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QUANTITATIVE, QUALITATIVE AND MIXED RESEARCH IN SPORT SCIENCE: A METHODOLOGICAL REPORT

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ABSTRACT

The aim of this research was to examine: (1) the nature of scientific thought in sport science (elite sport); (2) methodological aspects of sport science; (3) the relationship between philosophical-theoretical postulates and elite sport practice. The comparative method, as well as descriptive and theoretical analysis method was applied, and content analysis was used as a research technique. Research methods analysis demonstrated that sport scientists give greater importance to quantitative research tradition, whose knowledge can be seen as positivistic. Chi-square test (x^2) confirmed a statistically significant difference between the three types of research in sport science. There was a difference between quantitative, qualitative and mixed research, $x^2=131.95$ ($df=2$; $n=221$; $p=0.001$). Relationships between different types of research in percentage were: quantitative (63.3%), qualitative (36.2%), mixed research (0.5%). Sport science is positivistic oriented as quantitative research tradition and is more dominant than qualitative and mixed research. However, there is reasonable doubt in the pragmatic basis of sport science because of the small number of mixed research. Mixed method research is a new contemporary wave in the methodology of science and this wave represents the integration of both qualitative and quantitative research, which could provide a more comprehensive knowledge of sport science.

Keywords: Research methods; Mixed methods research; Sport science; Elite sport.

INTRODUCTION

Philosophical fundamentals of science

Understanding science involves insight into discussions on matters, such as the nature of science, scientific knowledge, methods and the value of science. The discipline dealing with these issues is the philosophy of science. Authors who have started discussions on the philosophy of science have first and foremost tried to answer the metaphysical problems of science. In this sense, they have searched to answer ontological, epistemological, methodological, logical and axiological questions (Guba & Lincoln, 1994; Heron & Reason, 1997; McGregor & Murnane, 2010).

The set of ontological, epistemological, methodological, logical and axiological questions with answers, beliefs and assumptions are referred to "paradigms" (Guba & Lincoln, 1994; Heron & Reason, 1997; McGregor & Murnane, 2010). There is a full spectrum of quandaries, from problems of paradigms to practical problems. Those quandaries are concerned with the purpose and outcome of science and scientific research. The methodological aspect of science is what connects ideas and practice, and holds an important place between those two antipodes. Researchers have always been interested in whether there is a connection, and if so, the nature of the connection between the broadest problems of science, such as the "paradigm dialogue", and the practical application of acquired knowledge, that is why and how scientific problems should be solved.

A contemporary philosophical and theoretical understanding of science with practical implications for elite sport will be presented here briefly. Mentioned understanding of science with practical implications is important so as to both widen and deepen knowledge in the sports area. The purpose of this research is to inform scientists interested in and researching the interdisciplinary domain of sport sciences about the relationships between quantitative, qualitative and mixed research. A methodological report such as this may induce authors to re-examine their attitude on research methodology in this discipline and lead to the expansion of scientific knowledge.

Guba and Lincoln (2005) distinguished five paradigms: positivism, post positivism, critical theory, constructivism and participatory paradigm, pointing out the basic beliefs contained in them in relation to ontology, epistemology and methodology. Considering that scientific research is somewhat guided by philosophical assumptions, it is justified to bear them in mind in every discipline which is, or aims to be, scientific. There are many different paradigm classifications in contemporary methodology of sciences. For this research, earlier paradigm classifications and paradigm debate regarding researches in physical education and sports should be kept in mind, like that proposed by Sparkes (1992). In this classification, he distinguishes three paradigms: positivist, interpretive and critical.

Taking into consideration the philosophy of science and thus obtained knowledge, it is hard to imagine that scientists could remain outside paradigmatic beliefs. Considering the extensive amount of paradigmatic problems would be beyond the scope of this text, so the conclusion on the relationship between philosophical assumptions and practical application of its knowledge will be discussed through the methodological aspects.

Positivism is characterised by methodology that is experimental/manipulative, a verification of hypotheses and chiefly quantitative in nature. *Post-positivism* represents modified experimental/manipulative, critical multiplism, falsification of hypotheses, and may include qualitative methods. *Critical theory* is dialogic/dialectic, while *constructivism is* hermeneutic/ dialectic. *Participatory* involves political participation in collaborative action inquiry, primacy of the practical and uses language grounded in shared experiential context (Guba & Lincoln, 2005). Depending on paradigmatic beliefs, a multitude of methodological approaches can beused. Considering that in the philosophy of science (in)commensurable theses are known, a new chapter has been opened dealing with the (im)possibility of applying various researching

traditions to scientific research (Bryman, 1984). An integration approach to research not only refers to the nature of the relationship between various paradigmatic approaches, but also to the relationship between things, such as strategies, methods and data. Seen from a researcher's point of view, it represents a spectrum from the purists to the pragmatists, who usually support mixed research. There are numerous classifications of types of research, and some of them being quantitative, qualitative and mixed research (Ristić, 2016). This is a general classification of research. This classification some authors understand as paradigms (Johnson & Onwuegbuzie, 2004). Quantitative research is different from qualitative in many ways, including a paradigmatic approach, method application, data selection and data analysis. In Table 1 the approaches of various types of research are presented.

