THE DISCOURSE OF THE EPISTEMIC COMMUNITY OF ARTISTIC GYMNASTICS: THE ANALYSIS OF ARTICLES' TITLES

Darija Omrčen, Kamenka Živčić Marković
University of Zagreb, Faculty of Kinesiology, Croatia

Original research article

Abstract

The goal of this study was to analyse 105 titles of articles published in 43 journals that are indexed in at least one of the three databases - ScienceDirect, MEDLINE and Scopus - in order to describe the epistemic community that deals with gymnastics-related topics. To analyse the collected data frequencies, Pearson Chi-square test and the hierarchical cluster analysis were used. The results showed that most articles were written by two or three authors, and that the titles written by two, three and four authors contained the largest number of words of Latin etymology. Words of Latin origin were used significantly more frequently than those of the English origin, whereas a word of Greek origin was used almost as frequently as a word of English origin. The word class most frequently used in the titles was the nouns. Neither the number of words of Latin origin per title nor the number of words of Greek origin differed significantly by the publication year. The cluster analysis showed that the principal cluster was formed of lexical words which were nouns predominantly of Latin origin. The results of this research showed that the scientific discourse of the analysed titles concurs with the basic principles of academic writing and that the epistemic community of artistic gymnastics can be identified by its specific vocabulary.

Key words: *titles, etymology, scientific discourse, academic writing*

INTRODUCTION

Epistemology shows that kinesiology employs different but complementary methods for gaining knowledge (Estes, 1994). The body of knowledge in kinesiology is said to be derived from various other disciplines. Already more than 70 years ago Sharman (1934, cited in Estes, 1994) said that "the subject matter of [physical and health education]" – considered to be the foundation stone from which the concept of kinesiology has emerged (e.g. Wrynn, 2003) – "is made up largely of material taken from biology, sociology, and education". His contemporaries Nixon and Cozens (1941, 42-43, cited in Estes, 1994) stated in a similar way that "the scientific foundations of modern physical education are to be discovered in the main in sociology, psychology, and the various branches of biology". Contemporary standpoint is that the subdisciplines comprising the contents of kinesiology are sport pedagogy, exercise physiology, sport biomechanics, sport humanities (sport history, sport philosophy, and sport literature), sport psychology, sport sociology, measurement and evaluation, and finally, motor development (Estes, 1994). In other words, the concepts usually studied in kinesiology belong to the areas of human anatomy, physical growth, motor development, biomechanical aspects of movement, acute and chronic effects of exercise, behavioural and neuromuscular control of movement, acquisition of motor skills, psychological factors in movement, exercise, sport, sociocultural factors in movement, and history/philosophy of movement (Charles, 1994).

Language symbolically represents information (Love, 2009). The common attitude says that words comprise the mental lexicon (Elman, 2004). However, there are various types of discourse that use language as a means of transferring information – political discourse, scientific discourse, etc.

The discourse of science is known to be well-structured. Bernstein (2000, p. 157, cited in Moore and Muller, 2002) distinguishes between two types of discourse – horizontal discourse, i.e. the 'everyday' discourse, and the vertical discourse which has a coherent, explicit and systematically principled structure that is either hierarchically organized as in the sciences (hierarchical knowledge structure), or takes the form of a series of specialized languages as in the social sciences and humanities (horizontal knowledge structure) (Moore & Muller, 2002). Further, each scientific discipline has its own terminology. According to Eugene Wüster (Felber, 1980), founder of the general theory of terminology, to improve the communication between experts in certain field, it is necessary to develop an appropriate instrument and that instrument is terminology which is considered to be one of the basic epistemological components of each science. As an epistemological characteristic, terminology is inherent to methodology, among other things because it strives towards a higher level of notional generalization, and each higher level demands more clear notions (Milat, 2005, p. 35). Neither scientific division nor scientific classification is possible without accurate terminology (Milat, 2005, p. 35). Milat (2005, p. 35) continues and says that accurate terminology is a prerequisite of valid scientific communication.

Like all other sciences, kinesiology also has its terminology. In accordance with the sciences considered to comprise the contents of kinesiology, its terminology is a conglomerate of terminologies from scientific disciplines such as physiology, sociology, anthropology on the one hand, and terminologies pertaining to sport and physical exercise on the other hand. Still, as in all other sciences, there are terminological problems in kinesiology that must be carefully dealt with (Starosta and Petrinsky, 2007) in order to make this terminology unambiguous.

Human anatomy is a science that contains more terms originating from Latin and Greek than any other scientific discipline. According to *Dorland's Illustrated Medical Dictionary* (1994, xxi), in anatomy, surgery as well as in clinical and laboratory medicine, Greek and Graeco-Latin terms have always comprised more than 90% of technical terms used. Since gymnastics is based on human anatomy, physiology of sport and exercise, biomechanical laws and biochemical principles which all belong to the domain of exact sciences, anatomy and physiology as branches of biology, biochemistry as a branch of chemistry, and biomechanics, as a branch of mechanics, i.e. a branch of physics, it will be interesting to analyse the language used in the titles of scientific texts on topics from its domain.

The analysis in this study is based on the assumption regarding the existence of epistemic communities. As Roth and Bourgine (2005) say, Haas (1992) introduced the notion of epistemic community and defined it as "a network of knowledge-based experts (…) with an authoritative claim to policy-relevant knowledge within the domain of their expertise". Roth and Bourgine (2005) further describe that this definition was supplemented by Cowan, David and Foray (2000) who said that an epistemic community must share a subset of concepts. The research collaborators must explicitly state their particular discipline's knowledge structure which is defined in five categories: disciplinary history and forms of scientific knowledge, spatial and temporal scales of that knowledge, precision (i.e. quantitative and qualitative forms), accuracy of predictions, and availability of data to construct, calibrate, and test predictive models (Boulton, Panizzon, and Prior, 2005). Therefore, epistemic community can be defined in various ways; however, they all concur that it is a group of agents who share and work within the same epistemic framework and towards a certain knowledge-related goal, on a given subset of concepts (Roth and Bourgine, 2005). The subset of concepts is in the analysis in this paper represented by words since, as Roth and Bourgine (2005) say, concepts can be got from words and nominal groups (terms).

