with more educational resources that may contribute to making teaching and coaching more effective. The task type, the principles of the model and the use of reflection are all important elements of the IT-TM, and need to be taken into consideration in the teaching and learning process of team sports (López-Ros, 2016; López-Ros & Avelar-Rosa, 2015; López-Ros et al., 2015). Task type is also relevant when studying the learning transfer process, in order to see the extent to which the use of a specific pedagogical approach, like the IT-TM, organises the contents being taught, plans how to adjust the help and delivers specific tasks to accomplish the learning objectives. Moreover, we intend to fulfil the claims of Harvey and Jarrett (2014) who remark, "yet further research is required especially in sports clubs" (p.14). Our study is in accordance with the practice-referenced research that Kirk (2005, 2010) also put forward as a future line of research on teaching and coaching team sports in the context of GCA.

Finally, we provide an assessment instrument specific to rugby, which is consistent with the principles of GCA, and the IT-TM in particular. It has specific characteristics that differ from previous assessment tools already used. These are related to the value of the coded actions observed and the subjectivity of observers. The RAAI establishes a new way of assessing attacking game performance in rugby that can be adapted to other sports and contexts. The process of validation of the RAAI has proved this instrument to be a valid and reliable tool for assessing players in a learning sequence of rugby. We

also show the learning outcomes of the IT-TM intervention, using the RAAI on both a macro- and micro-level.

This thesis, as stated previously, is divided into three articles. The first article introduces the RAAI, the second article reports the IT-TM intervention of the rugby coaching unit and its learning outcomes, and the third article analyses the interactivity of the coaching sequence and explores how the transfer of learning responsibility educational influence mechanism occurs.

The second chapter introduces the specific aims of the thesis. The third chapter includes the three articles submitted. The fourth chapter reports the discussion of the results. Finally, the last chapter highlights the general conclusions of this research.

2. OBJECTIVES OF THE THESIS

In this section we explain the objectives of the thesis as a whole. From this general perspective, we move on to detailing the specific objectives of the articles, which are the core of our research.

The research question guiding the entire investigation together with the secondary questions have their origin in the theoretical framework of our research. Since we understand learning as a process of knowledge construction by learners around a specific content, and mediated by an *instructional* agent, the focus of our study is placed on the joint activity of teaching and learning. Therefore, the study of interactivity between participants (teacher/coach and learners) around the content learnt and its characteristics is the main aim of our work. The research question is formulated as follows:

- How does the process of transferring the responsibility and control of learning from the coach to the players happen during the process of teaching and learning in rugby initiation?

With this main question, we assume that the learning transfer process will occur in a similar way to other studies of the interactivity in different fields of knowledge, as stated in the introductory chapter (e.g. Coll et al, 1992; Coll & Rochera, 2000; López-Ros, 2001; Pradas, 2012). Hence, other secondary questions guiding the research emerge from this main question, and are as follows:

- How is the organisation between participants in the joint activity going to develop during the learning sequence, while the learning transfer process occurs?

- Is this process of learning transfer going to be linear and progressive or are we going to find breakdowns and ruptures as happened in previous PE studies?

- To what extent do some of the features of the cession and transfer process caused by participants' reasons and intentions condition their activity in an extracurricular sports setting?

- Taking into account technique and tactics to teach/coach rugby, and the fact that this is reported for the first time in rugby; to what extent does the application of a pedagogical model condition the learning transfer process?

From these initial questions the following research aims are set out:

- To describe and analyse the joint activity organization between the coach and novice rugby union players in a teaching and learning sequence. This requires previous analysis on interactivity in this specific learning sequence of rugby initiation. In our research we consider different levels and units of analysis. Therefore, the segments of interactivity are the main units of analysis emerging from the data collected. These segments are specific to each learning sequence and are configured by different patterns of behaviour between participants who are identified and described (Coll et al, 1992; Coll & Onrubia, 1999; Coll & Rochera, 2000).

- To study how this interactivity develops throughout the learning sequence in order to analyse the educational influence mechanism of transferring the responsibility and control of learning from the coach to the players. How this

interactivity develops is mainly described by analysing how the segments of interactivity appear in every session and how they evolve along the learning unit. The patterns of interactivity in the segments show the dynamics of one part of the joint activity organisation in relation to the learning transfer process. This analysis gives a sense of how the coach scaffolds the players during this process, and how this help, understood as a part of the joint activity organisation, is modified and transformed during the process of learning (Rojas-Drummond, Torreblanca, Pedraza, Vélez & Guzmán, 2013; van de Pol & Elders, 2013).

- To describe how the principles of the Integrated Technique-Tactical Model (IT-TM) are applied to teach rugby to novice players and analyse the learning outcomes of the players' performance in the context of extracurricular sport practice. Since the sequence and organisation of the content of rugby greatly influences the transfer process, we study how this content is delivered to learners. We report for the first time how this pedagogical model is applied in a coaching situation with novice rugby players. One of the aspects explained is how tactical behaviour is integrated with techniques when planning the learning tasks, together with the unit plan, the kind of tasks and the principles of the model (López-Ros & Castejón, 1998a, 2005). Moreover, to fulfil this objective, we report how players' game performance develops, describing the tactics and techniques which improve along the unit, and putting special emphasis on the behaviour which is directly related to the learning objectives of the rugby learning sequence.

- To assess players' game performance during the teaching and learning sequence so as to describe players' knowledge appropriation regarding the tactical and technical aspects of the game of rugby. The assessment of players' game

performance is of paramount importance in order to explain the learning transfer process. With this purpose in mind, we have to design an assessment tool specific to rugby and consistent with the IT-TM approach, which can measure players' learning, specifically focusing on their procedural knowledge. A validation process of this instrument is also required to ensure its proper application.

We analyse a teaching and learning sequence of 12 sessions with 10 novice rugby players in order to study the process of cession and transfer of learning responsibility from the coach to the learners. The observational and discursive analysis of this learning sequence is the main source of data used in the study. The three articles share the focus of analysis on this sequence to fulfil the research objectives.

The first article entitled "Assessing novices' game performance in rugby union: the Rugby Attack Assessment Instrument (RAAI)" focuses on the assessment of players' game performance during the learning sequence. This paper has been published in the *Journal of Teaching in Physical Education* (JCR, I.F. 2014: 0,740). The specific objective of the paper is to introduce the Rugby Attack Assessment Instrument (RAAI). This assessment tool has been designed for use during the learning sequence of rugby initiation in order to assess game performance of players in attack, and the paper describes the main features of how RAAI is applied. Validity and reliability tests are also shown and an R package (R Foundation for Statistical Computing, Vienna, Austria) which computes the Index of Performance (IP) providing significance measures (confidence interval and p-value) when comparing two IP scores is also provided. The RAAI is not an assessment instrument designed for use in our study alone, but can be

used in a broader sense to evaluate game performance of rugby players beyond the boundaries of our research.

