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Knowledge of students of physical education in respect of the anatomy of the locomotive apparatus

Conhecimento de estudantes de educação física a respeito da anatomia do aparelho locomotor

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RESUMO

O conhecimento sobre a anatomia do aparelho locomotor é de suma importância para o profissional de Educação Física, uma vez que este intervém em ações de prevenção, promoção e reabilitação da saúde por meio do movimento humano. Diante disso, o objetivo da presente pesquisa foi analisar o conhecimento de 172 estudantes de bacharelado em Educação Física sobre anatomia humana do aparelho locomotor (AHAL). Para coleta dos dados, foi utilizado um questionário sociodemográfico e 45 questões fechadas a respeito do sistema esquelético (SE), articular (SA) e muscular (SM). As informações foram analisadas com base na estatística descritiva (%), e utilizados os testes de *Mann-Whitney*, *Kruskal-Wallis* e correlação de *Spearman* ($p < 0,05$) para comparar o índice de conhecimento encontrado com as variáveis sociais e acadêmicas da amostra. Percebe-se que o nível de conhecimento em AH do aparelho locomotor da maioria dos alunos é insatisfatório, sendo maior no sexo masculino (sistema esquelético), nos indivíduos mais velhos (sistema muscular) e naqueles que não ficaram de exame na disciplina de AH. O resultado indica a necessidade de as instituições de ensino superior repensarem as estratégias metodológicas em prol do processo de ensino e de aprendizagem. Conclui-se que o nível de conhecimento em AHAL da maioria dos alunos é insuficiente, sinalizando a carência de metodologias que procurem articular os conhecimentos com o cotidiano profissional por meio de práticas aplicadas e situações-problemas.

Palavras-chave: Corpo humano. Movimento. Universidade.

ABSTRACT

Knowledge on the locomotive apparatus is crucial for professionals of Physical Education since it intervenes in all activities on the prevention, promotion and health rehabilitation by human movement. Current research analyzes undergraduate students in the course of Physical Education on the human anatomy of the locomotive apparatus (HALA). Sample comprised 172 students and data were retrieved by a sociodemographic questionnaire and by 45 closed questioned on the skeleton (SS), articular (AS) and muscular (MS). Data were analyzed by descriptive statistics (5), whilst Mann-Whitney, Kruskal-Wallis and Spearman co-relation tests ($p<0.05$) were employed to compare knowledge scores with the sample´s social and academic variables. Data show that knowledge level on HALA of most students is unsatisfactory, but somewhat better with regard to males (SS), older students (MS) and students who had a direct pass in HA. The above demonstrates that higher education institutions should rethink their methodological strategies in the teaching and learning process. Results reveal that knowledge level on HALA by most students in insufficient and indicate the lack of methodologies that articulate knowledge with professional experience by applied practices and problem situations.

Keywords: Human body. Movement. University.

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INTRODUCTION

In the last few decades, initial formation in Physical Education has undergone several curricular restructuring (Resolution CNE/CP 01 and 02/2002; Resolution CNE/CP 07/2004) for the formation of professionals with knowledge, abilities and attitudes with regard to the fields of activities in the subject matter and with different contents for the solution of issues within their profession.

In the context of the above proposal, foregrounding the relevance between work and formation, knowledge and applicability in intervention, initial formation courses (undergraduate) have their curricular components distributed in issues on a broad (relationship between the human being and society, biology of the human body, production of scientific/technological knowledge) and specific (cultural components of human movement, technical-instrumental, didactic-pedagogical) formation[1-2].

Each component of the curriculum has its own specificity and contribution for the area of knowledge. Human Anatomy is one of the components in general formation that has, as its contents, the study of anatomy, the delimitation plans of the human body, bone, articular, muscular, respiratory, circulatory, reproduction, urinary, digestive, endocrine and nervous systems. Cardinot et al.[3] underscore that the traditional component in health courses is basic for the professionals´ formation and intervention.

Although the importance of curricular Anatomy, for the health area, and, in the case of Physical Education, knowledge on the anatomy of the locomotive apparatus, are above any discussion, several studies[4, 12,13] have underscored that students have to cope with the subject matter with difficulties. Motives include difficult terminology, the small size of the structures, inadequate preparation or wear of the samples, individual factors, such as lack of motivation, attention, uneasiness when students see human corpses and the lack of comprehension on the relationship between what is studied in the laboratory and human movement in general.

Due to the above situation, it should be emphasized that strategies of teaching and learning based on active methodologies should be introduced by higher education institutions[5;6,7,8,9,10,11] since they may decrease the difficulties and favor the construction of knowledge by the active interaction between professor and undergraduate and between students. Methodological strategies may include theoretical and practical (praxis) lectures worked and articulated for knowledge, schemes with anatomical items identified in practical lectures, applied examples of anatomic systems involved in the professional´s activities, problem-based studies and other transdisciplinary activities to make feasible a greater autonomy of undergraduates to cope with the proposed contents.

