Synthesis and literature review of different mixed methods designs in pedagogical research in physical education

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Abstract

Introduction: In recent years, hybrid methodologies have undergone considerable development. For sport pedagogy research, this mixed methods design is helpful because it moves beyond paradigm wars or conflicts between qualitative and quantitative research. However, mixed research in physical education remains rare, whereas the literature is much richer in the sports field.

Purpose: This paper gives a synthesis of the use of hybrid methods in sport pedagogy research both in a literature review and in this special issue entitled "Mixed methods in intervention sciences in PSE: a heuristic enrichment or a weakening of frameworks?".

Methods: For the literature review, we used the EBSCO database using SPORTDiscus. The keywords selected were "physical education" and "pedagogy" crossed with "multimethod" or "mixed methods" or 'multilevel analysis' or "multisource" or "multimodal" or "combined analysis". In total, 23 articles were found, and we retained 11 articles corresponding to the selection criteria. We added the six articles of this special issue. Thus, 17 articles were analyzed by identifying: the object of study, the type of data collected, the articulation of approaches, the articulation of methods, the articulation of data and the function of the MMR used.

Findings: The results of this literature review show that the term "mixed methods" covers the largest number of studies. The articles selected are recent with most studies from 2018 onwards. The 17 articles selected present different objects of study (mainly focusing on student perspectives, intervention programs and physical activity). The articulation of approaches shows that theoretical frameworks are often based on a contextualized approach, mainly in the classroom. Most of the studies presented in this review do not work on the

congruence of the theoretical frameworks (most often, the articulation is not specified). However, it is different in the special issue with precision about paradigm emphasis. Articulation of methods is mostly convergent, implementing both quantitative and qualitative methods in a single phase. The quantitative data analyzed are audio and/or visual recording, measure of physical activity (accelerometry), measures of performance or motor skills and surveys. The qualitative data are mainly from interviews (mostly semi-structured interviews in the literature review, and self-confrontation interviews in the special issue). Articulation of data priority is often given to qualitative data. The function of the mixed methods is mainly complementarity.

Discussion and conclusion: This section highlights the strengths, weaknesses, and opportunities of MMR, questioning its supremacy as a third research paradigm. The conclusion indicates the limitations of this literature review and offers perspectives for future research, advising making the articulation more explicit especially in theoretical concerns.

Keywords: mixed methods research, multimethod, pedagogy, physical education

Introduction

Hybrid methodologies have grown exponentially in recent years. Many terms are used: integrative research, mixed model (Johnson and Onwuegbuzie 2004), triangulation (Morse 1991), combined approach (Depraz and Desmidt 2019), multimethod (Greene 2015), articulating heterogeneous data (Adé et al. 2020), mixed methods research, mixed methods, (Anadón 2019; Camerino, Castañer, and Anguera 2014; Creamer and Reeping 2020; Creswell and Plano Clark 2018; Hesse-Biber and Johnson 2015; Pluye et al. 2018; Schweizer, del Rio Carral, and Santiago-Delefosse 2020).

The term "mixed methods research" (MMR) seems to be the most structured and widespread with the appearance in 2007 of a dedicated journal, the *Journal of Mixed Methods Research*, the production of numerous MMR framework documents (Anadón 2019; Camerino, Castañer, and Anguera 2014; Creamer and Reeping 2020; Creswell and Plano Clark 2018; Greene 2007; Hesse-Biber and Johnson 2015; Pluye et al. 2018; Schweizer, del Rio Carral, and Santiago-Delefosse 2020; Tashakkori and Teddlie 2003), and the increase in research mentioning "mixed methods". Timans et al. (2019) showed on Web of Sciences a very steep increase after 1994 with an increase of 855% between 1994 and 2008. Also, Creswell and Poth (2016) report an almost hundred-fold increase in the number of theses and dissertations with "mixed methods" in the citation and abstract (from 26 in 1990-1994 to 2524 in 2005-2009). The definition of MMR has evolved from a focus on methods (Greene et al., 1989), to methodology (Tashakkori & Teddlie, 2003), and finally to theoretical concerns with philosophical orientation (Johnson et al., 2007). Currently Creswell and Plano Clark (2018) state that in mixed methods, the researcher collects and analyses both qualitative and quantitative data rigorously in response to research questions and hypotheses, integrates (or mixes or combines) the two forms of data and their results, organises these procedures into

specific research designs that provide the logic and procedures for conducting the study, and frames these procedures within theory and philosophy.

However, it is not easy to find one's way through these approaches, as there are so many possibilities. Greene et al. (1989) proposed very early on a well-known classification (cited more than 8,000 times on Google Scholar) of the different MMR according to their function: triangulation, complementarity, development, initiation, and expansion.

> "Triangulation seeks convergence, corroboration, correspondence of results from the different methods. Complementarity seeks elaboration, enhancement, illustration, clarification of the results from one method with the results from the other method. Development seeks to use the results from one method to help develop or inform the other method, where development is broadly construed to include sampling and implementation, as well as measurement decisions. Initiation seeks the discovery of paradox and contradiction, new perspectives of frameworks, the recasting of questions or results from one method with questions or results from the other method. Expansion seeks to extend the breadth and range of inquiry by using different methods for different inquiry components." (Greene, Caracelli, and Graham 1989, 259).