The second article is entitled "Exploring the effect of the integrated technique-tactical model in a 12-session unit of rugby". This article has been submitted to the *Research Quarterly for Exercise and Sport* journal (JCR, I.F. 2014: 1,566) and is currently under review. The specific objectives of this article are: (a) to introduce the use of the Integrated Technique-Tactical Model (IT-TM) and analyse its specific application in a teaching and learning sequence of rugby initiation, then reporting the most relevant aspects of the pedagogical model employed in this context; and (b) to report the learning outcomes of the 12-session unit of rugby initiation using the Rugby Attack Assessment Instrument (RAAI) in relation to the technical and tactical behaviours of players. This assessment is centred on the procedural knowledge of players in offensive on-the-ball situations.

Therefore, this article has two main foci of attention. Firstly, it centres the attention on the explanation of the origins, principles and stages of the IT-TM, the game centred approach used in our learning sequence to teach rugby. This approach was created in Spain in accordance with the principles of the comprehensive teaching of sports (López-Ros & Castejón, 2005). Secondly, the paper reports the results of using the RAAI to assess game performance and individual behaviours of players during the learning unit. Pre-assessment, formative and summative assessments have been performed throughout the whole unit of work and the results of this assessment are presented and discussed in the paper. This article gives important clues about this thesis, since (a) it gives an account of the teaching approach used in the learning sequence, consistent with the

constructivist perspective; and (b) gives valuable information regarding the learning outcomes of the players after the 12-session unit. This is a relevant aspect of our study, because from our theoretical perspective, the analysis of the joint activity organisation is performed by studying the content learnt, and the main features of that content. With this analysis, we will be able to partly explain and understand the specific characteristics of the learning transfer process that we expound in the last article of this thesis.

The third article entitled "The analysis of interactivity in a teaching and learning sequence of rugby initiation: the transfer of control and learning responsibility" has been submitted to the *Physical Education and Sport Pedagogy* journal (JCR. I.F. 2014: 0,811) and is currently undergoing a second review. The specific objective of this paper is to describe the organisation of joint activity and its dynamic evolution for the teaching and learning sequence of rugby initiation. In this paper we have analysed 11 sessions of the learning sequence, instead of 12, since the first session was devoted only to pre-assessment purposes and has not been analysed. We explore the way in which the progressive cession and transfer of responsibility and control of learning from the coach to the players occurs in a naturalistic learning environment, within the context of an extracurricular sport. In this article we use the interactivity analysis model based on describing the evolution of the segments of interactivity that emerge from the analysis of the teaching and learning sequence. These units of analysis are not planned in advance, but are identified and described analysing the actions and the verbal exchanges between participants and their instructional functions around the content taught. We also explain the patterns of interactivity that appear in each segment that describe participants' different intentions and actions, either verbal or motor. These patterns also give a better understanding of the existent relationship between the coach and the

players -two vertexes of the interactivity triangle- in each coaching situation of the different segments of interactivity. Thereby, we also analyse the language exchanges, the semiotic devices and the contents of the conversations occurring in different segments. We use the interactivity analysis model because (a) it allows us to evaluate how the joint activity evolves along with the transfer of responsibility of learning; (b) it is consistent with the theoretical perspective of our work based on studying the joint activity organisation and its features; and (c) it is a model used in previous researches allowing to relate results obtained with other studies. In relation to the content, the third vertex of the interactivity triangle, the main learning objectives of the learning sequence is related to increasing players' competence in solving simple tactical situations in the game using the appropriate technical resources. These game situations are linked to the primary and secondary level of analysis of the rapport of strength in an opposition game situation (Gréhaigne, Godbout & Bouthier, 1999). We explain the main characteristics of the content in the second article. Finally, this third article discusses the results in relation to studies carried out in primary school physical education classes (López-Ros, 2001; Pradas, 2012). Therefore, it is our aim to increase knowledge regarding how the learning transfer mechanism occurs during the teaching and learning of team sports in different settings.

3. TRANSCRIPTION OF THE ARTICLES

The present thesis is submitted as a compendium of three articles. In the following lines we include their references. The references of other publications related to this research are included in the appendix of this document.

Authors: Bernat Llobet-Martí; Víctor López-Ros; Jose Barrera-Gómez; Joel Comino-Ruiz

Title: Assessing novices' game performance in rugby union: the Rugby Attack Assessment Instrument (RAAI)

Journal: *Journal of Teaching in Physical Education*

Status: Published.

Doi: http://dx.doi.org/10.1123/jtpe.2014-0134

Date of acceptance: 10th June 2015

Journal quality index: JCR impact factor (2014) = 0,740

Authors: Víctor López-Ros; Bernat Llobet-Martí; Jose Barrera-Gómez

Title: Exploring the effect of the integrated technique-tactical model in a 12-session unit of rugby

Journal: *Research Quarterly for Exercise and Sport*

Status: Submitted and under review

First submission date: 24th April 2016

Journal quality index: JCR impact factor (2014) = 1,566

Authors: Bernat Llobet-Martí; Víctor López-Ros; Ignasi Vila

Title: The analysis of interactivity in a teaching and learning sequence of rugby initiation: the transfer of control and learning responsibility

Journal: *Physical Education and Sport Pedagogy*

Status: Second submission after the first peer review

First submission date: 30th November 2014

First peer review reception date: 10th March 2015

Second submission date with changes: 5th March 2016

Journal quality index: JCR impact factor (2014) = 0,811

Abstract

The application of Teaching Games for Understanding (TGfU) and Game Centered Approaches (GCA) in team sports initiation generated the need for assessing game performance. In this paper we introduce the Rugby Attack Assessment Instrument (RAAI), a tool to assess the actions of players in attack and their incidence in the generated game situations in rugby. The RAAI focuses the attention on the ball carrier during a 5 vs. 5 situation. The actions of players in possession of the ball are described and codified. A weight is allocated to each simple and combined action in relation to its tactical value. Thus, the codified actions provide a weighted Index of Performance, the team score of the RAAI. Validity and reliability were tested in two different studies. Results suggest that the RAAI is valid and reliable to assess ball carrier's actions and their influence in attacking game situations of novice rugby union players.

Keywords

López-Ros, V., Llobet-Martí, B., Barrera-Gómez, J. "Exploring the effect of the integrated technique-tactical model in a 12-session unit of rugby". Manuscript submitted for publication

Llobet-Martí, B., López-Ros, V., Vila, I. "The analysis of interactivity in a teaching and learning sequence of rugby initiation: the transfer of control and learning responsibility". Manuscript submitted for publication

4. MAIN RESULTS AND DISCUSSION

The main aims of this study were (a) to explore and describe the educational influence mechanism of progressively transferring the responsibility and control of learning from the coach to the players of a 12-session learning sequence of rugby; (b) to analyse the organisation of the joint activity between the coach and the novice rugby union players in this teaching and learning sequence; (c) to analyse the outcomes of this learning sequence, describing the application of the Integrated Technique-Tactical Model; and (d) to assess players' game performance using a specific assessment instrument designed and validated for this purpose.