***Table 1*. QUALITATIVE, QUANTITATIVE AND MIXED-METHODS APPROACHES** (Creswell, 2003:19)

Tend to or typically	**Qualitative approaches**	**Quantitative approaches**	**Mixed-Methods approaches**
Use these philosophical assumptions Employ these strategies of inquiry	Constructive/ Advocacy/ Participatory knowledge claims Phenomenology, grounded theory, ethnography, case study, and narrative	Post-positive knowledge claims Surveys and experiments	Pragmatic knowledge claims Sequential, concurrent, and transformative
Employ these methods	Open-ended questions, Emerging approaches, Text or image data	Closed-ended questions, predetermined approaches, numeric data	Both open- and closed-ended questions, Both emerging and predetermined approaches, Both quantitative and qualitative data and analysis
Use these practices of research, as the researcher	Positions himself or herself Collects participant meanings Focuses on a single concept or phenomenon Brings personal values into the study Studies the context or setting of participants Validates the accuracy of findings Makes interpretations of the data Creates an agenda for change or reform Collaborates with the participants	Tests or verifies theories or explanations Identifies variables to study Relates variables in questions or hypotheses Uses standards of validity and reliability Observes and measures information numerically Uses unbiased approaches Employs statistical procedures	Collects both quantitative and qualitative data Develops a rationale for mixing Integrates the data at different stages of inquiry Presents visual pictures of the procedures in the study Employs the practices of both qualitative and quantitative research

The beginning of the twenty-first century has brought about a new wave in the methodology of research and is distinguished by mixed methods (Johnson & Onwuegbuzie, 2004). However, the idea of bringing research paradigms together was not unknown before this; it originated much earlier (Guba, 1990). Numerous researchers and supporters of this type of research have considered the advantages and shortcomings of the new approach. The following discussion is divided into four domains: (1) the essence of mixed methods, (2) the philosophical foundations, (3) the procedures for conducting a mixed methods study, (4) the adoption and use of mixed methods (Creswell, 2010:46). By defining the meaning of "essence" in mixed research, a better insight will be gained. Clarifying the essence of the new methodological approach refers to defining mixed methods and the language of mixed methods research (Creswell, 2010:50).

In defining mixed research, Johnson *et al.* (2007) conducted thorough research of the term and published it in the *Journal of Mixed Methods Research*. The authors listed the definitions of mixed research given by leading world authors. Some of these definitions are presented below.

- "Mixed methods research is a research design (or methodology) in which the researcher collects, analyzes, and mixes (integrates or connects) both quantitative and qualitative data in a single study or a multiphase program of inquiry" (Creswell as cited in Johnson *et al.*, 2007:119).
- "Mixed methods research is the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study or set of related studies" (Johnson & Onwuegbuzie as cited in Johnson *et al.*, 2007:120).
- "Mixed methods research is a type of research design in which QUAL and QUAN approaches are used in the type of questions, research methods, data collection and analysis procedures, or in inferences" (Tashakkori & Teddlie as cited in Johnson *et al.*, 2007:121).

Based on this, it can be concluded that mixed research provides a more complete methodological approach than a solely quantitative or solely qualitative approach. Such a methodological approach requires knowledge of the characteristics of both quantitative and qualitative research traditions.

It is justified to question to which scientific disciplines the new methodological approach can be applied. First of all, one should bear in mind that the discussion of different types of research started in the fields of psychology (Hanson *et al.*, 2005; Haverkamp *et al.*, 2005) and social science (Greene, 2006, 2008) before expanding into the health sciences (O'Cathain *et al.*, 2008; Creswell *et al.*, 2011).

Wisdom *et al.* (2012) provide a good example of how the scientists should be informed about different types of research. Their report was in the health science area and was conducted with the aim of emphasising the benefits of mixed research in that discipline. Conducting this type of research allows researchers to gain an insight into both the issue that they are dealing with, as well as into the methodology itself. Metaphorically, such knowledge can represent Ariadne's thread in the researching process which refers to the solving of a problem with multiple apparent means of proceeding. It appears that researchers increasingly refer to contemporary

methodological knowledge, such as mixed method research. Accordingly, it is justified to consider in which way those researching elite sport follow contemporary methodological discussions, and how philosophical assumptions and knowledge are practically applied in elite sport.