Since then, many classifications of mixed methods design have been developed, such as simultaneous triangulation, and sequential triangulation (Morse 1991), qualitative preliminary, quantitative preliminary, qualitative follow-up, and quantitative follow-up (Morgan 1998), sequential explanatory, sequential exploratory, sequential transformative, concurrent triangulation, concurrent nested and concurrent transformative (Creswell et al. 2003), parallel mixed designs, sequential mixed designs, conversion mixed designs, multilevel mixed designs, and fully integrated mixed designs (Teddlie and Tashakkori 2009),

convergent, explanatory sequential, and exploratory sequential (Creswell and Plano Clark 2018).

Beyond this diversity, it seems heuristically productive to look at the types of articulation to understand the specificity of MMR, articulation of approaches, articulation of methods, articulation of data. First, the articulation of approaches is problematic. The first generation of researchers who used mixed methods did not concern themselves with questions of epistemological foundations and even less with notions of incompatibility and incommensurability (Anadón, 2019). The congruence between quantitative and qualitative frameworks has become a huge debate. Pragmatists consider mixed method a new way to understand the world, a third paradigm: "Mixed method research as the third research paradigm can also help bridge the schism between quantitative and qualitative research" (Onwuegbuzie and Leech 2005). We have concerns about this debate. We will later question the approach that considers the MMR as a "third research paradigm" (Johnson and Onwuegbuzie 2004). Anyway, the articulation of approaches is not well developed in the articles. The most used qualitative approaches are based on exploratory case studies, ethnography, grounded theory, phenomenology and life stories or biographies (Pluye et al., 2018, 32). Typical quantitative approaches may be descriptive (e.g., prevalence or incidence surveys), non-randomised studies (e.g., cross-sectional analytical or cohort or case-control surveys or quasi-experiment) and randomised controlled experiments.

Second, the articulation of methods is an important point in the design of MMR. Quantitative and qualitative methods can be organised concurrently or sequentially (Morse, 1991). Concurrently, when the methods are used at the same time, on the same sample, and sequentially, when the study design separates the qualitative and quantitative phases. Creswell and Plano Clark (2018) chose method articulation as their central principle for classifying MMR in the third edition of their book *Designing and Conducting Mixed Methods Research*,

convergent, explanatory sequential, and exploratory sequential. Convergent design occurs when the researcher intends to bring together the results of quantitative and qualitative data analysis so they can be compared or combined. For example, in an elite rowing pair crew, quantitative biomechanical data were articulated with qualitative phenomenological data to investigate the cooperation between rowers (R'Kiouak et al. 2018). Explanatory sequential design occurs in two distinct interactive phases. It starts with the collection and analysis of quantitative data, then the collection and analysis of qualitative data, to explain or expand on the first-phase quantitative results. For example, in this special issue, Girard et al. (in this special issue) use a quantitative method with questionnaires on a large number of students to identify those with the greatest variation in perceived teacher support. These students are then selected for further qualitative case studies with self-confrontation interviews to understand the underlying experiential processes. On the other hand, the exploratory sequential design begins with the collection and analysis of qualitative data in the first phase.

> "Building from the exploratory results, the researcher conducts a development phase by designing a quantitative feature based on the qualitative results. This feature may be the generation of new variables, the design of an instrument, the development of activities for an intervention, or a digital product, such as an app or website. Finally, in the third phase the investigator quantitatively tests the new feature. The researcher then interprets how the quantitative results build on the initial qualitative results or how the quantitative results provide a clear understanding because they are grounded in the initial qualitative perspectives of participants" (Creswell and Plano Clark 2018, 65).

This design is also called generative methodology and is used in neurophenomenology (Varela, 1996) and cardiophenomenology (Depraz & Desmidt, 2019). For example, in the field of sport, this design was used in a study of hydration packs in trail running (Rochat,

Hauw, and Seifert 2018). The lived experience of the trailer was analysed first, using a phenomenological approach, to identify a macroscopic variable. This qualitative method highlighted that the runners perceived the sloshing of the hydration pack as uncomfortable. This allowed the researchers to focus quantitatively on this problem, using quantitative methods such as pack movements, accelerations, and coordination of movement between the runner and the carrying system.

Third, the articulation of data is a key issue in MMR. The type of data can be varied. Varela and Shear (1999) propose a modelling in first-person and third-person data. First-person data are linked to the lived experience associated with cognitive and mental events.

> "Sometimes terms such as 'phenomenal consciousness' and even 'qualia' are also used, but it is natural to speak of 'conscious experience' or simply 'experience'. These terms imply here that the process being studied (vision, pain, memory, imagination, etc.) appears as relevant and manifest for a 'self' or 'subject' that can provide an account; they have a 'subjective' side" (Varela & Shear, 1999, 1).

In sport and physical education, first-person data is mostly qualitative, mainly from interviews, focus groups and accounts of experience (e.g., Mouchet, Morgan, and Thomas 2018). Third-person data concerns the descriptive properties of world events without a direct manifestation in the experiential-mental sphere of the actor. "The ostensive, direct reference is to the 'objective', the 'outside', the content of current science that we have today concerning various natural phenomena, such as physics and biology" (Varela & Shear, 1999, 1). Third-person data is often quantitative, such as mechanical and biomechanical data on athletes' gestures, postures and movements (e.g., Adé et al. 2009; R'Kiouak et al. 2018; Seifert et al. 2014) or physiological (e.g., Vors et al. 2019).