We assume that learning transfer occurs when there is an intentional setting where learners build their knowledge with the help of an expert (Coll et al., 1992), the coach in our case. The study of this educational influence mechanism has often been conducted alongside another educational influence mechanism: the progressive construction of a shared meanings system (Coll et al., 1992; Coll, Onrubia & Mauri, 2008; Colomina et al., 2001). In our research, we focus specifically on the transfer of responsibility when learning. This does not mean that the creation of system of shared meanings is overlooked, it means that we feel the scope of the analysis of the first educational influence mechanism is wide enough to deserve the full attention of this thesis. According to other authors (Coll & Rochera, 2000; López-Ros, 2001; Pradas, 2012), an in depth explanation of different aspects of this first mechanism is needed in order to understand how the coach adjusts help during this process of learning transfer, and how the players progressively take responsibility over their knowledge construction. We share the idea expressed by Coll et al. (2008) in relation to the "mutual

interdependence" (p. 40) of both mechanisms, but our aim is to provide a deep understanding of how the transfer of learning responsibility occurs. This is achieved through studying how the joint activity is organised and evolves over the course of the learning sequence of rugby.

During the process of planning the rugby teaching and learning sequence, some decisions concerning the learning assessment and the coaching approach had to be made. These important decisions had to be well planned, accurate and, above all, consistent with our theoretical framework. They concern the last two objectives of the thesis stated above (c and d). Firstly, we designed and validated the Rugby Attack Assessment Instrument (RAAI), an assessment tool that ascertains the learning progress of the players. This instrument meets two important prerequisites: (a) it is specific to rugby and (b) it assesses those objectives of the learning sequence related to the players' tactical and technical performance. The first paper of this thesis explains the features of the RAAI, and the validation results in detail. Secondly, the decisions related to the coaching model led us to apply the Integrated Technique-Tactical Model (IT-TM) (López-Ros & Castejón, 2005). This teaching/coaching model could be considered a game-centred approach (GCA) with specific features, and is consistent with the constructivist perspective in its principles of application (López-Ros, 2016; López-Ros & Avelar-Rosa, 2015). The second paper, therefore explains the principles of the IT-TM and its application on our coaching sequence. Here we report the learning outcomes of the rugby unit when applying the RAAI in relation to the learning objectives of the unit and the characteristics of the IT-TM, paying particular attention to the principles of the model and the type of learning tasks delivered during the sessions.

From the results of these two articles we have enough evidence to claim that (a) the RAAI is a valid and reliable assessment tool; (b) during the teaching and learning sequence the participants of the study built knowledge (procedural knowledge in particular), regarding the learning objectives of the unit; and (c) the IT-TM is a comprehensive approach to teaching and coaching team sports that has proved to be effective in the coaching context of our study. With these results we are able to relate the main aim of this thesis: to study coaching sequence interactivity in order to explore the transfer of responsibility and control of learning from coach to players. This is dealt with in the third paper of this compilation. Results show that (a) the transfer of learning responsibility seems to be linked with a decrease in the joint activity segmentation of the sessions; (b) The adjustment of help provided by the coach implies a transfer of reflection periods from specific segments of discussion to reflections made during the practice segments; (c) The principles and learning tasks of the comprehensive pedagogical model of teaching rugby (IT-TM) may facilitate and enhance the learning transfer process; and (d) the learning transfer process is complex, and non-linear, with setbacks and ruptures as reported in other studies (e.g. Coll & Rochera, 2000; López-Ros, 2001; Pradas, 2012).

This research gives insight into interactivity and the transfer of learning responsibility in an extracurricular sports setting by exploring the effects of the IT-TM on novice rugby players after 12 sessions, focusing on their tactical and technical performance. It also provides the RAAI, a new assessment tool specific to rugby. Below we discuss the results obtained in each of the articles of this thesis.

Assessing novices' game performance in rugby union: the Rugby Attack Assessment Instrument (RAAI)

Concerning the first article, we highlight that the assessment of tactical performance in the context of GCA has mainly used the Game Performance Assessment Instrument (GPAI, Oslin, Mitchell, & Griffin, 1998) and the Team Sport Assessment Procedure (TSAP, Gréhaigne, Godbout, & Bouthier, 1997). These are generalist assessment tools that have been used in different sports, the GPAI being the most widely used (Arias & Castejón, 2012; Arias-Estero & Castejón, 2014). There have been other assessment tools used in other studies related to the application of GCA in the teaching/coaching of team sports (i.e. Game-test situations, Memmert, 2007; coding instrument of Blomqvist, Vänttinen & Luhtanen, 2005). However, none of these instruments fulfilled the requirements of our study for the following reasons: they were neither rugby specific instruments capable of assessing novice players, nor designed in accordance with the IT-TM; and they were based on subjective scores that judged the actions of players as good/appropriate or bad/inappropriate, without taking into account any other judgments in between. In this vein, Memmert and Harvey (2008) outlined several limitations of GPAI, similar to our reflections.

Analysing the available assessment tools brought about the need to design a new tool adapted to the purposes of our study, and consistent with the coaching approach applied. Thus, we designed and tested the Rugby Attack Assessment Instrument (RAAI) explained in our first article. The first contribution of the RAAI is that the score of the game performance is a team-score based on the sum of the actions performed by the ball carrier and his/her immediate support teammate, who may become a ball carrier. We

understand performance as being the result of cooperative work among the members of a team, and this interaction should be assessed as a team product. In this sense, MacPhail, Kirk and Griffin (2008) state, "it is difficult and possibly inappropriate to take the individual as the unit of analysis when assessing learning progression. Perhaps the most appropriate unit of analysis in games programs should be the game itself" (p. 113). The second contribution refers to the actions observed and coded. These actions have previously been identified and classified, with each action being weighted in relation to its tactical value. This means that there are not only good or bad actions, but actions with different weights. These weights are either positive or negative, and will affect the final Index of Performance (IP) obtained. This IP is a whole index for team progression. The third contribution is in relation to the type of actions identified. We have grouped some actions that happen one after the other, and where the outcome of the ball carrier and his/her immediate support teammate has an added tactical value. These are the combined actions that solve tactical problems, such as solving a 2 vs. 1 or giving continuity to the game. Finally, the RAAI does not assess skill execution, or give a value to whether a technique is executed well or poorly. We understand that skills are part of the game performance and lead to an outcome of each game situation. Thus, we do not judge if a pass is good or bad from a skill execution point of view. Instead, we give a score to the action in relation to the outcome of the play, since we understand that the skills executed during the game are the product of decision-making and the tactical performance of the players involved in each situation. This idea of sport skill (or action) is in line with the notion that mental solutions cannot be isolated from motor executions (Gréhaigne, Godbout & Bouthier, 1999; Mahlo, 1969; Memmert & Harvey, 2010).