Hence, similarly to Roth and Bourgine's analysis in which the sample was drawn from the population of titles, full texts and key words, our sample were the titles of articles published in various journals. However, the data were treated according to methodology different from the one applied by Roth and Bourgine in their research (2005). The purpose of their paper was to determine the existence of epistemic communities on the basis of words. In our study we used words as concepts to describe the discourse of the epistemic community of artistic gymnastics.

The goal of this analysis was to analyse 105 titles of articles published in 43 journals that are indexed in at least one of the following three

databases: ScienceDirect, MEDLINE and Scopus, in order to describe the epistemic community that deals with artistic gymnastics-related topics.

METHODS

Data collection

ScienceDirect, a full-text scientific database, covers a wide range of the world's STM (Science, Technical and Medical) articles. The titles from this database were collected in the following way. First, the time period for the search was restricted to the years between 1999 and 2009 and the option *All sources* was limited to *Journals*. The key words *artistic* AND *gymnastics*, *balance beam* AND *gymnastics*, *vault* AND *gymnastics*, *asymmetric/uneven bars* AND *gymnastics*, *parallel bars* AND *gymnastics*, *horizontal bar/high bar* AND *gymnastics*, *pommel horse* AND *gymnastics*, *rings* AND *gymnastics* and *floor* AND *gymnastics* were then used for the search within the *Abstract, Title, Keywords* option. Altogether 30 titles were found that addressed the topic of artistic gymnastics. However, due to the polysemy, i.e. the diversity of meanings of the word *ring*, which resulted in finding the titles dealing with physics and medicine – in the latter, the research focused on the ring muscle (sphincter) gymnastics for spinal cord injured – meaning that the notion of the term *gymnastics* did not relate to artistic gymnastics, three titles/articles were omitted from further analysis.

MEDLINE, a bibliographic database, contains references of journal articles in life sciences with a concentration on biomedicine. To search this database the time period was again limited to the years from 1999 to 2009 and only the words *artistic* and *gymnastics* were written into the *Basic search* option. The search done by using the key words *artistic* and *gymnastics* alone yielded the total of 1,126 articles/titles covering a rather broad range of various meanings of the word *gymnastics*. Such a large number of titles was the result of the fact that first the titles and abstracts of articles that contain both the word *artistic* and the word *gymnastics* were listed followed by the titles containing either of the two words. Other key words used to search the database ScienceDirect were not used here since the already obtained selection was quite comprehensive. The initial number of 1,126 articles was far too large for the purposes of this article and therefore 113 articles with focus on the concept covered by the term *gymnastics* were chosen at random. Next, the titles already found in the database ScienceDirect were omitted from further analysis as well as the titles that obviously addressed a much broader range of the term *gymnastics* than covered by the term *artistic gymnastics*. Additionally, one title relating exclusively to rhythmic gymnastics was also omitted. A total of 68 articles remained.

Scopus is a bibliographic database with abstracts and citations, which covers literature and web resources in the field of social sciences, but also has strength in life, health and physical sciences. To search this database, again only the words *artistic* and *gymnastics* were used and 19 articles, i.e. their titles, published between the year 1999 and 2009 were found. Since 9 titles have already been selected from the previous two databases and considered for research, the number of titles that remained in further research was 10.

Hence, the ultimate number of cases, i.e. the titles of articles in the sample was 105. These 105 articles were published in 43 different journals.

The categorization of words from the titles as regards their etymology was done as follows.

There were cases of terms consisting of two or more morphemes originating from the same language, e.g. *amenorrhea* that was coined from the Greek prefix *a-* and two combining forms – *meno-* and *–rrhea* – both of Greek origin. Another example is the term *uneven* that was created from the base, *even*, that is of Old English origin - *efen* (*Random House Webster's Unabridged Dictionary*, 1999), and the prefix *un-* that is also of Old English origin. The same applies to the noun *menarche* that consists of *meno-*, a combining form borrowed from Greek, and *arch£* also from Greek. In such cases there was no doubt as regards the origin of the word/term.

In cases when the morphemes that comprised the term originated from different languages the following principle was applied. For example, the word *preflight* was categorized as being of English origin – the base *flight* originates from Old English, however, the prefix *pre-* is of Latin etymology. Hence, it was the base of the word that was used as a criterion for its categorization.

Variables

The variables used in this analysis were – *publication year (the year in which an article was published)*, *number of authors* (the number of authors of an article), *lexical word* (number of lexical words per title), *verbs* (number of verbs per title), *nouns* (number of nouns per title), *adjectives* (number of adjectives per title), *Latin* (number of words/terms of Latin etymology per title), *Greek* (number of words/terms of Greek etymology per title), *English* (number of words/terms of English etymology per title), *French* (number of words/terms of French etymology per title), *Old Norse* (number of words/terms of Old Norse etymology per title) and *Other* (number of words/terms of etymology in other languages per title). As for the last variable – *Other* – there were not many words/terms that originated from languages other than Latin, English, Greek, French or Old Norse. Two will be mentioned here for illustration. The word *average*, i.e. its earlier form *averay* meant *charge on goods shipped*, i.e. originally it meant *duty* (*Random House Webster's*
Unabridged Dictionary, 1999). The word entered English from Middle French (*avarie*) into which itcame from Old Italian (*avaria*), and the language of origin is Arabic ('*aw!r#yah* meaning *damaged merchandise*) (*Random House Webster's Unabridged Dictionary*, 1999). The term *felge* is a loan-word from German (*Felge*).