The status of this data varies according to the study. Qualitative or quantitative data may have a subordinate or equal relationship. For example, in sport, the study by Adé et al. (2020),

based on the cross-referencing of three studies, showed different types of articulation between the data, with a prevalence of qualitative data of lived experience over biomechanical data in a technological training device for swimming, or an equal relationship between quantitative and qualitative data on the use of different ice axes in glacier climbing. Other studies grant a predominance of quantitative kinetic data over qualitative data to study interpersonal coordination in rowing performance (Seifert et al., 2017). This status of the data has a direct influence on its articulation in the analysis. Articulation of data in the analysis is considered a high-quality feature of MMR (Schweizer et al., 2020). Data fusion is a particular articulation (Creswell & Plano Clark, 2018) that includes: comparing and contrasting two sets of results for key study topics. The fusion allows to analyse one form of data (e.g., quantitative scores) against the other (e.g., groups identified from qualitative data). Furthermore, this articulation of data transforms one type of result into another form of data for further analysis (e.g., converting qualitative themes into numbers for statistical analysis) (Schweizer et al., 2020, 36). The joint presentation of data in the results ensures an articulation with a high level of integration that is considered particularly useful. The articulation of data in the analysis is considered a high-quality feature of MMR (Schweizer et al., 2020).

The proliferation of MMR first took place in the frameworks of social and behavioural research (e.g., Greene 2007; Tashakkori and Teddlie 2003; Timans, Wouters, and Heilbron 2019). Over the years, the general acceptance and use of this approach has varied according to the disciplinary context. For example, psychology has been one of the slowest disciplines to adopt mixed methods (e.g., Creamer and Reeping 2020; Mayring et al. 2007; Schweizer, del Rio Carral, and Santiago-Delefosse 2020). This delay is often attributed to the strong quantitative orientation in psychology's training and research practices (Creamer and Reeping 2020; Schweizer, del Rio Carral, and Santiago-Delefosse 2020). Beyond the theoretical framework, the proliferation of MMR has been important in various fields like health (e.g.,

Hong et al. 2018; Morgan 1998), education (e.g., Creswell et al. 2003; Teddlie and Tashakkori 2009), and sport (e.g., Camerino, Castañer, and Anguera 2014; Smith and McGannon 2018). However, mixed research in physical education remains rare, whereas the literature is much richer in the sports field (e.g., Adé et al. 2020; Smith and McGannon 2018). For instance, only one physical education study is presented in the major work of Camerino et al. (2014), which covers different domains in the field of physical practices such as sport, physical education, and dance. It therefore seemed important to make an inventory of the use of mixed methods in physical education and particularly in practices in the field of intervention sciences (Vors et al. 2020) or sport pedagogy (Kirk and Haerens 2014).

Method: Identification of Studies

This literature review was conducted to make an inventory of the use of hybrid methods in physical education in pedagogy field.

We used the EBSCO database, as was done in other literature reviews published in PESP (S. Harvey and Jarrett 2014; Hastie, Ojeda, and Luquin 2011), using SPORTDiscus, based on fifteen databases: AAFLA, Atlantes Database, Coaching Association of Canada Documents, Grosse Adapted Aquatics Database, Handicapped/Disabled Sport and Recreation Documents, Heracles Database, Indexing Partner Contribution, National Coaching Certification Program of Canada, Olympic Museum Library Database, Passor Bibliography, Recreation Research Report, Recreation and Leisure, SIRLS Database, Sport Canada Applied Research Grant Program/Fitness Canada, Sport History Project. The selection of articles was carried out in three stages: keywords choices, inclusion criteria, and exclusion criteria. The keywords selected were “physical education” and “pedagogy” crossed with “multimethod” or “mixed methods” or ‘multilevel analysis’ or “multisource” or “multimodal” or “combined analysis”. The research was extended to “Apply related words” and “Apply equivalent subjects”. The

inclusion criteria were: English language, academic journal, peer-reviewed. The exclusion criteria were: literature reviews, conference proceedings, article about sport, article using only one methodology, article evaluating scale or an instrument. In total, 23 articles were found, and we retained 11 articles corresponding to the selection criteria (Dyson et al. 2016; Farias et al. 2019; Fernandez-Rio et al. 2020; Freak and Miller 2017; Grimminger 2013; Harris et al. 2018; W. Harvey et al. 2014; Hastie, Rudisill, and Boyd 2016; Morales-Belando, Calderón, and Arias-Estero 2018; Powell et al. 2019; Wainwright et al. 2018). Furthermore, we added the six articles of this special issue "Mixed methods in intervention sciences in PSE: a heuristic enrichment or a weakening of frameworks?". Thus, 17 articles were analysed by identifying: the object of study, the type of data collected, the articulation of approaches, the articulation of methods, the articulation of data and the function of the MMR used according to the nomenclature of Greene et al. (1989).