Current research analyzes knowledge of undergraduate students in the course of Physical Education on the human anatomy of the locomotive apparatus (HALA) (skeleton, articular and muscular systems) to investigate the situation of learning on anatomical contents.

METHODS

PARTICIPANTS AND PROCEDURES

Current transversal study was approved by the Committee for Ethics in Research of the Centro Universitário Metropolitano de Maringá, with protocol 2.570.809/2017. The Institute of Higher Education where research was undertaken was chosen intentionally and by convenience. All second to fourth year undergraduates enrolled in the Physical Education course, who had already studied Human Anatomy, were invited. Curricular contents are given during the first year of the course, with a load of 80 h, during the semester. The study on Human Anatomy is based on anatomical terminology, introductory lectures on concepts (limitation plans, parts of the human body, lines, movement axes and regions), coupled to the study on bone, articular, muscular, respiratory, circulatory, digestive, urinary, reproduction, endocrine and nervous systems. Assessment criterion of the curricular subject matter involves the presence and par-

ticipation in practical lectures, theoretical and practical tests, with average equal to or higher than 7.0 for approval without final examination.

Research sample comprised undergraduates of both genders, with different age brackets (18 to 42 years old), who were successful in the periodical tests for HA and who were present for data collection previously scheduled by the dean of the course. Undergraduates who failed to answer the entire questionnaire or who did not want to participate in the research were excluded. All complied with the inclusion criteria.

First-year undergraduates were excluded since they did not complete the whole contents of the discipline HA up to the date of data collection, between April and September 2017. The sample was thus composed of 172 students: 70.9% were males, between 18 and 29 years old (85.5%), mean age 24.8±4.87 years. Most undergraduates were in the third year of the course (35.5%), followed by undergraduates of the second year (34.9%) and by undergraduates of the fourth year (29.6%). More than half the undergraduates were on trainee experience in the area (78.5%); 77.9% had to sit for the final exam in HA (77.9%); 83.7% were approved with final average score ranging between 6.0 and 7.0; (94.2%) liked the discipline; and 95.3% considered the curricular subject matter highly relevant for the Physical Education professional.

Data were collected by a questionnaire handed out during the morning and evening lecture period, according to classes, during and after lectures. The undergraduates were instructed with regard to the aims and proposals of the research and the participants were invited to sign the Free Consent Form. Collection lasted 30 minutes, at an average. The students could not use any material to answer the questions. No revision of the subject matter was given so that they were examined on what they actually learned and remembered on the curricular subject matter.

Instruments

The questionnaire was prepared by the researchers and contained questions on age, age group (< 18 years old; 19 - 29 years old); gender (male; female); whether the undergraduate already had a diploma in Physical Education (yes; no); undergraduate year (2nd, 3rd, 4th year), whether the undergraduate is a paid trainee in the subject matter (yes; no); approximate score in the discipline HA (< 6.0; 6.0 – 7.0; 7.0 – 8.0; 8.0 – 9.0; >9.0); whether the undergraduate liked the discipline HA (yes; no); whether the undergraduate considered HA important within the professional knowledge of Physical Education (yes; no); whether the professor of HD had a graduation degree in Physical Education (yes; no).

Forty-five questions on the HA of the locomotive apparatus were prepared by one of the researchers who is responsible for the curricular subject matter of the discipline HA. He has a degree in Physical Education and Physiotherapy and a Specialist Degree in Human Anatomy. The questionnaire features 15 questions on the skeleton system, 15 questions on the articular system and 15 questions on the muscular system. Since the above form the locomotive apparatus, they were included in the questionnaire and they were elaborated on the professional practice of Physical Education. The questions had four options. Percentage (0% - 100%) of undergraduates´ scores for each question (skeleton, articular and muscular systems) was thus calculated.

Analysis of data

Undergraduates´ knowledge index was analyzed by descriptive statistics for frequency (f) and percentage (%) by the simple sum of the number of answers on the item divided by the number of applied questionnaires, with Microsoft Office Excel 2010. Data were given in medians and quartiles. Index was compared with sample´s social and academic variables by IBM SPSS 22.0 and Mann-Whitney and Kruskal-Wallis tests. Spearman´s co-relation coefficient was employed to verify the relationship between knowledge on the anatomy of the locomotive apparatus and age, at significance level $p < 0.05$.

RESULTS

As a general rule, undergraduates in the study had a low score percentage in the questions related

to the muscular (Md = 40.0), articular (Md = 26.7) and skeleton (Md = 40.0) systems, featuring an unsatisfactory knowledge in HALA. Undergraduates revealed low level of knowledge on anatomy (Md = 33.3).

When knowledge on the undergraduates´ HALA was analyzed according to their gender (Table 1), there was a significant difference between males and females only with regard to the skeleton system (p=0.010). Males (Md=40.0) showed a higher score percentile when compared to females (Md=26.7). However, it should be underscored that the two groups had a low score percentage in all the questions evaluated.