Statistical analyses

To analyse the collected data frequencies, Pearson Chi-square test and hierarchical cluster analysis were used. The significance level considered was $p \leq .05$. The Chi-square test was used to identify the differences between the *number of authors*, between the *number of words/terms of Latin etymology per title* and between the *number of words/terms of Greek etymology per title* as regards the *publication year* on the one hand, and on the other to identify the differences between the *number of words/terms of Latin etymology per title* and between the *number of words/terms of Greek etymology per title* as regards
the *number of authors*. The number of words from French, English, Old Norse and other languages was not taken into account in the Chi-square test since the number of words/terms originating from Latin and Greek were in the focus. Finally, to perform the hierarchical cluster analysis (tree clustering method), the data were first standardized and the 12 variables were then submitted to the analysis to find out whether they formed any meaningful structures. The statistical package *Statistica 7.0 for Windows* was used to process the data.

RESULTS

The largest number of articles – 15, i.e. 14.3%, and 10, i.e. 9.5% – was found in two journals whose domain is biomechanics. In other words, considered by journal domain, the largest number of topics was devoted to biomechanics. The third largest number of articles (9, i.e. 8.6%) was found in the journal whose domain is broader than the twopreviously mentioned, and in which the topics-dealt with were, for example, sport- and psychology-related issues, juries' evaluation processes, judging/scoring, auditory feedback and self- and expert-modelling. Between 1 and 6 articles dealing with gymnastics-related issues were found in other journals.

The number of articles published increased after 2004 (1999 – 5; 2000 – 9; 2001 – 3; 2002 – 7; 2003 – 13; 2004 – 5; 2005 – 12; 2006 – 12; 2007 – 15; 2008 – 17; 2009 – 7 articles thus far).

Table 1 shows that the number of authors ranged from one to seven, however, that most articles were written by two or three authors, followed by the number of articles written by more than three authors. What is interesting is that only ten articles were written by only one author.

As for the relationship between the *publication year* and the *number of authors*, the Pearson Chi-square test showed significant differences ($\chi 2=93.44$; $df=60$; $p=.004$). The articles written by only one author appeared around the years 2000, 2004, 2007 and 2008. Except for the year 2007, the other three years mentioned were Olympic years.

Starting from 2003 the titles contained slightly more words of Latin origin than previously, whereas such difference was not to be noticed when the usage of words of Greek origin is concerned. Still, neither the number of words of Latin origin nor the number of words of Greek origin used in the titles differed significantly by the publication year.

Altogether 889 lexical words were used in the titles and 397 function words, i.e. less than a half of lexical words (Figure 1). Considering the 889 lexical words in 105 titles analysed, a word of Latin etymology occurred 460 times (51.7%) and a word of Greek origin 177 times (19.9%). In other words, 71.6% of all lexical words used in 105 titles were either of Latin or Greek etymology. The average number of lexical words in the titles was 8.47.

173 times a word of English etymology was used in the titles, 45 times a word of French origin (for example, *jury*, *judgement*, etc.), 11 times a word originating from Old Norse, the Germanic language spoken in medieval Scandinavia – for example, *skill*, *skin*, *score*, etc. – and 18 times a word whose etymology is to be traced to other languages, for example, Old Danish (*link*), *average* from Arabic, *Felge* from German, etc. Also the terms denoting artistic gymnastics elements were found that were named after the gymnasts who invented them, e.g. Azarian, Yurchenko and Tkatchev.

In other words, a word of Latin etymology was used more than two times more frequently than a word of English origin (Figure 2) and a word of Greek origin was used almost as frequently as a word of English origin. The average number of words of Latin origin was 4.38.

As for lexical words, the word class most frequently used in the titles was the nouns (623), followed by adjectives (219) and verbs (42) (Figure 3). The remaining five words were adverbs.

Significant differences were found (χ^2=90.42; df=66; p=.02) in the *number of words/terms of Latin etymology per title* used in the titles as regards the *number of authors*, however, not in the *number of words/terms of Greek etymology per title*. The titles written by two, three and four authors contained the largest number of words of Latin etymology.

The Euclidean distances (Table 2) and the hierarchical tree plot (Figure 4) show that the tree clustering plot developed in the following way. The principal cluster was formed of lexical words and nouns. In the next node *Latin etymology* joined the cluster, followed by *adjectives*, and *English* and *Greek etymology*. Next, the *number of authors* was added to the cluster. In other words, most lexical words in the 105 analysed titles were nouns that were predominantly of Latin origin. The cluster further developed by adjoining the following most frequent word class of lexical words – *adjectives* – and the etymology of lexical words expanded to *English* and *Greek*.

Table 1. *Frequency and percentage of articles by the number of authors*

NUMBER OF AUTHORS	FREQUENCY	PERCENT
One	10	9.5
Two	27	25.7
Three	28	26.7
Four	13	12.4
Five	14	13.3
Six	11	10.5
Seven	2	1.9