Findings

The results of this literature review show that the term "mixed methods" covers the largest number of studies (n=18), while the other terms "multimethod" or "multilevel analysis" or "multisource" or "multimodal" or "combined analysis" cover only five articles. After applying the exclusion criteria, only 11 articles were retained (Table 1), as the others were mostly articles about sport, scale validation or instrument validation. "Multimethod" or "multilevel analysis" or "multisource" or "multimodal" or "combined analysis" often refer to different statistic tests using only one kind of method. Even if the research was not limited in time, the articles selected are recent: their publication date is between 2013 and 2020 with most studies from 2018 onwards. To report on the 18 articles selected (11 from the literature review, Table 1; and six from the special issue, Table 2), we will present: 1) the object of study, 2) the articulation of the approaches, 3) the articulation of the methods, 4) the

articulation of the data, and 5) the function of the MMR used according to the nomenclature of Greene et al. (1989).

[Table 1 near here].

[Table 2 near here].

Subject of Study

The purposes of the selected studies, both in the literature review (Table 1, Column 2) and in the special issue (Table 2, Column 2), are various. Among the 11 studies selected from the literature, two are focused on the teacher's perspective. One analyses pre-service generalist teachers' perceptions of preparedness to teach primary school physical education (Freak and Miller 2017), the other explores classroom teachers' perspectives on external providers in their primary schools (Dyson et al. 2016). The nine other studies are focused on the student's perspective. Four studies are about intervention programmes, the use of gamification in physical education with the Marvel universe of superheroes (Fernandez-Rio et al. 2020), a Teaching Game for Understanding unit of floorball (Morales-Belando, Calderón, and Arias-Estero 2018), a Foundation Phase for the development of physical literacy in Wales (Wainwright et al. 2018), and a preschool mastery climate physical education programme (Hastie, Rudisill, and Boyd 2016). Two papers analyse students' physical activity in different contexts, during primary physical education (Powell et al. 2019), and with children with attention-deficit hyperactivity disorder (W. Harvey et al. 2014). The other studies are about health (Harris et al. 2018), game-play configurations (Farias et al. 2019), and social recognition among peers (Grimminger 2013). In this special issue, one article is about teachers, focusing on their adaptation of the products of didactic engineering (Lenzen et al., in

this special issue). The five others are about students with various perspectives, including a physical activity programme (Berrigan et al., in this special issue), social interactions (Escalié et al., in this special issue), perception of the teacher's support activity with difficult class (Girard et al., in this special issue), dynamics of students' interactions and of students' learning (Adé et al., in this special issue), and self-regulated learning (Kermarrec et al., in this special issue).

Articulation of Approaches

The theoretical frameworks are often based on a contextualised approach, mainly in the classroom, in five studies out of the eleven from this literature review (e.g., naturalistic intervention, ecological approach), and four for this special issue (ecological approach or enactive approach). Beyond that, our results confirm the difficulty of articulating approaches within mixed-method research. Indeed, to our knowledge, most of the studies presented in this review do not work on the congruence of the theoretical frameworks. Most often, the articulation is not specified in the literature review. This is different in the special issue, entitled "Mixed methods in intervention sciences in PSE: a heuristic enrichment or a weakening of frameworks?" Each article explains how the articulation of approaches is done. This articulation is possible because the different approaches share a minimum of theoretical assumptions. For instance, the study of Adé et al. (in this special issue) specifies how and why the ecological and enactive approaches can be intertwined in physical education lessons. In a different way, Girard et al. (in this special issue) explain how the psychosocial approach with a contextual survey is used to expand the range of data of the course-of-action approach because they share a contextual understanding about perception and action.

Articulation of Methods

Articulation of methods is mostly convergent (Table 1, Column Design, and function); seven studies implement both quantitative and qualitative methods during a single phase. The convergent design allows comparison or combination of the quantitative and the qualitative methods. Three studies are sequential since they implement the methods in two distinct interactive phases. More precisely, they are explanatory sequential designs starting by collecting and analysing quantitative data before using the qualitative data type. One of the eleven studies does not specify any articulation strategies. We can illustrate the concurrent mixed-method design with the study of Freak and Miller (2017). The research design features survey and interview data collection methods in a single phase: "a survey method was to collect data representative of all participants in the study whereas interview was employed as a method to collect rich data pertaining to perceptions of individuals within stratified samples". In this special issue (Table 2, Column Design, and function), convergent design occurs in four studies, and sequential design in two studies. For instance, according to the study of Escalié et al. (in this special issue) protocols could be designed using a "sequential" approach, whereby the quantitative data collected in the pre-test and post-test questionnaires could be used to "guide" a more targeted approach to data gathering in the self-confrontation exercise. Moreover, the synthesis of Kermarrec et al. (in this special issue) illustrates how qualitative data can be converted into quantitative data. Thus, conversion mixed data analyses highlight self-regulated learning processes during a learning task in PE. Here quantitative methods provided results about what students learned, and mixed method offered insight into how students learned.