To test the RAAI we have assessed content and construct validity and inter-observer, intra-observer and test-retest reliability (see appendixes). Results are specified in the first article and they show that the RAAI is a valid and reliable instrument to measure game performance of a group of players playing in a 5 vs. 5 situation for 10 minutes. We also provide an R package (R Foundation for Statistical Computing, Vienna, Austria), specially designed for this purpose, and which computes the IP providing significance measures (confidence interval and p-value) when comparing two IP scores (see appendixes). The IP is a holistic measure that takes into account positive and the negative actions in relation to the principles of the *game in movement* of supporting the ball carrier, keeping possession of the ball and giving continuity to the game. (Villepreux, Brochard, & Jeandroz, 2007).

Exploring the effect of the integrated technique-tactical model in a 12-session unit of rugby

The second article of this thesis reports the learning outcomes of the rugby coaching sequence where IT-TM was applied. We decided to use this comprehensive approach as its principles are consistent with the constructivist perspective and it facilitates meaningful learning and understanding. We used the RAAI to assess the learning outcomes of the rugby unit by bringing together two teams of 5 players. Assessment was carried out in sessions 1, 4, 8 and 12. The RAAI was used on two levels of analysis. On the first level (macro-level), we compare the IP score of each team (A and B) in the four assessment times over the course of the unit (initial, two formative and summative). Thus, we can observe how the team's IPs develop during the learning sequence. On the second level of analysis (micro-level), we look at how specific actions

influence the IPs development and the game performance. This closer look to the results provides a deeper understanding of how players' performance evolves, as we could detect which actions increased, and which decreased in frequency of appearance. This information has proven to be effective when analysing the results of the RAAI application in a teaching and learning sequence, especially if it includes not only pre- and post-assessment, but also formative assessment.

Results on the macro-level were calculated fitting a linear regression model to assess a possible linear trend in the IP scores (Rao & Toutenburg, 1999). We found that the linear trend of the IPs of the unit was non significant for both teams as reported in the second article. The scores of the IP of both teams decrease in the second and third tests compared to the pre-assessment, but in the post-assessment the IPs increase to the levels of the pre-assessment. Thus, the IP is a holistic measure that takes both the positive and the negative actions into account. The players of a team may increase both actions but the IP will remain at similar levels. In this sense, Harvey, Cushion, Wegis and Massa-Gonzalez (2010) found the same issue regarding the use of the game performance index of GPAI in their study on the application of Teaching Games for Understanding (TGfU) approach in a unit of soccer in the context of a club.

The second level of analysis (micro-level), observes the evolution of each type of action, and shows an increase in the frequency of actions with a tactical added value, the combined favourable actions (CF), by the end of the unit. The simple favourable actions (SF) also increase, positively influencing IP scores. The most relevant CF action that improves is the ability to solve superiority situations in attack. These actions include the ability to draw a defender and pass the ball to a teammate who has no defender in front

of him/her. The SF action that also increases over the course of the learning sequence is the pass-and-reception, involving the ball carrier and the receiver. By the end of the unit, players were able to pass the ball more times without losing possession, leading to a more fluent game. However, players also broke the defence fewer times and, interestingly, they made more handling errors. These results suggest that players also improved their defensive skills and they risked the transmission of the ball more frequently. This idea is in accordance with studies that suggest a strong relationship between attack and defence in team invasion games, particularly the interdependence between these two phases during the learning process (Gréhaigne, Godbout & Bouthier, 1999; Gréhaigne, Richard & Griffin, 2005).

In view of these results, by the end of the rugby unit, the participants of this study (a) were able to solve more game situations involving a tactical demand; (b) played with more continuity and were able to pass the ball more consecutive times in order to find spaces to break the defence; (c) improved their defensive skills; and (d) took more risks in attack that led to making more mistakes during the game. These results come from a deeper analysis on the micro-level of the RAAI application and should be considered with caution since we do not provide measures of significance. The IP is a measure that gives holistic results on a macro-level, but may miss changes on a micro-level. Therefore, we suggest that when using the RAAI to assess the outcomes of a learning sequence, the evolution of the actions influencing the IP scores should be evaluated to obtain more detailed information regarding the changes to specific actions of players' game performance.

These results also show that the IT-TM is an effective teaching/coaching approach to facilitate players' knowledge construction in relation to their tactical and technical competence during the game. We suggest that using tactical and technical learning tasks with specific learning objectives, which are then followed by their application during the posterior game-forms, facilitates players' game competence acquisition. Similarly, the principles of simplification and exaggeration of the IT-TM are used to scaffold players by adapting the task conditions to their learning progress. These principles have been used during the sequence of rugby, changing the size of the playing areas, increasing or decreasing the pressure of physical contact and outnumbering or balancing the defence, among other task conditions. The use of reflection to enhance players' tactical thinking and awareness, as well as their understanding of the game, is another important feature of the IT-TM, and this is analysed in the third article. Reflection has been used to discuss some issues arising from the problem-solving tasks executed, using semiotic devices, such as questions, debates and interrogative feedbacks (e.g. Harvey & Light, 2015; Harvey, Cope & Jones, 2016).

The results of the second article of this thesis confirm that players have learnt new technique-tactical behaviours and they have improved their game competence during the coaching process. Therefore, as assumed in our research, a process of transfer of responsibility and control of learning from the coach to the players progressively happened over the course of the 12 sessions. The third article focuses on describing the characteristics of interactivity among participants that may depict this educational influence mechanism of learning transfer.

The analysis of interactivity in a teaching and learning sequence of rugby initiation: the transfer of control and learning responsibility

In this third article we analyse joint activity organization, employing different units of analysis. Some of these units come from the instructional and time characteristics of the teaching and learning process, as is the case of the work unit and the sessions. The work unit constitutes the whole teaching and learning unit. Therefore, it includes specific objectives, learning tasks to achieve these objectives and assessment instruments. The sessions are shorter time units with a well-defined beginning and ending, and are organized in a way that facilitates and gives continuity to the learning process (see Coll et al, 1992).