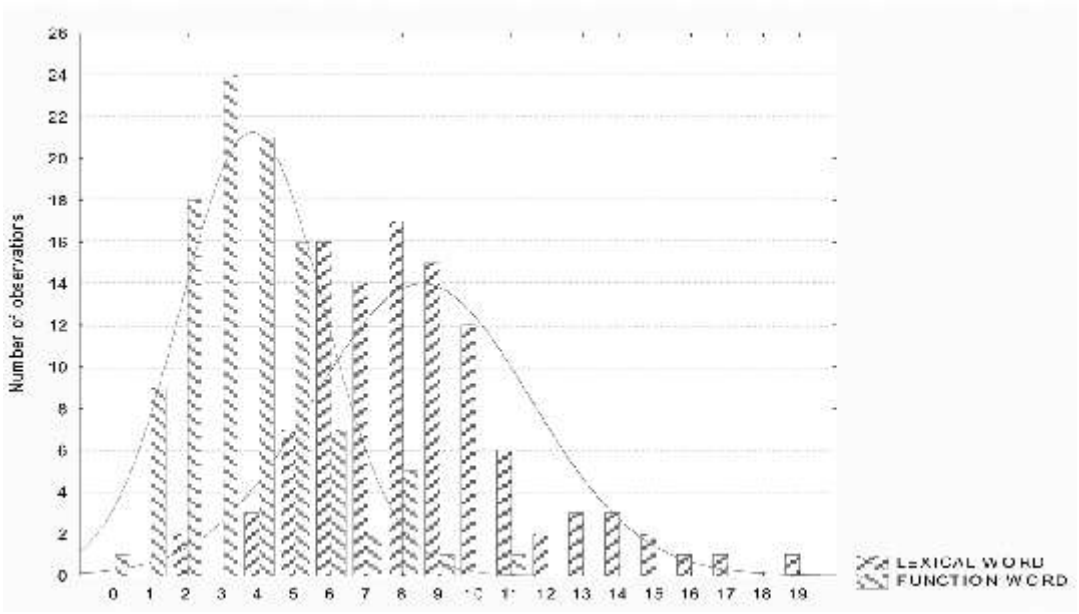

Figure 1. *Frequency distributions of lexical and function words used in the titles (Legend: LEXICAL WORD – number of lexical words per title; FUNCTION - number of function words per title)*

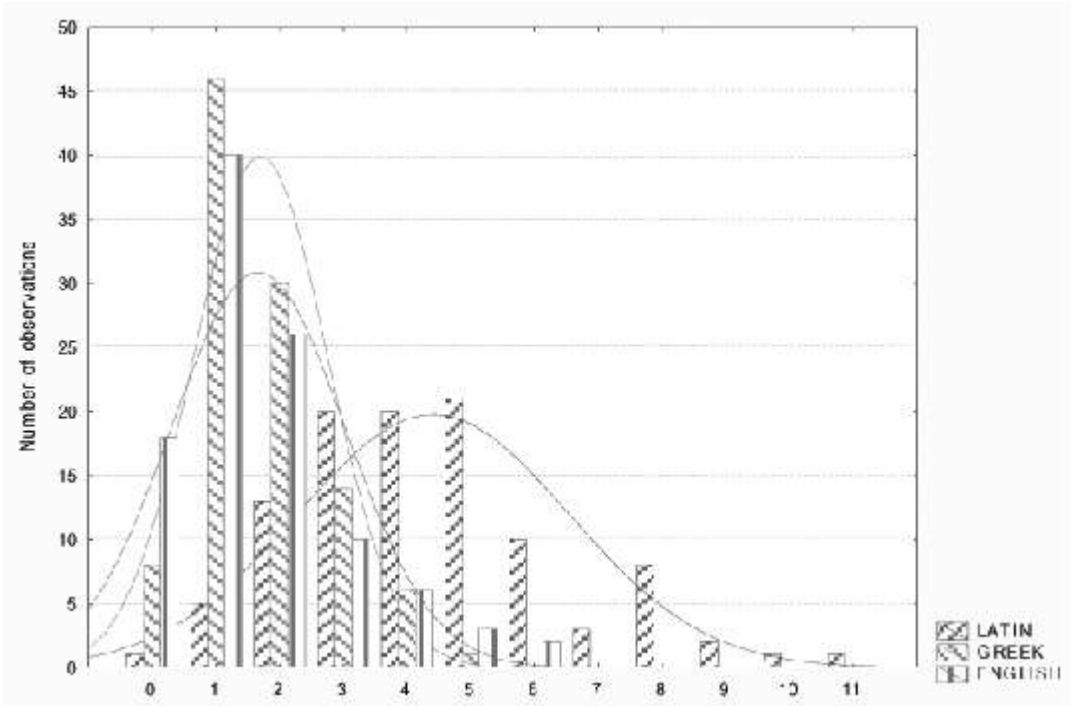

Figure 2. *Frequency distributions of words of Latin, Greek and English etymology used in the titles (Legend: LATIN - number of words/terms of Latin etymology per title; GREEK - number of words/terms of Greek etymology per title; ENGLISH - number of words/terms of English etymology per title)*

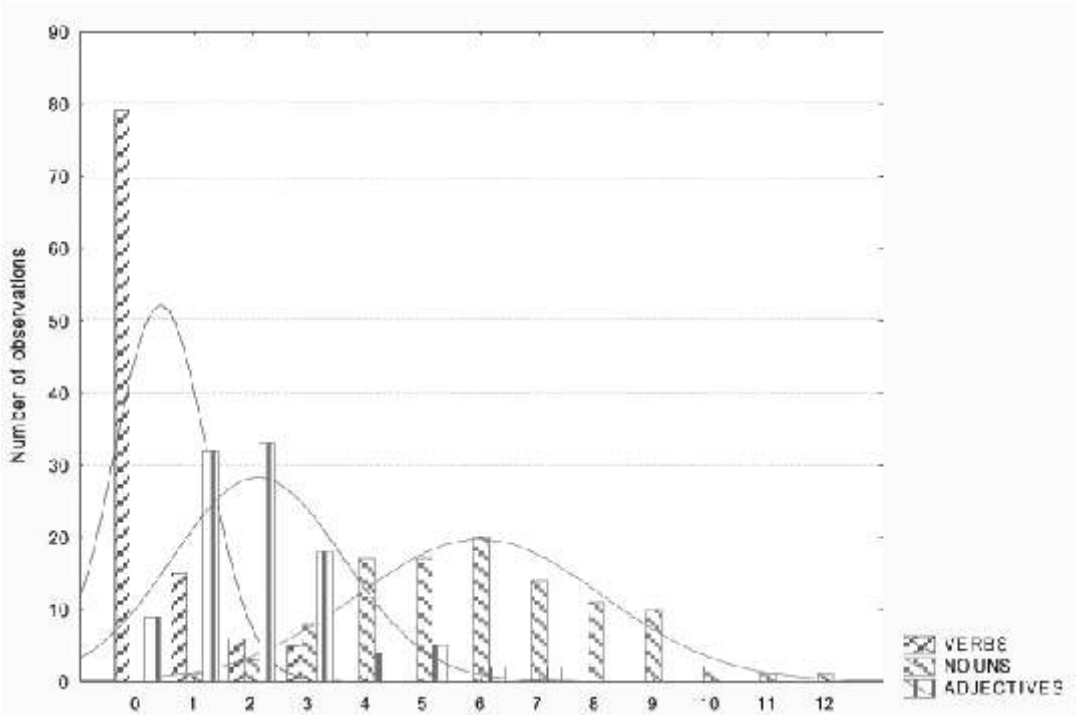

Figure 3. *Frequency distributions of three word classes – nouns, adjectives and verbs – in the titles (Legend: VERBS - number of verbs per title; NOUNS - number of nouns per title; ADJECTIVES - number of adjectives per title)*