Theoretical and methodological assumptions in sport science

This section will discuss what is commonly understood by the term sport science (physical culture). It means applying physical activity with different goals, for example, the influence of physical activity on human health and recreation; applying physical activity in the educational realm; applying physical activity in elite sport; applying physical activity in art; and so on. Jirásek and Hopsicker (2010) suggest that the major trends in philosophy of sport (physical culture) could include, phenomenology of existence and the body; the nature and naming of the discipline; analyses of physical culture and its various phenomena; the ethics and aesthetics of sport; Olympism; ancient sport; recreation and tourism; and sport and spirituality. Also, we consider that methodology could occupy an important place in the philosophy of sport science (physical culture).

Besides this, it is necessary to bear in mind that research on physical activity is part of an interdisciplinary space. Therefore, physical activity research is related to physiological, social, philosophical and even spiritual and biological areas of human research. Take into account that the expression physical culture is also used in wider scientific literature. Each of these areas is developing daily and the number of scientific papers on sport, including topics such as physical culture, is increasing.

In this section the focus will be on research that has been conducted with elite athletes. Considering that research in sport science with elite athletes belongs to an interdisciplinary space, an all-encompassing view needs to be taken. More precisely, sport science research analyses knowledge related to planning training, such as the development of motor abilities, testing motor abilities and the effects of an exercise programme on human motor abilities. This section focuses on research in elite sport as a part of a comprehensive sport science system. Accordingly, conceptualising the sport training theory includes understanding methodological assumptions, not only when it comes to physical activity research that aims to improve sports results, but also for interdisciplinary research into physical activity. Scientific disciplines, such as psychology, sociology and medicine, have contributed greatly to the current understanding of physical activity.

Methodological assumptions in these disciplines may differ. This does not only point to there being varied applications of methodology. It is necessary to understand these methodological issues more deeply and requires an understanding of science on a paradigmatic level. Such discussion and understanding would contribute greatly to widening and deepening of knowledge of sport science. Sport science should not be outside contemporary methodological assumptions context. Notwithstanding that there are methodological texts referring to various research approaches in sport and/or movement (physical culture) science (Thomas *et al.*, 2005; Smith, 2010; Camerino *et al.*, 2012; Young & Atkinson, 2012), it is essential to continue the discussion on the strengths and weaknesses of these approaches. Bokan (2013) states that such discussion would in many ways begin the conversation about the growth of scientific

knowledge, including comprehension, as well as about methodological problems in the aforementioned scientific disciplines. Seen from the aspect of paradigms, such problems can start a discussion with the aim of clearing up difficulties in understanding the paradigms, and provide a more contemplated research approach for the given discipline.

It has been said that research in elite sports is one of the entities (physical education, sports/elite sports, exercise, recreation, art, etc.) in the entire space of sports science (physical culture). Why is it important to bear this in mind? Ultimately, it is because of practical decision-making where mixed method research is based on a pragmatic philosophical background (Onwuegbuzie & Leech, 2005). Research in the sport science with elite athletes has interested researchers of varying domains, like psychology, sociology and education for a long time. Such research highlights the human capability to realise itself through physical activity, without downgrading other aspects of research-related to physical activity. By the middle of the twentieth century, the issue of the sport training of elite athletes emerged in discussions and was written about on a scientific level. An acceptable theoretical-methodological answer to the problem of sports training can bring about an improvement in competition results for athletes.

A great contribution to the theoretical and methodological study of sports training was by authors from Russian language regions. In the past 20 years, the dialogue has reached a global scale, where discussions have been started between the supporters of two opposing theories – traditional theory of sports training and block periodisation (Верхошанский, 1998a, 1998b, 2005; Матвеев, 1998; Платонов, 1998; Issurin, 2010; Kiely, 2010; Koprivica, 2012). If one analyses the suggested theories a bit deeper, one sees that they contain the majority of the hitherto most valuable scientific knowledge in sport science. Those two approaches did not come out of nowhere, but are based on the most valuable research of the past and present.

PURPOSE OF RESEARCH

Seen from the perspective of natural science and logic of science, which also includes the methodology of science, an attempt has been made in this paper to present problems that researchers in sport science have or may come across in the future. On the basis of the presented issues, the following *research questions* have been asked:

1) Which paradigm does sport science research belong to?
2) What is the frequency of different types of sport science research?
3) What is the practical/paradigmatic importance of knowing different types of sport science research?

The basic *aim*, therefore, of this research is to examine: (1) the nature of scientific thought; (2) methodological aspects; and (3) the relationship between philosophical-theoretical postulates and practice in elite sport.

METHODOLOGY

This paper examines the scientific reasoning behind sport science research, the frequency of various types of research and the relationship between scientific and practical/pragmatic thought in elite sport. Furthermore, papers in sport sciences were found in which mixed research methodology was applied and were compared to other types of research. A statistical analysis was conducted which indicates the proportion of various types of research. The comparative method, descriptive method and theoretical analysis method were also applied, where content analysis was used as a research technique.