Segments of interactivity (SIs) are the main units of analysis as they provide a better understanding of how joint activity is organised. They are periods of time during the sessions which are compounded by different forms of interaction emerging from (a) the actions and verbal interactions among participants in relation to the learning tasks; and (b) the underlying instructional function in these forms of interactivity and in these verbal exchanges. Coll, Rochera and Colomina (2010) point out that the identification of the SIs "is based on the participation structure that governs how participants act, that is, who can do or say what, with whom, how, when, for what outcome, and what use can be made of resources" (p. 525). Therefore, the SIs are not planned in advanced in the same way the work unit and the sessions are. They are inductive units of analysis that emerge from the analysis of the transcriptions and videos of the sessions (Montanero, 2015). SIs can be identified through the systematic observation of the development of the sessions, along with analysed transcriptions of verbal exchanges

between participants. This inductive process is consistent with our theoretical framework, since we assume that an important part of the learning process is partly unpredictable, it emerges during practice, and it requires continuous negotiation between participants (Daniels, 2001; Mercer, 1995; van Geert & Steenbeek, 2005). Therefore, the SIs can only be described after analysing the actions and interactions among participants of this teaching and learning process. Each SI includes different patterns of interactivity that provide information about some configurations of behaviour of participants and show the particular joint activity organisation. These patterns are identified through analysing the following: the instructional function that guides the process of interaction; the order of intervention by the coach and the players during this interaction; and their communication and actions using specific semiotic resources (i.e. questions, debates, orders, requests, etc.) (Coll et al, 1992; Coll & Rochera, 2000; López-Ros, 2001; Pradas, 2012). To carry out the analysis of the interactivity, and after identifying the SIs of the teaching and learning sequence of rugby and their patterns of interactivity, we have focused the attention on how SIs evolved over the course of the 11 sessions. We have produced a map of interactivity showing the distribution of the SIs of all sessions (see figure 1). This map explains the sequence of appearance of each SI and its duration in minutes. Both the type and time of each of SI informs us about the characteristics of the interactivity of each session and how the joint activity evolves. Through observing and analysing the map, we can identify the configurations of the SIs related to the repeated sequences of appearance of different SIs, as well as the segmentation of each session, and the dominant SIs of the learning sequence. Finally, we have paid special attention to how reflection has developed and evolved during those SIs where the coach and the players discussed issues related to the learning objectives of the rugby sequence.

Figure 1: temporal distribution of the segments of interactivity in the map of interactivity
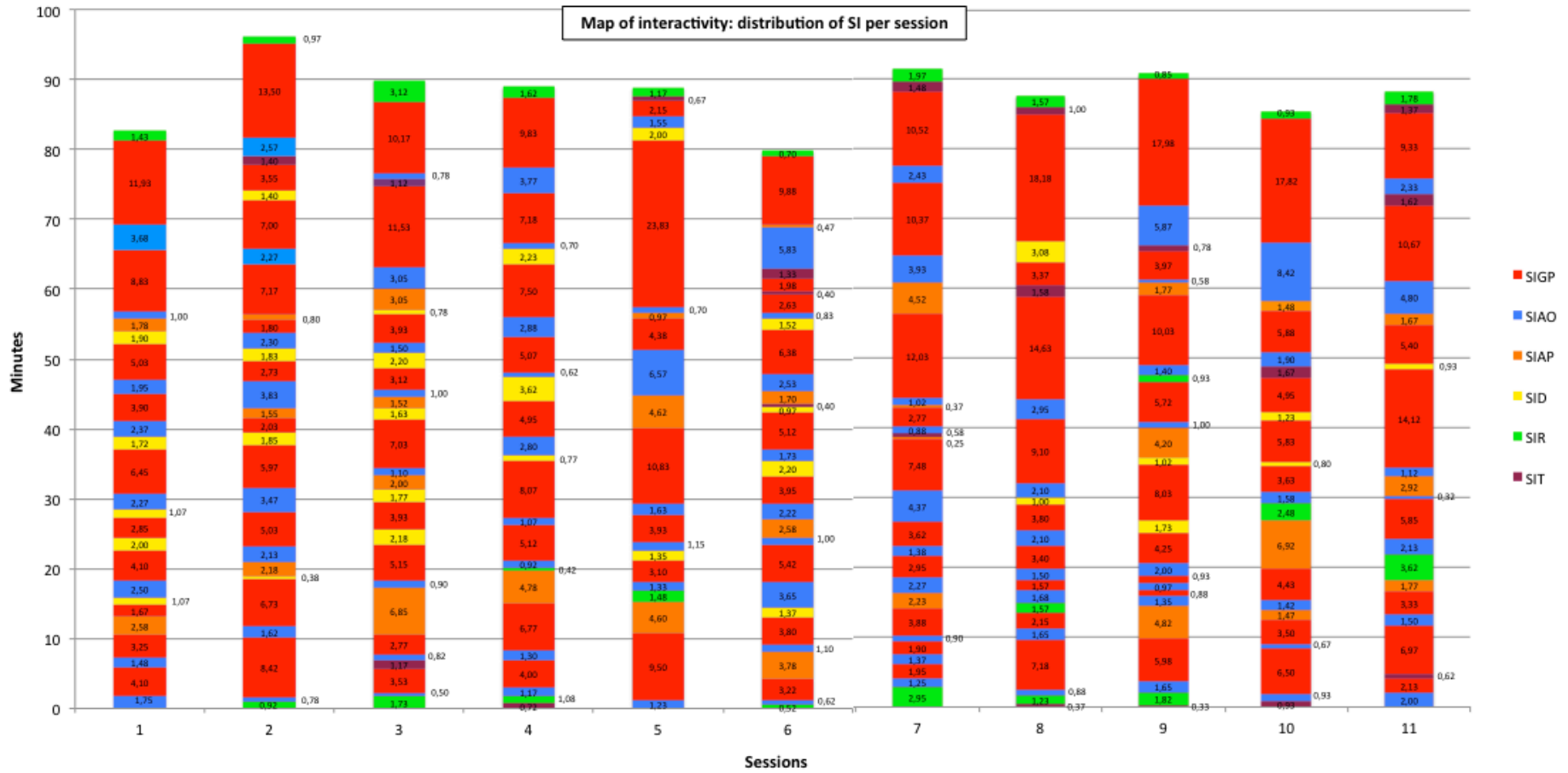
The numbers in the figure are the minutes of each segment

The segments of interactivity

We have identified six SIs: (1) SI of Activity Organization (SI Activity Organisation), when the coach explains the main conditions of the tasks to the players, and the players listen and ask questions to clarify aspects of the tasks; (2) SI of Guided Practice (SI Guided Practice), when the players perform the learning tasks and the coach guides this performance, corrects the players providing different types of feedback, asks questions about players' performance and adapts the task conditions when needed; (3) SI of Autonomous Practice (SI Autonomous Practice), when the players lead their own practice while the coach works on other aspects that are not directly related to the task performed; (4) SI of Discussion (SID), when the coach stops the practice creating reflection time around the task contents and the players debate specific contents of the session; (5) SI of Recapitulation (SIR), when the coach reflects on the learning objectives of previous sessions, or the ones worked on in the current session, and the players listen, ask questions or answer the coach's questions; and (6) SI of Transition (SIT), when there is no specific instruction and participants may talk or perform actions that are not relative to the learning objectives. We have also identified different patterns of interactivity of each SI. These patterns configure the actions and dialogues, which take place during the SIs, as outlined above. They provide further information regarding the actions and semiotic resources performed and used during each SI, and are explained in detail in the results section of this third article.