Table 2. *Table of Euclidean distances*

VARIABLE	*PUBLICATION YEAR*	*NUMBER OF AUTHORS*	*LEXICAL WORD*	*VERBS*	*NOUNS*	*ADJECTIVES*	*LATIN*	*GREEK*	*FRENCH*	*OLD NORSE*	*ENGLISH*	**OTHER**
PUBLICATION YEAR	.0	14.9	13.6	13.2	14.0	14.2	13.1	15.3	13.2	15.6	14.5	13.6
NO. OF AUTHORS	14.9	.0	12.2	14.3	11.8	14.0	12.2	13.9	15.0	14.2	12.8	15.3
LEXICAL WORD	13.6	12.2	.0	12.8	6.5	8.1	6.8	11.4	13.2	13.2	10.6	13.9
VERBS	13.2	14.3	12.8	.0	14.9	14.3	13.2	14.4	14.4	14.0	14.4	13.1
NOUNS	14.0	11.8	6.5	14.9	.0	12.6	8.0	13.0	14.0	12.6	11.0	13.4
ADJECTIVES	14.2	14.0	8.1	14.3	12.6	.0	10.4	10.8	12.8	14.6	12.3	15.8
LATIN	13.1	12.2	6.8	13.2	8.0	10.4	.0	14.6	13.6	13.5	13.5	14.4
GREEK	15.3	13.9	11.4	14.4	13.0	10.8	14.6	.0	14.6	13.7	13.8	14.8
FRENCH	13.2	15.0	13.2	14.4	14.0	12.8	13.6	14.6	.0	14.3	16.7	15.1
OLD NORSE	15.6	14.2	13.2	14.0	12.6	14.6	13.5	13.7	14.3	.0	15.2	13.2
ENGLISH	14.5	12.8	10.6	14.4	11.0	12.3	13.5	13.8	16.7	15.2	.0	14.9
OTHER	13.6	15.3	13.9	13.1	13.4	15.8	14.4	14.8	15.1	13.2	14.9	.0

(Legend: LEXICAL WORD – number of lexical words; VERBS - number of verbs per title; NOUNS - number of nouns per title; ADJECTIVES - number of adjectives per title; LATIN - number of words/terms of Latin etymology per title; GREEK - number of words/terms of Greek etymology per title; FRENCH - number of words/terms of French etymology per title; OLD NORSE - number of words/terms of Old Norse etymology per title; ENGLISH - number of words/terms of English etymology per title; OTHER - number of words/terms of etymology in other languages per title)

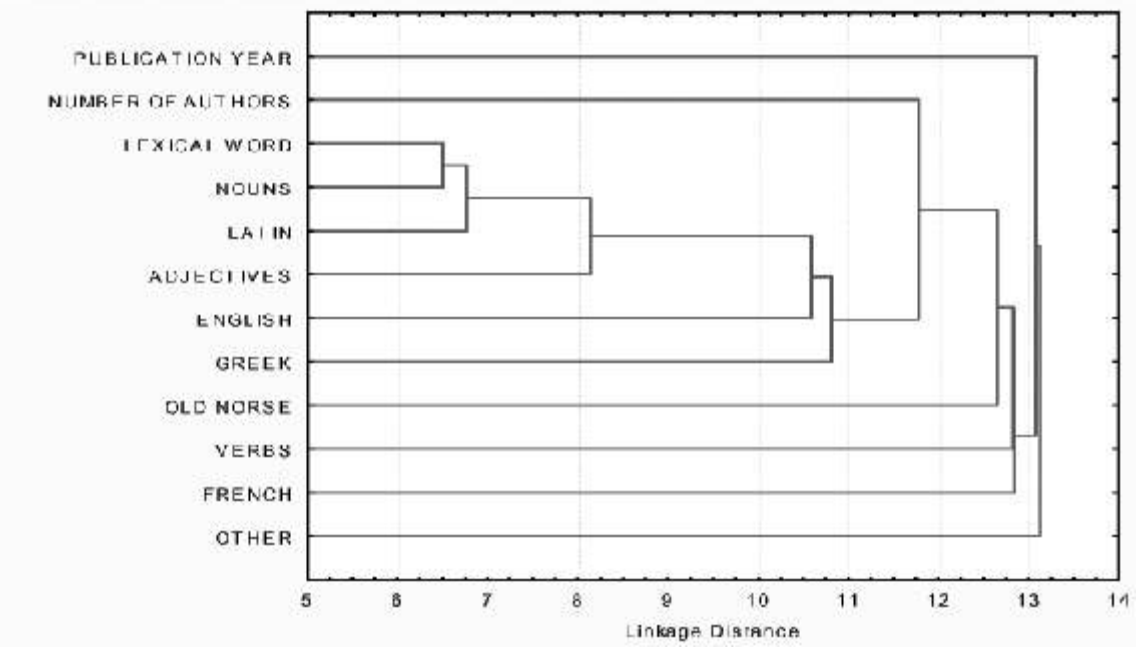

Figure 4. *Single linkage – Euclidean distance (Legend: LEXICAL WORD – number of lexical words; VERBS - number of verbs per title; NOUNS - number of nouns per title; ADJECTIVES - number of adjectives per title; LATIN - number of words/terms of Latin etymology per title; GREEK - number of words/terms of Greek etymology per title; FRENCH - number of words/terms of French etymology per title; OLD NORSE - number of words/terms of Old Norse etymology per title; ENGLISH - number of words/terms of English etymology per title; OTHER - number of words/terms of etymologyin other languages per title)*

DISCUSSION AND CONCLUSIONS

As regards the number of articles published, the results showed that this number increased after 2004 which may be interpreted either as the result of increased interest of scientists for artistic gymnastics-related topics in the last five years, as the result of the increased number of journals dealing with gymnastics-related issues, or as a combination of the two.