Articulation of Data

Articulation of data is also an important trend in MMR. First, it is important to characterise the data. The type of data collected is relatively similar (Table 1, Columns 3 & 4). The

quantitative data analysed are audio and/or visual recording (in five out of eleven cases), measures of performance or motor skills (four studies) and surveys (four studies). For example, motor skill performance in the study of Wainwright et al. (2018) is evaluated with the Test of Gross Motor Development-2 as a quasi-repeated measure with 18 children. Freak and Miller (2017) use a survey on preparation to teach physical education in primary school with 400 pre-service teachers. In this special issue (Table 2, Columns 3 & 4), the quantitative data are questionnaires or tests (in three out of six studies), motor activity measures (three studies), analysis of tasks with coding system (one study), or occurrences of interaction patterns (one study). In the review of Kermarrec et al. (in this special issue) on self-regulated learning, the quantitative data are mainly questionnaire answers and performance indicators. The qualitative data are mainly from interviews (in ten out of eleven studies), and these are mostly semi-structured interviews (five studies). For instance, the qualitative data of the study of Morales-Belando et al. (2018) is based on two semi-structured interviews at the end of the post-test assessment, one targeting the pupils in groups of five and the other targeting the teacher, with various broad categories including decision-making, technical execution, and game performance. For the articles of this special issue, the qualitative data are also mainly interviews, but the nature of the interviews is different. Five studies out of six use self-confrontation interviews, two studies use semi-structured interviews (one uses both). Regarding the articulation of data, priority is given to qualitative data in three studies (e.g., "The qualitative data were given a higher priority" [S. Harvey, Kirk, and O'Donovan 2014]), to quantitative data in two studies, and in the others no priority is specified. For the articles in this special issue, when the predominant type of data is specified, it is in favour of qualitative data for all studies considered.

Function of MMR

Based on Greene et al.'s (1989) classification, the mixed method aims at data complementarity in nine of the eleven studies considered and triangulation in three studies (Table 1, last column). This trend is reflected in this special issue where the mixed method has a complementarity function in six studies. However, the studies often considered couple complementarity with another function (Table 2, last column). The mixed-method functions are complementarity and triangulation in two studies (Escalié et al.; Berrigan et al., in this special issue) and complementarity and development in two studies (Girard et al.; Adé et al., in this special issue). We can also note that one study illustrates only the initiation function (Adé et al., in this special issue). Moreover, for the literature review of self-regulated learning (Kermarrec et al., in this special issue), the mixed-method functions are triangulation, or complementarity or development, but these functions are not coupled in the studies. Quantitative and qualitative data is nevertheless connected in multiple ways in some of the studies.

Discussion: Strengths, Weaknesses and Opportunities of MMR

The results of our literature review have highlighted that hybrid methodologies in pedagogical research in physical education are exclusively MMR. This is consistent with the increase in the amount of research published in the field of MMR (Timans, Wouters, and Heilbron 2019) and its greater representativeness compared to the multimethod (Greene 2015). According to Greene (2015, 606):

> "compared to a multimethod approach, a mixed methods approach offers (a) opportunities to mix at a method, methodology, and paradigm level; (b) a valuing of both consonance and dissonance; and (c) key opportunities for respectful conversations among different ways of knowing and different ways of valuing. In these ways, a mixed methods approach to inquiry is considered to have a broader reach and potential than a multiple methods approach."

Moreover, MMR is very structured and prompts a deep reflection on methodological questions and philosophical and scientific questions (Creswell and Plano Clark 2018; Hesse-Biber and Johnson 2015; Pluye et al. 2018). This literature review also highlights that publications in the field of sport pedagogy in physical education are very recent, with a majority of studies published from 2018 onward. This shows that the field of pedagogy in physical education has only recently started to use mixed methods research, unlike the field of sport where the interest is longer term (Camerino, Castañer, and Anguera 2014).

Our results allow us to open a more general discussion on MMR. In the selected articles, the contribution of MMR is undeniable as it allows an enrichment of research results. However, the supremacy of MMR, presented as the "third methodological movement" or the "third research paradigm" (Johnson and Onwuegbuzie 2004), and "a new star in the social science sky" (Mayring, 2007, cited by Creswell & Plano Clark, 2018), is questionable. Firstly, the notion of paradigm has must differentiated with exemplars (Kuhn 1962). In a Kuhnian perspective, a paradigm is linked to the social and cultural organizations of researchers. While exemplars are linked to the conceptual-theoretical, technical-procedural, and methodological apparatus for research. So, a paradigm could not be a kind of methodology, as has been shown in the fields of science in physical education and physical education teacher education (Lawson 2009). This point of view denies this use of third research paradigm for MMR. Secondly, is it the quantitative/qualitative distinction that is in fact heuristic? Does the enrichment of results have more to do with the different articulations of approaches, methods, and data than with the quantitative/qualitative distinction? What is heuristic is not simply to cross (qualitative) words with (quantitative) numbers. Even more, as one can qualify numbers and quantify words. Some studies try to quantify qualitative data to help the comparison (Johnson and Onwuegbuzie 2004; Greene, Caracelli, and Graham 1989). In this special issue, we can see this kind of conversion in self-regulated learning (Kermarrec et al., in this special

issue). “Conversion mixed data analysis” is even a categorisation on its own (Teddlie and Tashakkori 2009).

In our view, the interest of MMR lies in the multiple articulations it allows. For example, Mouchet et al. (2014) show the added value in articulating different qualitative approaches, methods, and data to better understand coaches’ intervention in action, employing pre-match semi-structured interviews to explore coaches’ conceptions, recording of coaches’ in-game communications, game analysis using video and ‘scenario of the match’ clips and episodes, and explicitation interviews conducted after the match, exploring coaches’ subjective experience. We see mixed methods thinking in ways that Greene (2007, 20) called “multiple ways of seeing and hearing”. Multiple ways are visible in everyday life, and mixed methods research provides multiple ways to address a research problem. Other factors also contribute to this interest in mixed methods. Researchers recognise it as an accessible approach to inquiry. They have research questions (or problems) that can best be answered using mixed methods, and they see the value of using them, as well as the challenges they pose (Creswell and Plano Clark 2018). The interest is therefore indeed in the interdisciplinarity allowing the articulation of approaches, methods and data around an education phenomenon investigated in its diversity (e.g., Frodeman, Klein, and Pacheco 2017). Interdisciplinarity allows for changes in scale, enabling different levels of understanding of a complex social phenomenon (De Rosnay 1975; Morin 1990). The change of scale allows different and complementary visions: details become invisible on a large scale, but new regularities appear, so that with each grain of observation we both gain and lose intelligibility (Durand, Saury, and Sève 2006).