Using the SIs as a reliable method for analysing how joint activity evolves (e.g. Coll et al, 1992; López-Ros, 2001; Pradas, 2012), we provide answers to the first two objectives of this study. These are to analyse and describe how joint activity is

organised and describe how players progressively take responsibility and control of learning. The results show the main trends during the learning sequence. Firstly, there is a slight decrease in the total number of SIs over the course of the rugby unit, and this suggests that the transfer of responsibility might occur when the sessions have less segmentation and become more fluid. According to other studies (López Ros, 2001; Pradas, 2012), this is an indication of an interactivity evolution, where the time of activity is longer, denoting that players have a better understanding of task organisation and completion. This trend appears in our research with a decrease in the number of SI Guided Practice, but maintaining a similar time span, meaning that as the learning sequence progresses, each SI Guided Practice becomes longer. The SIs Activity Organisation show a similar trend as the SIs Guided Practice over the course of the unit. López-Ros (2001), in this sense, reported a decrease in number and length of time in both Activity Organisation and Guided Practice. The author explains these results, saying "because the students have a higher practical knowledge and therefore they require less time to execute the tasks in good conditions" (p. 391).

Another result relative to joint activity evolution shows an inverse proportion between the time of the Guided Practice and the time of the Activity Organisation. Thus, by the end of the unit, we find a trend towards more practice time and less organisation time. This is in accordance with the assumption that players take progressive control over their learning, acquiring more knowledge about task conditions and needing less time for task organisation (López-Ros, 2001; López-Ros, Llobet & Comino, 2013). Moreover, we observe a progressive stabilisation of the times of Guided Practice and Activity Organisation by the end of the teaching and learning process. In relation to the segments on Autonomous Practice, Recapitulation and Transition, we do not find any

clear trend at this level of analysis that may give more clues about the cession and transfer of responsibility mechanism.

The map of interactivity

The most relevant information obtained from the interactivity map (Figure 1) shows some common aspects of the sessions and some changes in relation to segmentation. Firstly, the SI Guided Practice occupies most of the time during the sessions (between 60 and 70 %) and is always preceded by the SI Activity Organisation. This implies that the joint activity is mainly created around the execution of the tasks by players and the coach's intervention to scaffold players learning, and that the teaching and learning process revolves around the task control. It is from the players' task execution that the coach gathers immediate information about their game performance and learning progression, and can adjust the help needed to enhance the knowledge construction around tactics employed in rugby. Task type relative to the pedagogical model (IT-TM) emphasise tactical and technical aspects of rugby in the game context, and are also important elements of the coach's action influencing this specific joint activity organisation. Secondly, the first halves of the sessions are more fragmented, as they contain more SIs than the second halves, where there is less segmentation. This is due to the importance given to the warm up, which takes up a quarter of the whole session time. Because of the physical contact involved in rugby, this part of the session is quite specific, and it is usually structured in general and specific tasks for these purposes. Recapitulation of previous learning objectives or the introduction of new ones in the SIRs occur at the beginning of the sessions or after the warm up, and always at the end of the sessions where the coach sums up the major points learnt during every session in

relation to previous knowledge. Furthermore, a trend of less segmentation is observed in the interactivity map, where, by the end of the unit, sessions have fewer SIs. The interactivity map also shows that the process of learning transfer occurs with breakdowns, setbacks and disruption, and it is problematic and complex (Coll et al, 2008, 2010; Coll & Rochera, 2000; López-Ros, 2001; Pradas, 2012). This is observed in sessions three, five and six where segmentation increases abruptly in relation to the previous and subsequent sessions, and the configuration of the segments varies in a relevant way. This is explained by the fact that the teaching and learning process of knowledge construction relies on many different factors, which are not always observable. These factors condition and influence the mental constructive activity of learners, making it partially unpredictable (Pradas, 2012). In the context of our research, when new players came to some sessions to try the sport, contents and tasks from prior sessions had to be explained and recalled. However, this also meant that some participant-players of this study adopted supportive behaviour in order to help the new ones. The second article deals with players' procedural knowledge construction, and we observe that during this process learning outcomes were not lineal, and that players seemed to go back in their game performance level, before later progressing in relation to the learning objectives. Other works that study the learning transfer mechanism in PE also report these setbacks and breakdowns during the learning sequence (López-Ros, 2001; Pradas, 2012), in addition to other fields of knowledge and educational settings (e.g. Coll et al., 2008).

Reflection time: the SIDs and the B-patterns of the SIGP

When we examine the time devoted to reflection, and discussion of the contents learnt during the sessions, we find one of the most relevant results of this analysis. At the beginning of the unit, the coach creates specific spaces of debate and reflection during the SIDs. The discussion is mainly around tactical aspects of the game. As the unit evolves, this time of discussion is progressively transferred to the SI Guided Practice. One of the patterns of interactivity of this SI (see appendixes) describes the time spent correcting and discussing players' actions during the tasks. Thus, the coach does not stop the task, but find spaces during the task to promote dialogue and interrogative feedback around particular actions by the players. The time spent discussing (mainly) tactical issues during these B-patterns increases over the rugby unit, while the number of SIDs decreases. This result suggests that the progressive transfer process is linked to spending more time on the feedback and reflection directly related to the performance of players during the learning tasks, and less time on specific SIDs. Hence, declarative knowledge and tactical thinking are initially discussed in specific segments of discussion and, as the learning sequence evolves, the coach progressively relates this tactical thinking to the behaviours of players during their task execution in connection with their procedural knowledge construction. This is observed over the analysis of the contents discussed and corrected in the B-patterns of the SI Guided Practice along the learning sequence. Interestingly, the main topics discussed, first during the SIDs, and subsequently in the B-patterns, are relative to tactical aspects connected to the learning objectives of the unit. These are, for example, perceiving and finding spaces in the defensive line in order to attack, and drawing a defender and passing the ball in situations of superiority in attack.

There are few studies from the same theoretical framework that analyse the interactivity of teaching and learning sequences in physical education (PE) and sports. López-Ros (2001, 2013), in his research on team sports initiation in primary school PE, reported a decline of segmentation. However, Pradas (2012) did not find this reduction of the segmentation in his educational sequence of floorball in the context of primary school PE. In relation to the SIDs, both studies describe an increase of these segments, claiming that the increase of these 'conceptual' segments is related to the acquisition of procedural knowledge during the SI Guided Practice (López-Ros, 2013). In our study, the time devoted to discussion and reflection does not increase or decrease but is transferred from the SIDs to the B-patterns of the SI Guided Practice, as reported above.