Sampling scheme

It is known in the methodology of science that qualitative data can be quantitatively analysed and presented. A design of probabilistic and systematic sampling was used to select those data. The sample consisted of sport science research with elite athletes found on Web of Science (WoS). There are about 80 relevant journals worldwide in this database in the sport science section, as well as other scientific sections. While there are other databases (PubMed, Scopus, Index Copernikus, Google scholar, etc.) which can be sampled in the same way, this study used research from WoS, because it is one of the most relevant data bases. This database was also chosen because it is the choice of authors in sport science (Hart, *et al.,* 2010), and also for example, psychology authors, who state that universities worldwide are ranked based on papers published in journals indexed in WoS (Navarrete-Cortes *et al.,* 2010).

Sampling procedure

Selecting members of the basic set (population) by searching sport sciences and other sections using key words: "Sports training" OR "theory of sports training" OR "block periodisation" OR "traditional training periodisation" OR "traditional periodisation" OR "top athletes" OR "top sport" OR "elite athletes" OR "elite players" OR "top players". After determining the basic set, the papers were sorted according to their citation frequency – from the largest to the least. The time period, which served as criterion during the searching and determining of the sample, was 1980–2014. However, the final extent of the sample was 1996–2014. It should also be mentioned that the suggested words, used for the database search, were directed towards greater generality and that it is probable to expect this type of search to cover interdisciplinary space too, such as psychological, sociological or medical papers. For example, when searching the keyword "elite players", the search also included interdisciplinary areas (for example, Psychological research on elite athletes), which is not the case in reverse interpretation. Psychology and exercise do not comprise psychological research on elite athletes, but it can be researched in physical education and/or recreation.

Systematic sampling (Onwuegbuzie & Collins, 2007) by the "interval in sample" method, which can be marked by K=N/n. Here ‘N’ is the size of the basic set (population), and ‘n’ is the size of the sample. The size of the basic set at the moment of determining sample size was 3008 units, and the required minimal sample size calculated into the software package G*Power 3.1.3 is 220. Sample size was calculated by determining the effect size (ES=0.3), then α (alpha)=0.05 and test power 0.95. One of the first ten members of the basic set population was chosen by random process, and then the "interval" was applied so that from the chosen member every K of the further member was chosen. The interval was 14 and by random choice,

the first of the ten members was chosen. In cases where the supposed member (paper) was not available in full-text, the following one was taken, and then the previous, and so on until a maximum of the third furthest. In the case that the member was not available, sampling was continued from the beginning, but the first random member was 7, and then the sampling was continued by the same interval principle. Finding mixed research in sport science, the database was searched by adding the key words, "mixed methods" OR "mixed methodology" OR "mixed research" to the existing ones. In this way, additional units were found until the entire sample consisted of 221 units.

Sorting of the research papers in qualitative, quantitative and mixed researches was conducted in relation to the availability of information, which the authors stated and how they described their research in terms of: approach, strategy, procedure, method, design and type of data. The selected papers indicated elite sport, but there are other areas which could be examined in sports science (physical culture) in future. This is the basic limitation of this research.

Structure of sample

Considering that sport science is often analysed through interdisciplinary space, it should be pointed out that it is not easy to make a clear distinction between the analysed areas. The structure of this sample was:

- 59 (26.7%) exercise physiology papers;
- 30 (13.6%) motor ability (performance) papers;
- 29 (13.1%) sports illness and injuries papers;
- 23 (10.4%) sport biology papers;
- 19 (8.6%) sport nutrition, supplementing and doping papers;
- 18 (8.1%) sport psychology papers;
- 10 (4.5%) physiology and performance papers;
- 9 (4.1%) papers examining the application of new research methods and technical equipment;
- 8 (3.6%) sociology and/or sport business papers;
- 3 (1.4%) sports equipment papers;
- 3 (1.4%) sport nutrition and physiology papers;
- 3 (1.4%) sports biology and psychology papers;
- 2 (0.9%) sports nutrition and psychology papers;
- 2 (0.9%) sport psychology and sociology papers;
- 1 (0.5%) a physiology and sport psychology paper;
- 1 (0.5%) sport nutrition, psychology and physiology;
- 1 (0.5%) ethics (fair play) paper.

Data analysis

After sorting out (coding) various types of research, the Chi-square test was applied (x^2), with the aim of analysing the proportions of various types of research. Three types of research which were analysed were seen as equal (consisting of equal components). The relationship of results to other research was also checked. This proportion can be seen as subjective, namely the percentage of various types of research varies and it can be concluded that at least two thirds of scientific research belongs to the quantitative research tradition. Expressed in percentages, the suggested proportion can be presented as: 67/31/2, being quantitative/qualitative/mixed research. The second analysis was done using ATLAS.ti, a software package for qualitative data analysis. A Word cruncher analysis was applied on the sample. The analysis aimed to find out which words scientists use the most when talking about elite sport.