Conclusion: Limitation and Perspective for Future Studies

A limitation of our research is that the number of studies selected is far lower than the number of existing studies using MMR. If MMR, "multimethod", or "multilevel analysis" or "multisource" or "multimodal" or "combined analysis" do not appear in the title, abstract or keywords, the article did not come up in our search. This observation is also made by Creamer & Reeping (2020, 5) who state that "most research combining qualitative and quantitative methods is not explicitly labelled as 'mixed methods'." However, trying to integrate these terms differently by analysing the body of the text would generate too much documentary noise by drowning the relevant articles in a mass of articles that do not correspond to the criteria used for the literature review.

Perspectives for future research could be on making the articulation of approaches explicit. Our literature review showed that, most of the time, this theoretical or philosophical articulation between approaches was not communicated, and it was rare to have a questioning of their compatibility (e.g., with a naturalistic intervention [Wainwright et al., 2018]). It seems to us that there is a discrepancy between the conceptual evolution of MMR, which was interested early in theoretical concerns with philosophical orientation (Johnson et al., 2007), and the use that is made of MMR in a large amount of research. We recommend, as has been done elsewhere in this special issue (e.g., Escalié et al., in this special issue; Adé et al., in this special issue), clearly explaining the scientific issues involved in bringing together two theoretical frameworks that share a minimum of theoretical and epistemological presuppositions to keep a "paradigm emphasis" between frameworks (Morgan, 1998; Morse, 1991). These precautions will enrich the theoretical, practical, and even social perspectives of these hybrid methodologies in the field of sport pedagogy in physical education.

References

Adé, David, Nathalie Gal-Petitfaux, Nadège Rochat, Ludovic Seifert, and Olivier Vors. 2020. 'Activity Analysis in Sports Situations by Articulating Heterogeneous Data: Reflections and Perspectives for Design Engineering'. *Activités* 17 (17–2). https://doi.org/10.4000/activites.5517.

Adé, David, G. Poizat, Nathalie Gal-Petitfaux, H. Toussaint, and L. Seifert. 2009. 'Analysis of Elite Swimmers' Activity during an Instrumented Protocol'. *Journal of Sports Sciences* 27 (10): 1043–1050.

Anadón, Marta. 2019. 'Les Méthodes Mixtes: Implications Pour La Recherche «dite» Qualitative'. *Recherches Qualitatives* 38 (1): 105–123.

Camerino, Oleguer, Marta Castañer, and Teresa M. Anguera. 2014. *Mixed Methods Research in the Movement Sciences: Case Studies in Sport, Physical Education and Dance*. Vol. 5. London & New York: Routledge.

Creamer, Elizabeth G., and David Reeping. 2020. 'Advancing Mixed Methods in Psychological Research'. *Methods in Psychology* 3 (December): 100035. https://doi.org/10.1016/j.metip.2020.100035.

Creswell, John W., and V. L. Plano Clark. 2018. *Designing and Conducting Mixed Methods Research*. London & New York: Sage.

Creswell, John W., V. L. Plano Clark, Michelle L. Gutmann, and William E. Hanson. 2003. 'An Expanded Typology for Classifying Mixed Methods Research into Designs'. In *Handbook of Mixed Methods in Social and Behavioral Research*, edited by Abbas Tashakkori and Charles Teddlie, 209–240. CA: Sage.

Creswell, John W., and Cheryl N. Poth. 2016. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Sage.

De Rosnay, Joël. 1975. *Le Macroscope. Vers Une Vision Globale*. Paris: Seuil.

Depraz, Natalie, and Thomas Desmidt. 2019. 'Cardiophenomenology: A Refinement of Neurophenomenology'. *Phenomenology and the Cognitive Sciences* 18 (3): 493–507.

Durand, Marc, Jacques Saury, and Carole Sève. 2006. 'Apprentissage et Configuration d'activité : Une Dynamique Ouverte Des Rapports Sujets-Environnements'. In *Sujets, Activités, Environnements : Approches Transverses*, edited by J. M. Barbier and Marc Durand, 61–84. Paris: PUF.

Dyson, Ben, Barrie Gordon, Jackie Cowan, and Allison McKenzie. 2016. 'External Providers and Their Impact on Primary Physical Education in Aotearoa/New Zealand.' *Asia-Pacific Journal of Health, Sport & Physical Education* 7 (1): 3–19.

Farias, Cláudio Filipe Guerreiro, Stephen Harvey, Peter Andrew Hastie, and Isabel Maria Ribeiro Mesquita. 2019. 'Effects of Situational Constraints on Students' Game-Play Development over Three Consecutive Sport Education Seasons of Invasion Games.' *Physical Education & Sport Pedagogy* 24 (3): 267–86.