Discussion

To summarize, in accordance with other studies (e.g. Coll et al, 1992; Coll & Rochera, 2000; López-Ros, 2001; Pradas, 2012), the analysis of the interactivity seems to be a good way to better understand how the process of knowledge construction occurs during a teaching and learning sequence. With this research we provide more information about this process in a coaching setting. Results in relation to the transfer of responsibility in a coaching process suggest that this mechanism occurs and, in our case, is linked to (a) a certain decrease in the segmentation of the sessions, (b) a progressive transfer of the reflection time from specific segments of discussion to the dialogues that emerge during the practice of learning tasks, and (c) the application of the comprehensive coaching model that scaffolds players, adjusting the help provided by the coach. These are relevant contributions to enhance comprehension of the underlying features of a coaching process where players build their knowledge around a sport-

related content. Another methodological contribution of our study relies on the analysis of the SI Guided Practice. In this segment, we identified a pattern of interactivity in which the coach asked questions, provided feedback and promoted reflection during the practice session. Analysis of the coach's corrections and discussion by participants over the course of the learning unit during these segments, in parallel with an analysis of contents discussed during the SIDs, has provided substantial information relative to the evolution of the joint activity and the declarative knowledge construction, as set out above.

Although none of the published studies[2] analysing the teaching and learning process in PES from a social constructivist perspective use the interactivity analysis model applied in our research, we highlight authors that have studied aspects of the learning process with relevant links to our work. McNeill, Fry, Wright, Tan and Rossi (2008) studied student teachers (STs) applying the game concept approach, a GCA model from Singapore, in their PE practicum lessons. The study was based on analysing previously established segments of the session related to *teacher time* (including organisation, demonstration and closure) and *pupil time* (including practice time -drill time and skill time- and game time). The authors also analysed the types of questions asked by STs, including knowledge, technical, affective and tactical questions. Even though the results are difficult to match with our study, due to the different settings and research designs, it is interesting to note that in the context of primary and secondary schools, pupil time and teacher time (similar to our SI of Activity Organisation and Guided Practice) are quite similar in their study (53 and 47 % respectively). However, in our research the Guided Practice segment has the highest percentage; as mentioned above, this is

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[2] We refer to papers published in JCR journals of physical education and sports.

between 60 and 70 %, over the course of the unit, compared to the other segments. In relation to the types of questions used, tactical questions represent a low percentage (6.7 %), while knowledge questions make up the majority (76.3 %). Relating these results to the content analysis discussed during the SIDs and the B-patterns of interactivity of the SI Guided Practice, we observe that tactical aspects of the game are, by far the most frequently discussed issues during the learning sequence. Differences in these results compared to our study may be associated with (a) diverse settings –school vs. club- in which the educational intentionality, as well as the characteristics of learners, are quite different, and (b) the experience of the educational agent. McNeill et al. (2008) study STs in their practicum stage, but in our research the agent is an experienced coach. Similar to the conclusions reported in the third paper of this thesis, the above authors state "scaffolding through questioning is important for developing an appreciation of how the lesson practice task component relates to the game" (p. 242). This correlates with the conclusions of this thesis and is consistent with the principles of the pedagogical model (IT-TM) that we have applied. In relation to the importance of reflection during the teaching and learning process, Wallian and Chang (2007) point out the need for learners to share their understanding of actions through dialogue in order to co-construct knowledge in a community of practice. From the semio-constructivist approach, the authors advocate undertaking an authentic discourse analysis as they consider that language productions can be interpreted as projects of action, thus influencing knowledge co-construction. Following along these lines in our study, we interpret the actions and verbal productions of players in relation to the instructional function of each teaching-learning situation, when we identify and describe the segments of interactivity and the patterns of interaction of each segment. However, the dialogues between participants as a means of understanding the learning transfer

process are not analysed in depth. This more detailed analysis would take place when exploring the creation of a shared meanings system, something that is not the aim of this thesis. Light and Fawns (2003) highlight the idea of understanding knowledge as action, or knowledge-in-action, as expressed similarly by Wallian and Chang (2007). This conception of knowledge, shared in our study, brings about the integration of techniques and tactics when teaching team sports, since decisions and actions in a game context are inseparable and conceptualized as "embodied cognition" by Light and Fawns (2003; p. 165). In this sense, the authors express the need to use reflection and questioning to link knowledge-in-action of practice with the understanding of this embodied cognition, affirming that "speech, thought, and action interact to construct individual and collective understandings in a more integrated, cohesive, and human class dialogue" (p.167). This idea links with the evolution of the joint activity of our study, where dialogues and discussions promoted to co-construct this collective understanding were progressively transferred from specific segments of Discussion to reflections that emerged during the segments of Guided Practice.

Limitations and future recommendations

This research has limitations, and these open the door to further studies, which would deepen the knowledge of teaching and learning in PES. Regarding the limitations, we begin by focusing on the methodology and data collection. Firstly, given the fact that rugby is a contact sport, for safety reasons we could not attach a wireless microphone to each player. This meant that we could not record all verbal exchanges between players during practice. We addressed this problem by having three different devices to record the audio during the sessions: a wireless microphone worn by the coach, a fixed video

camera by the playing field and a digital audio-recorder held by the coach or a player during discussion segments. To record conversations between players even without the presence of the coach would have provided more insight into the learning transfer process and the acquisition of autonomy and increasing responsibility by players (Darnis & Lafont, 2015). Although we have not analysed the specific contents of these verbal exchanges from a linguistic perspective, further analysis of this type would be desirable to deepen the knowledge of the transfer process. Secondly, one reviewer of the third article argued that the length of the coaching sequence was too short to analyse the transfer of learning responsibility or to even claim learning outcomes. We believe, however, that in line with the aims of the thesis, we have been able to report results on both transfer of learning responsibility and learning outcomes. Moreover, most research carried out in the field of teaching and coaching has learning units of a similar length (Miller, 2015). A longer unit may have provided more consistent results, but we argue that 11 sessions of 90 minutes provide enough data to study the transfer of learning responsibility and to report certain achievement levels of the rugby unit learning objectives. Considering the use of the RAAI, the instrument has a limitation relative to the control of its application variables. Certain weather conditions, leadership of participants, specific instructions of the coach, situation of the players in relation to the ball carrier, among others, are variables that the RAAI do not take into account and that may influence the results of the IP. We suggest that when applying the RAAI several times to assess the learning progress of the players, the coach should make sure that players perform the tests in similar external (i.e. weather, kind of surface, time of the day) and internal (i.e. level of fatigue, level of players, physical characteristics of the players of each team) conditions in order to minimize the influence of these variables on the IP. Concerning the limitations relative to data analysis, we highlight the inferential