RESULTS

Research question 1: ***Which paradigm does sport science research belong to?***

Table 2 shows the frequency of words used in the analysed papers. The analysis used a sample of 221 papers (over 615 000 words). All words shown in Table 2 are in the top 100 based on frequency of occurrence in analysed scientific papers. The words were chosen based on the set research question. One should bear in mind that ontological assumptions in this case refer to the general questions about the research. Those questions refer to the nature of human and nature of science and its knowledge, when elite athletes are the research sample. Accordingly, the criterion for selecting words is easily found, and is related to what the sport science papers were about and the most commonly used words in them could reveal. Furthermore, an attempt was made to build an image of ontological assumptions about the nature of humans in sport.

Conjunctions were not included during selection. The words were divided into two logical groups. The first group, called "what we research", was based on the general focus of the text and divided into two subgroups, namely ontological aspects 1 and ontological aspects 2. The meanings of the first word subgroup (ontological aspects 1) refer to the broader context of comprehending elite sport, and the other subgroup (ontological aspects 2) refers to a narrow context or comprehension of motor abilities.

The other word subgroup called "how we research" refers to methodological aspects of research in both elite sport and motor abilities. The listed words undoubtedly refer to the nature of research. The criterion for selecting words related to research methodology was the question of how we research. The terms which entered methodological aspects construction can be considered to be high-frequency terms, and based on them one can assume which research tradition is used more often in sport science.

***Table 2*. MOST OFTEN USED WORDS FOR HOW AND WHAT IS RESEARCHED IN SPORTS SCIENCE**

What is researched				**How research is done**	
Ontological aspects 1		**Ontological aspects 2**		**Methodological aspects**	
Word	*f*	*Word*	*f*	*Word*	*f*
Athletes	5620	Performance	2523	Study	2439
Sports	3121	Exercise	2257	Between	2072
Training	2996	Muscle	1418	Subjects	1204
Elite	2547	Body	1227	Age	1139
Players	2178	Strength	943	Data	1120
Sport	2036	Level	939	Results	1093
Physical	1182	Balance	843	Test	1029
Soccer	804	Increase	778	Effect	911
Female	757	Power	724	Analysis	910
Male	629	Weight	699	Research	904
Medicine	617	Endurance	679	Control	873
Total	22487	**Total**	13030	**Total**	13694

f=Frequency of word occurrence

Research question 2: ***What is the frequency of different types of sport science research?***
All results are shown in Table 3.

Chi-square test (x^2) was used to test equally all categories of research (quantitative, qualitative and mixed research). The obtained results show significant differences in the application of various types of research in sport sciences x^2=131.95 (df=2; n=221; p<0.01). When establishing the proportion of papers included, about two thirds was quantitative (67%), about one third was qualitative (31%) and 2% mixed research. The obtained results showed no significant differences with x^2 =5.013 (df=2; n=221; p=0.082). The purpose was to examine if there was a difference between various scientific communities, when it came to the frequency of quantitative, qualitative and mixed research. The criterion used to define proportion was chosen after considering the results of similar research (Wisdom *et al.,* 2012; Bokan, 2013; Gustafsson *et al.,* 2014). The criterion for this research was somewhat smaller, had a subjective character and was based on the assumption that involves a smaller number of quantitative research. Serving as justification for somewhat different proportion is the way of sampling in the mentioned research.

Table 3. **RELATIONSHIP BETWEEN QUANTITATIVE, QUALITATIVE AND MIXED RESEARCH IN SPORTS SCIENCE**

Methods/techniques of research		**Frequency**	**%**
Quantitative research	Experiment	22	10
	Longitudinal study	8	4
	Measuring/Testing	72	33
	Survey	24	11
	Quantitative research with supplementary techniques	14	6
	Total quantitative	**140**	**63.3**
Qualitative research	Review/Document analysis	54	24
	Retrospective/Historical	5	3
	Interview	4	2
	Image/Video analysis	6	3
	Meta-analysis	3	1
	Ethnographic study	1	0.3
	Comparative study	1	0.3
	Presentation	3	1
	Letter	3	1
	Total qualitative	**80**	**36.2**
Mixed research	Report	1	0.3
	Total mixed	**1**	**0.5**

DISCUSSION

In searching for the answer to the *first research question*, regarding which paradigm sport research belongs to, it was suggested that scientists in sport are primarily interested in biological aspects of understanding human physical activity. The most commonly used words in papers in sport science were shown in Table 2 (what we research; ontological aspects 1 and 2), which indicate that the physical aspects of sport and medicine in elite sport takes precedence regardless of gender. Bokan (2013) calls this idea of physical culture, biological anthropology and an inductive way of drawing conclusions.

In the biological sense, things which could be called motor or physical abilities hold a dominant position. This fact is supported by commonly used words such as 'performance', 'strength', 'balance', 'power', and 'endurance'. Furthermore, the motor abilities in question are most often understood by the authors in connection to the human body. One is left with the impression that sport science neglects other aspects of human nature. Amongst the most commonly used words there are none whose meaning could indicate psychological, sociological or any other

aspects of the human condition in elite sport. This does not mean that there were no such research, but that their number is significantly smaller.