Fernandez-Rio, Javier, Esteban de las Heras, Tristan González, Vanessa Trillo, and Jorge Palomares. 2020. 'Gamification and Physical Education. Viability and Preliminary Views from Students and Teachers.' *Physical Education & Sport Pedagogy* 25 (5): 509–24.

Freak, Annette, and Judith Miller. 2017. 'Magnifying Pre-Service Generalist Teachers' Perceptions of Preparedness to Teach Primary School Physical Education.' *Physical Education & Sport Pedagogy* 22 (1): 51–70.

Frodeman, Robert, Julie Thompson Klein, and Roberto Carlos Dos Santos Pacheco. 2017. *The Oxford Handbook of Interdisciplinarity*. Oxford University Press.

Greene, Jennifer C. 2007. *Mixed Methods in Social Inquiry*. San Franscisco: John Wiley & Sons.

———. 2015. *Preserving Distinctions Within the Multimethod and Mixed Methods Research Merger*. Edited by Sharlene Nagy Hesse-Biber and R. Burke Johnson. Oxford, UK: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199933624.013.37.

Greene, Jennifer C., Valerie J. Caracelli, and Wendy F. Graham. 1989. 'Toward a Conceptual Framework for Mixed-Method Evaluation Designs'. *Educational Evaluation and Policy Analysis* 11 (3): 255–74. https://doi.org/10.3102/01623737011003255.

Grimminger, Elke. 2013. 'Sport Motor Competencies and the Experience of Social Recognition among Peers in Physical Education – a Video-Based Study.' *Physical Education & Sport Pedagogy* 18 (5): 506–19.

Harris, Jo, Lorraine Cale, Rebecca Duncombe, and Hayley Musson. 2018. 'Young People's Knowledge and Understanding of Health, Fitness and Physical Activity: Issues, Divides and Dilemmas.' *Sport, Education & Society* 23 (5): 407–20.

Harvey, Stephen, and Kendall Jarrett. 2014. 'A Review of the Game-Centred Approaches to Teaching and Coaching Literature since 2006'. *Physical Education and Sport Pedagogy* 19 (3): 278–300. https://doi.org/10.1080/17408989.2012.754005.

Harvey, Stephen, David Kirk, and Toni M. O'Donovan. 2014. 'Sport Education as a Pedagogical Application for Ethical Development in Physical Education and Youth Sport'. *Sport, Education and Society* 19 (1): 41–62. https://doi.org/10.1080/13573322.2011.624594.

Harvey, William, Shawn Wilkinson, Cindy Pressé, Ridha Joober, and Natalie Grizenko. 2014. 'Children Say the Darndest Things: Physical Activity and Children with Attention-Deficit Hyperactivity Disorder.' *Physical Education & Sport Pedagogy* 19 (2): 205–20.

Hastie, Peter A., Diego Martinez de Ojeda, and Antonio Calderón Luquin. 2011. 'A Review of Research on Sport Education: 2004 to the Present'. *Physical Education and Sport Pedagogy* 16 (2): 103–32. https://doi.org/10.1080/17408989.2010.535202.

Hastie, Peter A., Mary E. Rudisill, and Korey Boyd. 2016. 'An Ecological Analysis of a Preschool Mastery Climate Physical Education Programme.' *Physical Education & Sport Pedagogy* 21 (2): 217–32.

Hesse-Biber, Sharlene Nagy, and R. Burke Johnson. 2015. *The Oxford Handbook of Multimethod and Mixed Methods Research Inquiry*. Oxford Library of Psychology. Oxford, New York: Oxford University Press.

Hong, Quan Nha, Pierre Pluye, Mathieu Bujold, and Maggy Wassef. 2018. 'Les Défis Des Revues Systématiques Mixtes: Devis de Synthèse Convergents et Séquentiels'. In *Oser Les Défis Des Méthodes Mixtes En Sciences Sociales et Sciences de La Santé*, 49–63. Canada: ACFAS Montréal.

Johnson, R. Burke, and Anthony J. Onwuegbuzie. 2004. 'Mixed Methods Research: A Research Paradigm Whose Time Has Come'. *Educational Researcher* 33 (7): 14–26. https://doi.org/10.3102/0013189X033007014.

Kirk, David, and Leen Haerens. 2014. 'New Research Programmes in Physical Education and Sport Pedagogy'. *Sport Education and Society* 19 (7): 899–911. https://doi.org/10.1080/13573322.2013.874996.

Kuhn, Thomas S. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Lawson, Hal A. 2009. 'Paradigms, Exemplars and Social Change'. *Sport, Education and Society* 14 (1): 97–119. https://doi.org/10.1080/13573320802615247.

Le Menn, Marie, Cyril Bossard, Bruno Travassos, Ricardo Duarte, and Gilles Kermarrec. 2019. 'Handball Goalkeeper Intuitive Decision-Making: A Naturalistic Case Study'. Journal of Human Kinetics 70: 297- 308. https://doi.org/10.2478/hukin-2019-0042.

Mayring, Phillipp, Günter L. Huber, Leo Gürtler, and Mechthild Kiegelmann, eds. 2007. *Mixed Methodology in Psychological Research*. Rotterdam: Sense Publishers.