analysis of results when applying the RAAI. Due to the lack of data on inferential purposes when performing the RAAI during the learning sequence, it was not possible to establish significance between the four IPs of the RAAI. Therefore, we decided to study the linear trend significance of the four tests, as previously reported. Another limitation of the study linked to data analysis was the identification and delimitation of the segments of interactivity. This required analysing the sessions several times; paying special attention to the communication between participants and the actions they performed. It also implied identifying the use of semiotic devices and their intentionality. Once identified, understanding and delimiting the segments was a long process. We have not conducted observers' reliability statistical tests in this data analysis, although this process has been carried out and discussed jointly with the members of our research group. Finally, we discuss some theoretical limitations in relation to the object of study, that is, the transfer and cession of learning responsibility and control to the learners. This process, as stated in the introduction is influenced by the bidirectional relationships established in the interactive triangle, and is based on the constructive mental activity of the learner (Coll, 2001). The coach, as the educational agent in this process, is responsible for adjusting the help when scaffolding the players, promoting their constructive activity around rugby. However, we considered the group of 10 players as one, assessing them as a unit, or a team, assuming that this educational mechanism influenced all players in a similar way. This is probably the best way to research the transfer of learning in our teaching and learning setting of a team sport, but it could miss individual differences and nuances of the mental constructive activity of each player. Moreover, we did not take into consideration the analysis of peers' influence on this learning process (Barker, Quennerstedt & Annerstedt, 2013; Ward & Lee, 2005). More expert players have a relevant role in supporting the knowledge

construction of their peers, at times in addition to the coach (Darnis & Lafont, 2015). To understand these social interactions between peers sharing a common learning space in the ZPD, we should focus the analysis on the peers' interactions and verbal exchanges in a similar way to our analysis of the coach-players interactions. The theoretical construct of this thesis supports the role of the coach as the mediation agent between the learners and the content, and we have focused our study on this role of educational influence. However, it is important to consider to what extent peers also play a relevant role in the appropriation of knowledge.

Further research could enrich the development and results of this thesis. Firstly, there is room to explore the benefits of RAAI. The assessment of off-the-ball actions is one of the issues worth developing, as mentioned by Harvey and Jarrett (2014). Following the same method used to identify and weight the actions of the ball carrier, defensive and supportive actions could be also described and weighted, and included in the IP of a team. In addition, other sports could be assessed using a similar assessment tool to that used in the RAAI, but adapted to their specific circumstances. Secondly, the learning sequences of other sports could be assessed in order to more consistently show the benefits of the IT-TM approach to teaching and coaching. Since the interactivity triangle has three elements that interact and have bidirectional influences, we propose a deeper analysis of the content and how it influences teachers' and coaches' decisions during the constructive activity of learners, when IT-TM is applied. Thus, content sequencing during the learning unit, and its influence on the learning transfer process, is proposed as another relevant focus of attention of research needed to better understand the interactions between all the elements of joint activity organisation. In relation to analysing interactivity and studying the transfer of learning responsibility, there is the

need to develop further studies in the field of physical education and sports coaching to observe if there is a general trend in the evolution of interactivity and if educational influence mechanisms emerge. This is relevant given the fact that PE and sports contents are procedural by nature (as well as declarative), and rely on specific motor skills and decision-making competence (Gréhaigne, Richard et al., 2005). Another aspect of research that could be triggered in this field of sports sciences is the study of the progressive construction of a shared meanings system. We believe that the study of this second educational influence mechanism, related to the application of GCA, makes sense and would help to understand the learning process in the context of a constructivist perspective. If learning is social and cultural by nature (Vigotsky, 1978), the analysis of semiotic devices, particularly language and signs, enhance the understanding of physical education and sports pedagogy (López-Ros et al., 2013; Wallian & Chang, 2007). Analysing the messages which lead to understanding the creation of a common frame of reference relative to the shared meanings often takes place alongside the study of learning responsibility transfer (Coll et al., 2008), and is considered of major relevance in the understanding of joint activity organisation in the teaching and learning process.

5. GENERAL CONCLUSIONS

To conclude, each article highlights specific results in relation to the research methods and outcomes. The main conclusions set out in this chapter refer to the following: the design and validation of the RAAI; the results obtained after applying the IT-TM; and an analysis of the interactivity and transfer of learning responsibility from coach to players.

In the first article, we highlight the main contributions of the RAAI as a rugby-specific assessment tool:

- The RAAI is a valid and reliable instrument to assess game performance of novice rugby players' in attack.

- The RAAI provides a team score that sums up the actions of all players in a team when they become ball carriers.

- The RAAI assesses tactical performance attached to skill execution by taking into account both combined actions and simple actions.

- The IP is a holistic measure that serves as a macro-level score to determine learning evolution.

- Changes in performance on a micro-level may be observed with the RAAI by analysing the influence of specific actions on the IP scores.

The conclusions of the second article are related to applying the IT-TM in the rugby unit and the effects observed by using the RAAI:

- The IT-TM is a teaching/coaching approach that has had a positive effect on players' knowledge construction in the context of our 12-session learning sequence of rugby union.

- The overall learning evolution of the sequence, regarding the IP, did not produce significant changes in relation to the linear trend of the four tests performed.

- The changes observed in the descriptive analysis were mainly due to a higher frequency of combined actions with a tactical value. These actions were related to solving superiority situations and simple actions of passing the ball.

- Descriptive analysis shows that players took more risks by the end of the unit leading to an increase in handling errors.

- Descriptive analysis also shows a decrease in the frequency of players breaking the defence, possibly due to an increase in players' defensive skills.

- The principles of simplification and exaggeration of the IT-TM are effective in scaffolding players during their learning progress. This adjustment in help offered is not always planned and often emerges during the practice according to the players' responses to learning tasks.

- Stage two of the IT-TM is crucial in designing tactical and technical tasks that will affect game competence when players perform small-sided games in the following stage three.

Finally, the third article analyses the joint activity organisation of the learning sequence and the educational influence mechanism of progressively transferring the learning responsibility and control from the coach to the players. From this analysis we can conclude the following:

- The learning sequence has a decreasing trend in the number of segments of interactivity. This progressive reduction of segmentation seems to be in accordance with the transfer of learning responsibility.

- The interactivity is mainly built around the SIs of Guided Practice, which take up the majority of the time in the sessions. These increase slightly during the learning sequence, and are always preceded by SIs of Activity Organisation, which show a slight decrease over the course of the sequence.

- The time devoted to discussing tactical aspects of the game in relation to the learning objectives is progressively transferred over the course of the unit from specific SIDs to the SIs Guided Practice, when patterns of correction and discussion occur. This may represent another feature of the transfer of learning responsibility mechanism.

- The use of a comprehensive approach to coaching rugby (IT-TM) enhances knowledge acquisition as it places learners at the centre of coaching and promotes critical reflection and discussion to create tactical awareness.

- This teaching and learning sequence in rugby has not been a smooth, linear process. Instead, it encounters unpredictable disruptions, setbacks and breakdowns. This can be seen in the interactivity map; where there are segmentation breaks in some sessions, and also in the RAAI results, where players' performance decreases during formative assessment, only to increase again by the end of the unit.

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