A theoretical interpretation, seen from the aspect of paradigms and in relation to the interpretation of the most commonly used words in sport science, could be seen as predominantly positivistic. Scientists search for truthful knowledge on the biological human. The ontological basis of sport science is realistic with objective knowledge most often inclusive of understandings of corporeality and motor abilities. Researchers in sport science generally consider the positivistic paradigm as sufficient to understand a human through physical activity. The question now is, "Is this a justifiable conclusion?"

Understanding the experimental/manipulative, verification of hypotheses, chiefly quantitative (Guba & Lincoln, 1994) methodology on which positivism is grounded, could one agree that it is sufficient to conduct research in a scientific community, such as sport science, based only on positivist beliefs and methodologies? This paper shows that sport science also belongs to interdisciplinary space, and because of that, it is necessary to switch from a positivist paradigmatic approach to a multi-paradigmatic research approach. It does not mean that a positivist approach is rejected, but that the problem should be seen in a wider multi-paradigmatic context. A great number of methodological possibilities proposed by Guba and Lincoln (1994) refer to this idea:

- Post positivism is modified experimental/manipulative, critical multiplism, falsification of hypotheses and may include qualitative methods;
- Critical Theory *et al is* dialogic/dialectical;
- Constructivism is hermeneutical/dialectical.

In answer to the *second research question*, this study found that quantitative research tradition is most commonly used. The results shown in Table 2 highlight the methodological aspects of sport science research. Table 3 shows the results of relationships between the three types of research. Measuring and testing, surveys and experimental studies are the research techniques and methods most commonly used in sport science research. These results reflect other research conducted in health service (Wisdom *et al.,* 2012), as well as the sport science area (Gustafsson *et al.,* 2014). The results of the first study on health service showed that the proportion of different types of research is 90.98%/6.18%/2.85%, while the results of the second study, in the area of sport science, and more specifically sports psychology, showed the proportion of 75%/23%/2% for quantitative, qualitative and mixed research respectively. It can be seen that the percentage of different types of research is varied. In support of this claim is the study by Bokan (2013) on different types of research in physical culture, which showed a proportional relationship between empiric research and theoretical and philosophical opinion of 85%/15%/0% respectively. In accordance with these results, the assumption of this paper is that the proportions obtained in different research areas do not differ.

Table 3 highlights that the proportion between different types of research is 63.3%/36.2 %/0.5%. Based on these results, it can be concluded that the assumed proportion of two thirds quantitative (about 67%), one third qualitative (about 31%) and about 2% of mixed research,

does not differ from other proportions in different research disciplines where the dominant methodology is quantitative research tradition, followed by qualitative and the research tradition combining both qualitative and quantitative methods. There is a similar frequency of qualitative, quantitative and mixed research as found in various other scientific disciplines. On the other hand, when seeing the results of this research (x^2) as equal proportions, there is a statistically significant difference between researches of different types.

Knowing the strengths and weaknesses of quantitative, qualitative and mixed method research, does that mean we do not want to amend the weaknesses, let us say of quantitative research, because it is the dominant research tradition in sport sciences? According to Johnson and Onwuegbuzie (2004) those weaknesses may be because:

- The *categories* used by the researcher may not reflect the understandings of local constituencies;
- The *theories* used by the researcher may not reflect the understandings of local constituencies;
- The researcher may miss out on phenomena occurring because of the *focus* on theory or hypothesis testing rather than on theory or hypothesis generation (called the confirmation bias);
- *Knowledge* produced may be too abstract and general for direct application to specific local situations, contexts and individuals.

On the other hand, if the strengths of mixed research is known (Johnson and Onwuegbuzie, 2004), there should be more research conducted in this manner as advocated by authors of contemporary science methodology. This refers to research such as this:

- Can provide quantitative and qualitative research strengths;
- Can provide stronger evidence for a conclusion through convergence and corroboration of findings;
- Means that qualitative and quantitative research can be used together to produce more complete knowledge necessary to inform theory and practice.

The results of this research (Table 2 and Table 3) undoubtedly suggest that quantitative research tradition is represented more in sport science than the qualitative and mixed research tradition. There are no significant differences between the results obtained in this research and that of other similar research, when taking into account the aspect of proportions. There is a large difference between proportions of sport science research. There were practically no mixed research applied in sport science with elite athletes. Although contemporary methodology and philosophy of science suggest and invite the application of new wave research in order to deepen knowledge, this is done rarely. Sport science has chosen real, but not pragmatic knowledge, for which the supporters of mixed research plead. Such methodology assures the dominantly positivistic paradigm, which sport science has chosen.

In answer to the *third research question*, this study points to the relationship between the broadest of discussions and practical implications. Considering that the two conceptions are of sports training, researchers have their free will to decide which of the two conceptions is more acceptable. This presents a choice between different approaches, paradigms, understanding of science and sports practice. Such knowledge is most directly connected with that which occurs in practice. Being aware of it or not, the researcher decides which knowledge he turns to and is guided by.