Morales-Belando, María T., Antonio Calderón, and José L. Arias-Estero. 2018. 'Improvement in Game Performance and Adherence after an Aligned TGfU Floorball Unit in Physical Education.' *Physical Education & Sport Pedagogy* 23 (6): 657–71.

Morgan, David L. 1998. 'Practical Strategies for Combining Qualitative and Quantitative Methods: Applications to Health Research'. *Qualitative Health Research* 8 (3): 362–376.

Morin, E. 1990. *Introduction à La Pensée Complexe*. Paris: ESF éd.

Morse, Janice M. 1991. 'Approaches to Qualitative-Quantitative Methodological Triangulation'. *Nursing Research* 40 (2): 120–123.

Mouchet, Alain, Kevin Morgan, and Gethin Thomas. 2018. 'Psychophenomenology and the Explicitation Interview for Accessing Subjective Lived Experience in Sport Coaching'. *Sport, Education and Society* 19 (3): 1–14. https://doi.org/10.1080/13573322.2018.1495189.

Onwuegbuzie, Anthony J., and Nancy L. Leech. 2005. 'On Becoming a Pragmatic Researcher: The Importance of Combining Quantitative and Qualitative Research Methodologies'. *International Journal of Social Research Methodology* 8 (5): 375–387.

Pluye, Pierre, Enrique García Bengoechea, Vera Granikov, Navdeep Kaur, and David Li Tang. 2018. 'Tout Un Monde de Possibilités En Méthodes Mixtes: Revue Des Combinaisons Des Stratégies Utilisées Pour Intégrer Les Phases, Résultats et Données

Qualitatifs et Quantitatifs En Méthodes Mixtes'. In *Oser Les Défis Des Méthodes Mixtes En Sciences Sociales et Sciences de La Santé*, 28–48. Canada: ACFAS Montréal.

Powell, Emma, Lorayne A Woodfield, Alan M Nevill, Alexander J Powell, and Tony D Myers. 2019. '"We Have to Wait in a Queue for Our Turn Quite a Bit": Examining Children's Physical Activity during Primary Physical Education Lessons.' *European Physical Education Review* 25 (4): 929–48.

R'Kiouak, Mehdi, Jacques Saury, Marc Durand, and Jérôme Bourbousson. 2018. 'Joint Action in an Elite Rowing Pair Crew after Intensive Team Training: The Reinforcement of Extra-Personal Processes'. *Human Movement Science* 57: 303–313.

Rochat, Nadège, Denis Hauw, and Ludovic Seifert. 2018. 'Enactments and the Design of Trail Running Equipment: An Example of Carrying Systems'. *Applied Ergonomics* 80: 238–47. https://doi.org/10.1016/j.apergo.2018.07.002.

Schweizer, Angélick, Maria del Rio Carral, and Marie Santiago-Delefosse. 2020. *Les Méthodes Mixtes En Psychologie. Analyses Quantitatives et Qualitatives: De La Théorie à La Pratique*. Malakoff: Dunod.

Seifert, Ludovic, Léo Wattebled, Romain Herault, Germain Poizat, David Adé, Nathalie Gal-Petitfaux, and Keith Davids. 2014. 'Neurobiological Degeneracy and Affordance Perception Support Functional Intra-Individual Variability of Inter-Limb Coordination during Ice Climbing'. *PloS ONE* 9 (2): e89865. https://doi.org/10.1371/journal.pone.0089865.

Smith, Brett, and Kerry R. McGannon. 2018. 'Developing Rigor in Qualitative Research: Problems and Opportunities within Sport and Exercise Psychology'. *International Review of Sport and Exercise Psychology* 11 (1): 101–21. https://doi.org/10.1080/1750984X.2017.1317357.

Tashakkori, Abbas, and Charles Teddlie. 2003. *Handbook of Mixed Methods in Social & Behavioral Research*. CA: Sage. https://doi.org/10.4135/9781506335193.

Teddlie, Charles, and Abbas Tashakkori. 2009. *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*. CA: Sage.

Timans, Rob, Paul Wouters, and Johan Heilbron. 2019. 'Mixed Methods Research: What It Is and What It Could Be'. *Theory and Society* 48 (2): 193–216.

Varela, Francisco J., and J. Shear. 1999. 'First-Person Methodologies: What, Why, How?' *Journal of Consciousness Studies* 6 (2–3): 1–14.

Vors, Olivier, François Cury, Tanguy Marqueste, and Nicolas Mascret. 2019. 'Enactive Phenomenological Approach to the Trier Social Stress Test: A Mixed Methods Point of View'. *JoVE - Journal Of Visualized Experiments* 143: e58805. https://doi.org/10.3791/58805.

Vors, Olivier, Amélina Girard, Nathalie Gal-Petitfaux, Benoît Lenzen, Nicolas Mascret, Alain Mouchet, Sylvain Turcotte, and François Potdevin. 2020. 'A Review of the Penetration of Francophone Research on Intervention in Physical Education and Sport in Anglophone Journals since 2010'. *Physical Education and Sport Pedagogy* 25 (4): 331–45. https://doi.org/10.1080/17408989.2020.1729348.

Wainwright, Nalda, Jackie Goodway, Margaret Whitehead, Andy Williams, and David Kirk. 2018. 'Laying the Foundations for Physical Literacy in Wales: The Contribution of the Foundation Phase to the Development of Physical Literacy.' *Physical Education & Sport Pedagogy* 23 (4): 431–44.