According to the results in this analysis, the largest number of articles was found in journals whose domain is biomechanics. This is in favour of the existence of an epistemic community that devotes its knowledge and effort to the artistic gymnastics-related issues. Secondly, since there are also journals whose domain is broader and that consider a certain subject matter from various aspects, it is obvious that interdisciplinary approaches link different epistemic communities that have succeeded in combining their bodies of knowledge to research into the topics that, when observed from various angles, shed new light on certain subject matters.

The number of authors per article may be considered as a certain recurring pattern, i.e.r most articles were written by two or three authors. According to Wray (2002), one author per article is the characteristic of papers written within the scope of social sciences. However, collaboration in scientific work has its justification in its significant causal role for the success of scientific communities in the realization of epistemological goals, i.e. the formation of knowledge and the efficiency of such work (Wray, 2002). Also, it is almost impossible for only one person to realize an experimental research (Viskić-Štalec, Omrčen, & Štalec, 2007).

Therefore, the conclusions regarding the number of authors of papers written within the analysed literature must be taken with a grain of salt. In accord with empirical-data-based conclusion making, the philosophy of science postulates in its positivist approach variety, that observation-based conclusion making yields law-like regularities between observations which are then projected into the future (Timms, 2008), i.e. the observation-based conclusions must have their predictive value. However, Timms (2008) further emphasizes that such an approach is questionable in application because it deals with people rather than inanimate their

behaviour. However, from the realist point of view, which focuses on finding causal factors that form the conclusions, it could be reasoned that nowadays success in sport is the result of many different people, and many different factors, contributing with their knowledge and effort to the development of a successful athlete in any sport, hence also in artistic gymnastics, and collaboration of expertsobjects and the potential of people is to changeseems to be the only possible way to achieve this goal. That is the reason why research into various issues in sports is done by teams of experts which is consequently manifested in scientific and professional articles being written by more than one author. Therefore, the predictive value of the fact that artistic gymnastics-related articles considered in this study were written by more than one author is related with the state-of-the-art of competitive sports.

Regarding the relationship between *publication year* and *number of authors* which showed significant differences in the number of authors by publication year it was found that there were years in which the number of articles written by only one author dominated. With one exception, these can be identified as the Olympic years and the reason for the obtained results is very likely that in the Olympic years many researchers focused on actual competitions and not so much on scientific research which followed thereafter. This conclusion seems to be logical; however, there may be other reasons not perceptible in this analysis for the decreased number of authors by publication years.

The continuous rather high number of words of Latin and Greek origin in the titles substantiates the reasoning regarding one of the characteristics of sport-specific terminology on the one hand and the scientific style of writing on the other. Both constantly operate with a substantial number of words/terms of Latin and Greek origin.

As for the words/terms found in the analysed titles, among the oldest words of Greek origin were *diet* which started to be used in the English language between 1175 and 1225 (*Random House Webster's Unabridged Dictionary*, 1999), *giant* which started to be used around 1250 AD (*Random House Webster's Unabridged Dictionary*, 1999), *mass* and *history*, and among the youngest the words *hormone,* which started to be used in English around 1900 (*Random House Webster's Unabridged Dictionary*, 1999), and *peripheral*, *aesthetic*, *biology* and *technique* whose usage in the English language started after 1800 (*Random House Webster's Unabridged Dictionary*, 1999).

Among the words that can be traced back to Latin there also were some rather 'old' words such as *use* and *image* that came into use in thEnglish language at the end of the 12th century, *element*, *number* and *pain* around 1250s, as well as *pattern* and *level* at the beginning of the 14th century (*Random House Webster's Unabridged Dictionary*, 1999).

It is well known that the English language originated from Anglo-Frisian and Lower Saxon. The first line of Latin influence occurred even before the time the ancestral Saxons came to Britain from continental Europe. Apart from being closely related to Old Frisian, Old English was strongly influenced by Old Norse spoken by the Vikings who repeatedly invaded the territory of Britain.Vikings who repeatedly invaded the territory of Britain.

Most words of Latin and Greek origin together with French words entered Old and Middle English through French, again due to the invasions of foreign conquerors, this time the Norman French, the mixed Scandinavian and French people who conquered England in the year 1066. These words came into use approximately at the end of the Middle Ages. At that time Latin was the diplomatic as well as scholarly language used throughout Europe, and many Latin words entered Old English either directly or indirectly through French. Latin extended all over Europe and it was at the beginning of the Middle Ages that Biblical Latin became current in the western parts of Europe. After the Norman invasion in 1066 the English language was under the influence of the Norman language, also termed *Old Norman* and *Anglo-French*. However, two things were important here regarding the existence of many Latin words in the English language. First, it is from Vulgar Latin that the Romance languages (including French) developed, and consequently, many words used in Old French were derived from classical Latin. Secondly, the runic alphabet was replaced by Latin alphabet.

At the dawning of Renaissance many Latin and Greek words streamed into the discourse of the new concept of scientific research. Greek and Arabic texts were translated into Latin and original Latin texts were studied as well.

The 1990s saw the skyrocketed usage of the world computer network that, quicker than anyone could expect, established itself as the global communication network used in all areas of the society. Scientific research results became accessible to more people than ever. Science demanded a scientific language common and understandable to all who worked within the contemporary scientific paradigm and the words of Latin and Greek origin played an important role in creating the terminologies of various scientific disciplines.