It depends on the worldview taken as to whether the knowledge that the positivists plead for is sufficient. In this view, decisions should be made. Namely, those who consider that knowledge obtained through a positivistic worldview and by quantitative research tradition neglect other paradigms. Accordingly, this way of understanding of science could reduce the growth of knowledge in sport science. Is the pragmatic knowledge necessary? Certainly it is, but there is as yet not enough of that knowledge. There is no mixed research to ground such knowledge. Philosophy of science allows an understanding of the nature of science, as this knowledge helps to find our way in the system of science. Finally, it tells us what knowledge in sport science can be applied in practice.

PRACTICAL APPLICATION

Practical applications should be understood when deciding which worldview is the most acceptable for studying humans through physical activity. Such knowledge will greatly determine the practical applications. This dialogue should continue through identifying the advantages and shortcomings, not only of positivistic, but other worldviews too, which in themselves carry practical decisions.

CONCLUSIONS

Contemporary philosophy of science has seen a new wave of mixed research in the methodology of science. This approach has a pragmatic philosophical background and comprises various approaches, methods, strategies and other aspects of quantitative and qualitative research traditions. In the philosophical-theoretical sense, it can be concluded that positivism is the dominant paradigm chosen by sport science researchers. Although there are other paradigmatic approaches, sport science researchers largely choose positivism. Authors, studying sport science involving elite athletes, do not follow the contemporary methodological discussion. There are practically no researchers who can qualify as mixed method researchers in elite sport. Mixed research in sport science is largely ignored. This reduces the pragmatic basis of research results that are applied in sport, and the dominant position is held by the quantitative research tradition with mostly a realistic philosophical background.

REFERENCES

BOKAN, B. (2013). Physical anthropology and inductive reasoning in domestic scientific literature: The basic paradigm for research and argumentation on human physical activity. *Serbian Journal of Sports Sciences*, 7(1-4): 85-128.

BRYMAN, A. (1984). The debate about quantitative and qualitative research: A question of method or epistemology? *British Journal of Sociology*, 35(1): 75-92.

CAMERINO, O.; CASTAÑER, M. & ANGUERA, T.M. (Eds.) (2012). *Mixed methods research in the movement sciences: Case studies in sport, physical education and dance.* New York, NY: Routledge.

CRESWELL, J.W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches.* Thousand Oaks, CA: SAGE Publications.

CRESWELL, J.W. (2010). Mapping the developing landscape of mixed methods research. In A. Tashakkori & C. Teddlie (Eds.), *SAGE handbook of mixed methods in social and behavioral research* (2nd ed.) (pp. 45-68). London, UK: SAGE Publications.

CRESWELL, J.W.; KLASSEN, A.C.; PLANO CLARK, V.L. & SMITH, K.C. (2011). *Best practices for mixed methods research in the health sciences*. Bethesda, MD: National Institutes of Health.

GREENE, J.C. (2006). Toward a methodology of mixed methods social inquiry. *Research in the Schools*, 13(1): 93-98.

GREENE, J.C. (2008). Is mixed methods social inquiry a distinctive methodology? *Journal of Mixed Methods Research*, 2(1): 7-22.

GUBA, E.G. (1990). The alternative paradigm dialog. In E.G. Guba (Ed.), *The paradigm dialog* (pp.17-27). Newbury Park, CA: SAGE Publications.

GUBA, E.G. & LINCOLN, Y.S. (1994). Competing paradigms in qualitative research. In N.K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (pp.105-117). Thousand Oaks, CA: SAGE Publications.

GUBA, E.G. & LINCOLN, Y.S. (2005). Paradigmatic controversies, contradictions and emerging confluences. In N.K. Denzin & Y.S. Lincoln (Eds.), *Handbook of qualitative research* (3rd ed.) (pp.191-215). Thousand Oaks, CA: SAGE Publications.

GUSTAFSSON, H.; HANCOCK, D.J. & CÔTÉ, J. (2014). Describing citation structures in sport burnout literature: A citation network analysis. *Psychology of Sport and Exercise*, 15(6): 620-626.

HANSON, W.E.; CRESWELL, J.W.; CLARK, V.L.P.; PETSKA, K.S. & CRESWELL, J.D. (2005). Mixed methods research designs in counseling psychology. *Journal of Counseling Psychology*, 52(2): 224-235.

HAVERKAMP, B.E.; MORROW, S.L. & PONTEROTTO, J.G. (2005). A time and place for qualitative and mixed methods in counseling psychology research. *Journal of Counseling Psychology*, 52(2): 123-125.

HART, J.M.; PIETROSIMONE, B.; HERTEL, J. & INGERSOLL, C.D. (2010). Quadriceps activation following knee injuries: A systematic review. *Journal of Athletic Training*, 45(1): 87-97.