The number of words/terms of Latin and Greek origin in scientific texts is undoubtedly large. Such a large number of Graeco-Latin words are the result of the fact that gymnastics is incomprehensible without the knowledge of human anatomy, physiology and biochemical processes. Since these three scientific disciplines comprise the vast domain of medical sciences, which use a large number of terms of Latin and Greek origin, the utilization of a large number of terms of these origins in language from scientific research in gymnastics seems to be logical.

Significant differences found in the number of words of Latin etymology used in the titles as regards the varying number of authors may be explained by the reason that what links the smaller number of authors is primarily the compact lexicalstructure dominated by two word classes (nouns and adjectives) of Latin, and then the words of English and Greek origin. In other words, when more authors are included the writing style, i.e. its lexical characteristics, starts to dissolve. The writing style of teams consisting of fewer authors is manifested in a coalescent expression. Since no such differences were found for the number of words/terms of Greek origin per title in relation to the number of authors, it is obvious that what differentiates the writing styles is the number of words/terms of Latin etymology.

Another characteristic of language used in titles that should be emphasized is its compactness and informativeness. The type of language used in them is termed *block language*, i.e. it is a kind of language characterized by the omission of unnecessary words in such a way that only the relevant data (denoted by words) are retained. As it is evident from the results, the vocabulary used in the titles is characterized by the usage of lexical words, predominantly nouns, followed by adjectives and verbs. Obviously, nouns were the most frequently used word class, which are a word class that can be organized into hierarchical relations (Marinellie & Chan, 2006). In other words the meanings of nouns tend to be stable and predictable (Marinellie & Chan, 2006), therefore, convenient for accurate expression. On the other hand, the verbs do not have well-organized structure and their meanings are not as stable or predictable as those of nouns (Marinellie & Chan, 2006). Further, most words used in the analysed titles may be categorized as low-frequency words taking into account the general language. Unlike general language in which low-frequency words often result in poorer definitions compared to high-frequency words that often result in better definitions (Marinellie & Chan, 2006), in scientific and technical language where some low-frequency words may be considered to be more frequent, it is mandatory that they be accurately and unambiguously defined to avoid misunderstanding. Although function words were also used in the titles, their number, which was more than two times smaller than the number of lexical words, denotes precisely the block-language style in which the analysed titles were written.

Much of the vocabulary type, i.e. of the type of discourse used in the titles can also be attributed to the academic style of writing. There is a list of academic words, i.e. of words that are most frequently used in academic writing, which was compiled by A. Coxhead (1998, 2000). Coxhead (1998, 2000) devised a list of academic words containing 570 word families by compiling the body of academic words used in science, law, arts and commerce, and consequently many authors have stated that this *Academic Word List* (AWL) plays a significant role in academic writing (e.g. Vongpumivitch, Huang, & Chang, 2009). Research has shown that the knowledge of words found on this list is necessary for academic writing (Chung & Nation, 2003; Mudraya, 2006; Chen & Ge, 2007). When we compared Coxhead's AWL with the list of lexical words from our analysis, we found out that approximately 10% of all lexical words – and roughly 7% if both lexical and function words were taken into account – from the analysed titles were words from Coxhead's *Academic Word List*. This concurs with Coxhead's findings, as well as with findings of Nation (2001, p. 17) who confirmed Coxhead's thesis on the existence of a set of words that

characterize academic discourse. The percentage of *academic words* in conversational style, according to Nation (2001, p. 17) is about 1.9%, in fiction 1.7% and in newspapers 3.9%, whereas in academic texts the percentage of academic words increases to 8.5%. It is therefore obvious that, concerning the selection of academic words, the style of writing of gymnastics-related scientific texts, i.e. their titles, conforms to the generally accepted academic writing style. The value of approximately 10%, i.e. 7% of academic words used in the titles is naturally not the same as the one determined by Nation, however, this is probably due to the fact that language used in titles is always, or tends to be, devoid of redundant words, so that these percentages would probably be slightly different if full texts of articles were considered.

Regarding the interpretation of the results of cluster analysis, it would not be altogether correct to conclude that scientific discourse of the gymnastics-oriented epistemic community is as a rule dominated by the use of nouns and adjectives because the analysis in this paper did not address the full texts of articles. True, nouns were the dominant word class in the titles; however, this was due to the specific type of language, i.e. block language used in them. Still, there is the fact that, in general, scientific texts are dominated by lexical words as well as by words of Latin and Greek etymology. In congruence with the block-language-style of writing the titles, few verbs were used from which only three were the finite forms of the auxiliary verb *to be*. The omission of finite forms of the auxiliary *to be* is also one of the characteristics of block language. The dominance of nouns and adjectives in this analysis could be attributed to the fact that the sample was comprised of titles, and their style is, as already said, specific because the language used in them is the so called *block language* that has its specifics that are not found in the language used in the actual texts of articles. Undoubtedly, the words of Latin and Greek origin were used abundantly and this is one of the characteristics of scientific discourse of texts originally written in English.

The most frequent word class within the set of lexical words were the nouns of Latin etymology. The second most frequent word class used in the analysed titles were the adjectives, and the nouns and adjectives in the analysed titles were, apart fromLatin, also of English and Greek origin. The number of authors per title was rather distantly connected with the usage of nouns and adjectives from Latin, English and Greek origin. In other words, with the increase of author's number, the type of vocabulary, i.e. style of discourse used in the titles changed from a rather compact style to the style which contained a broader range of word classes originating from languages other than Latin, English and Greek.

Almost two thirds of all lexical words used in the titles were either of Latin or Greek origin. Adding French, Old Norse and *Other* languages to this calculation, the number of words whose origin is not in the English language, meaning 80%, amounted to more than two thirds of the total number of lexical words used in the titles. Whereas the usage of words from French, Old Norse, Old Danish, etc. origin may be attributed to the transfer of words across languages due to various commercial, political and migratory reasons, the reasons for the usage of the words of Latin and Greek origin are to be sought in the type of discourse used in sciences in general and that can be put under the same common denominator – *scientific*. Therefore, and compared to the Coxhead's AWL, once again it was confirmed that there is a set of words shared by scientific disciplines whose usage determines the writing style of the whole academic community. This broad epistemic community can be subdivided further into other smaller ones characterized by the usage of vocabulary typical only for a particular community – in this case the gymnastics-oriented epistemic community. This is evidenced by the usage of terms that are typical for the epistemic community, which is in the focus of the analysis in this paper. In other words, an additional characteristic of the analysed titles were the words/terms that are even more specific than the so called academic words. These words can be put under the same common denominator of *technical terms* that, in combination with the academic words, comprise the vocabulary of the analysed epistemic community. If the terms *gymnast* and *gymnastics* itself, which occurred 76 times in the titles, are considered, it is clear that they amount to 8.5% of all lexical words used in the titles, enough to determine the vocabulary of epistemic community concerned. If the incidence of the word *artistic* (28 times, i.e. 3.1% of all lexical words) is added, the resulting 11.7% mean that the presence of only four

words could be used to describe the epistemic community in question. It is also clear that if other technical terms used in the titles were added to the equation, e.g. asymmetric/uneven bars, parallel bars, giant circle, dismount, etc., the academic vocabulary type could be understood as being comprised of scientific and technical terms. Hence the epistemic community of artistic gymnastics-related researchers can be identified both by the academic vocabulary used by all members of the scientific community and by itsspecific vocabulary. The more specialized an occupation, the more technical its vocabulary. Also, the longer an occupation belongs to an established tradition; more specific linguistic rituals will be accepted by its members as discourse criterion (Crystal, 2002, p. 370). To avoid ambiguity, the terms used by one occupation must be standardized. The process of standardization of terms within the system of concepts then results in creating a terminological system, i.e. the terminology of the activity in question.

The existence of typical vocabulary is in accordance with the fact that terminology belongs to the set of basic epistemological characteristics of each science, and that it should be considered with outmost care in order to validate scientific communication.

REFERENCE

Boulton, A.J., Panizzon, D., and Prior, J. (2005). Explicit knowledge structures as a tool for overcoming obstacles to interdisciplinary research. Conservation Biology, 19(6): 2026-2029.

Chen, Q., and Ge, G.-C. (2007). A corpus-based lexical study on frequency and distribution of Coxhead's AWL word families in medical research articles (RAs). English for Specific Purposes, 26: 502-514.

Chung, M., and Nation, P. (2003). Technical vocabulary in specialized texts. Reading in a Foreign Language, 15: 103-116.

Cowan, R., David, P.A., and Foray, D. (2000). The explicit economics of knowledge codification and tacitness. Industrial and Corporate Change, 9(2): 212-253.

Coxhead, A. (1998). An Academic Word List, Occasional Publication Number 18, LALS, Victoria University of Wellington, New Zealand.

Coxhead, A. (2000). A new academic word list. TESOL Quarterly, 34, 213-238.

Crystal, D. (2002). The Cambridge Encyclopedia of the English Language. (p. 370). Cambridge: Cambridge University Press.

Elman, J.L. (2004). An alternative view of the mental lexicon. Trends in Cognitive Sciences. 8(7): 301-306.

Estes, S. (1994). Knowledge and kinesiology. Quest, 46, 392-409.

Felber, H. (1980). In memory of Eugen Wüster, founder of the general theory of terminology. International Journal of the Sociology of Language, 23: 7-14.

Haas, P. (1992). Introduction: Epistemic communities and international policy coordination. International Orgnization, 46(1): 1-35.

Love, N. (2009). Science, language and linguistic culture. Language & Communication, 29: 26-46.

Marinellie, S.A., and Chan, Y.-L. (2006). The effect of word frequency on noun and verb definitions: A developmental study. Journal of Speech, Language, and Hearing Research, 49: 1001-1021.

Moore, R., and Muller, J. (2002). The growth of knowledge and the discursive gapBritish Journal of Sociology of Education, 23(4): 627-637.

Mudraya, O. (2006). Engineering English: A lexical frequency instructional model. English for Specific Purposes, 25:235-256.

Nation, I.S.P. (2001). Learning Vocabulary in Another Language, (p. 17). Cambridge: Cambridge University Press.

Random House Webster's Unabridged Dictionary. (1999). V2.2 for 16bit WindowsTM systems, V3.0 for 32bit WindowsTM systems, Random House, Inc. Collexion Reference Software (1998) Lemout and HousepieTM.

Roth, C., and Bourgine, P. (2005). Epistemic communities: Description and hierarchic categorization. Mathematical Population Studies, 12:107-130.

Starosta, V. and Petrinsky, W. (2007). Selected problems in international terminology of the human movement science. Kinesiology, 39(1): 5-14.

Timms, P. (2008). Transport models, philosophy and language. Transportation, 35: 395-410.

Viskić-Štalec, N., Omrčen, D. i Štalec, J. (2007). Ogleda li se razvoj kineziologijske

znanosti u radovima časopisa «Kineziologija»/»Kinesiology»? In B. Maleš, D. Miletić, N. Rausavljević and M. Kondrič (Eds.)

Proceedings of the 2nd International Conference «Contemporary Kinesiology», Mostar, 14 – 16, December 2007, (66-82). Split, Mostar, Ljubljana: Faculty of Kinesiology University of Split, Faculty of Natural Science,Mathematics and Education University of Mostar, Faculty of Sport University of Ljubljana.

Vongpumivitch, V., Huang, J.-Y., & Chang, Y.-Ch. (2009). Frequency analysis of the words in the Academic Word List (AWL) and non-AWL content words in applied linguistics research papers, English for Specific Purposes, 28: 33-41.

Wray, K.B. (2002). The epistemic significance of collaborative research. Philosophy of Science, 69, 150-168.Wrynn, A. (2003). Contesting the canon: Understanding the history of the evolving discipline of kinesiology, Quest, 55(3): 244-256.

Wray, K.B. (2002). The epistemic significance of collaborative research. Philosophy of Science, 69: 150-168.