HERON, J. & REASON, P. (1997). A participatory inquiry paradigm. *Qualitative Inquiry*, 3(3): 274-294.

ISSURIN, V.B. (2010). New horizons for the methodology and physiology of training periodization. *Sports Medicine*, 40(3): 189-206.

JIRÁSEK, I. & HOPSICKER, P.M. (2010). Philosophical Kinanthropology (Philosophy of physical culture, philosophy of sport) in Slavonic Countries: The culture, the writers, and the current directions. *Journal of the Philosophy of Sport*, 37(2): 253-270.

JOHNSON, R.B. & ONWUEGBUZIE, A.J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7): 14-26.

JOHNSON, R.B.; ONWUEGBUZIE, A.J. & TURNER, L.A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, 1(2): 112-133.

KIELY, J. (2010). New horizons for the methodology and physiology of training periodization: Block periodization: New horizon or a false dawn? *Sports Medicine*, 40(9): 803-805.

KOPRIVICA, V. (2012). Block periodization: A breakthrough or a misconception. *SportLogia*, 8(2): 93-99.

МАТВЕЕВ Л. П. (1998). К дискуссии о теории спортивной тренировки. [trans.: Toward the discussion about the theory of sports training]. *Теория и практика физической культуры* [trans.: *Theory and Practice of Physical Culture*], 73(7): 55-61.

MCGREGOR, S.L. & MURNANE, J.A. (2010). Paradigm, methodology and method: Intellectual integrity in consumer scholarship. *International Journal of Consumer Studies*, 34(4): 419-427.

NAVARRETE-CORTES, J.; FERNÁNDEZ-LÓPEZ, J.A.; LÓPEZ-BAENA, A.; QUEVEDO-BLASCO, R. & BUELA-CASAL, G. (2010). Global psychology: A bibliometric analysis of Web of Science publications. *Universitas Psychologica*, 9(2): 553-567.

O'CATHAIN, A.; MURPHY, E. & NICHOLL, J. (2008). The quality of mixed methods studies in health services research. *Journal of Health Services Research and Policy*, 13(2): 92-98.

ONWUEGBUZIE, A.J. & COLLINS, K.M. (2007). A typology of mixed methods sampling designs in social science research. *Qualitative Report*, 12(2): 281-316.

ONWUEGBUZIE, A.J. & LEECH, N.L. (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.

ПЛАТОНОВ, В.Н. (1998). О «Концепции периодизации спортивной тренировки» и развитии общей теории подготовки спортсменов. [trans.: The concept of a periodization of sports training and development of the general theory of training of athletes]. *Теория и практика физической культуры* [trans.: *Theory and Practice of Physical Culture*], 73(8): 23-26.

RISTIĆ, Ž. (2016). *Objedinjavanje kvantitativnih i kvalitativnih istraživanja*. [trans.: *Unifying qualitative and quantitative research*]. European Center for Peace and Development (ECPD), University for Peace (established by the United Nations). Belgrade, Serbia: ECPD.

SMITH, M.F. (2010). *Research methods in sport*. Padstow, UK: Learning Matters.

SPARKES, A. (1992). The paradigms debate: An extended review and a celebration of difference. In A. Sparkes (Ed.), *Research in physical education and sport: Exploring alternative visions* (pp. 9-60). London, UK: Routledge.

THOMAS, J.R.; NELSON, J.K. & SILVERMAN, S.J. (2005). *Research methods in physical activity*. Champaign, IL: Human Kinetics.

ВЕРХОШАНСКИЙ, Ю.В. (1998a). На пути к научной теории и методологии спортивной тренировки. [*trans*.: On the way to the scientific theory and methodology of sports training]. *Теория и практика физической культуры* [trans.: *Theory and Practice of Physical Culture*], 73(2): 21-41.

ВЕРХОШАНСКИЙ, Ю.В. (1998b). Горизонты научной теории и методологии спортивной тренировки. [Horizons of the scientific theory and methodology of sports training]. *Теория и практика физической культуры* [trans.: *Theory and Practice of Physical Culture*], 73(7): 41-54.

ВЕРХОШАНСКИЙ, Ю.В. (2005). Теория и методология спортивной подготовки: блоковая система тренировки спортсменов высокого класса. [*trans.*: Theory and methodology of sports preparation: Block system of training of high-class athletes]. *Теория и практика физической культуры* [trans.: *Theory and Practice of Physical Culture*], 80(4): 2-14.

YOUNG, K. & ATKINSON, M. (2012). *Qualitative research on sport and physical culture.* Bingley, UK: Emerald Group Publishing.

WISDOM, J.P.; CAVALERI, M.A.; ONWUEGBUZIE, A.J. & GREEN, C.A. (2012). Methodological reporting in qualitative, quantitative, and mixed methods health services research articles. *Health Services Research*, 47(2): 721-745.

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