Table 1. Comparison of knowledge on Human Anatomy of the Locomotive Apparatus by undergraduates according to their gender

KNOWLEDGE ON ANATOMY	Gender		*P*
	Males (n = 124)	Females (n = 48)	
	Md (Q1-Q3)	Md (Q1-Q3)	
Muscular System	40.0 (26.7-53.3)	40.0 (26.7-46.7)	0.302
Articular System	26.7 (13.3-40.0)	20.0 (13.3-33.3)	0.452
Skeleton System	40.0 (26.7-53.3)	26.7 (20.0-46.7)	**0.010***
Total	35.6 (24.4-46.7)	28.9 (22.2-39.4)	0.089

* Significant difference: p<0.05 – Mann-Whitney´s U test
Md: median; Q1- Q3: quartiles; n: number of undergraduates.

When undergraduates´ knowledge on HALA was compared according to their age group (Table 2), there was a significant difference between the groups only with regard to knowledge on the muscular system (p=0.021) and total knowledge (p=0.040). This fact demonstrated that undergraduates within the 30 years-old group and above had the lowest score percentiles when compared to younger students.

Table 2. Comparison of undergraduates´ knowledge on HALA according to their age group

KNOWLEDGE ON ANATOMY	18 - 29 years old (n = 147)	30 years old and over (n = 20)	P
	Md (Q1-Q3)	Md (Q1-Q3)	
Muscular System	40.0 (26.7-53.3)	30.0 (20.0-45.0)	**0.021***
Articular System	26.7 (13.3-40.0)	20.0 (6.7-31.7)	0.062
Skeleton System	40.0 (26.7-53.3)	30.0 (26.7-46.7)	0.311
Total	33.3 (25.6-45.6)	28.9 (20.6-35.6)	**0.040***

* Significant difference: p<0.05 – Mann-Whitney´s U test
Md: median; Q1- Q3: quartiles; n: number of undergraduates.

When undergraduates´ knowledge on HALA was compared according to the course year (Table 3), there was a significant difference between the groups with regard to knowledge on the muscular system (p=0.008), articular system (p=0.008) and general knowledge (p=0.004). It should be underscored that third year undergraduates had a better knowledge (higher score percentiles) on HALA when compared to first and second year undergraduates

Table 3. Comparison of undergraduates´ knowledge on HALA according to the year of their course

KNOWLEDGE ON ANATOMY	Course year			*P*
	First (n = 62)	Second (n = 50)	Third (n = 61)	
	Md (Q1-Q3)	Md (Q1-Q3)	Md (Q1-Q3)	
Muscular System	33.3 (16.7-46.7)	40.0 (26.7-53.3)	46.7 (33.3-56.7)[a]	**0.008***
Articular System	20.0 (10.0-33.3)	20.0 (13.3-33.3)	26.7 (20.0-40.0)[b]	**0.008***
Skeleton System	33.3 (20.0-46.7)	40.0 (20.0-46.7)	40.0 (26.7-53.3)	0.128
Total	28.9 (20.0-43.3)	31.1 (22.2-42.2)	37.8 (27.8-48.9)[c]	**0.004***

* Significant difference: p<0.05 – Kruskal-Wallis´s test between: a, b, c) Third with Second and First. Md: median; Q1- Q3: quartiles; n: number of undergraduates.

Since there was no significant difference (p>0.05) between groups in any of the variables when undergraduates´ knowledge on HALA was compared to traineeship, it became clear that trainee in Physical Education was not an intervening factor in the acquisition of knowledge on Anatomy.

When undergraduates´ knowledge on HALA was compared according to the student´**s sitting for** the final examination in the discipline (Table 4), there was a significant difference between the groups with regard to all the variables with regard to knowledge (p<0.05). Results evidence that undergraduates who did not have to sit for the final exam had better knowledge (score percentile) in all the anatomic systems and in the general evaluation with regard to knowledge on HALA.

Table 4. Comparison of undergraduates´ knowledge on HALA according to sitting for the final examination of the discipline

KNOWLEDGE ON ANATOMY	Final exam of the discipline		*P*
	Yes (n = 134)	No (n = 38)	
	Md (Q1-Q3)	Md (Q1-Q3)	
Muscular System	40.0 (20.0-46.7)	46.7 (31.7-68.3)	**0.001***
Articular System	20.0 (13.3-33.3)	30.0 (18.3-46.7)	**0.006***
Skeleton System	40.0 (26.7-46.7)	50.0 (26.7-60.0)	**0.019***
Total	31.1 (22.2-42.2)	42.2 (26.7-57.8)	**0.003***

* Significant difference: p<0.05 – Mann-Whitney´s U test

Md: median; Q1- Q3: quartiles; n: number of undergraduates.

When undergraduates´ knowledge on HALA was compared according to their final score in the discipline (Table 5), there was no significant difference ($p>0.05$) between the groups with regard to any variable. The above reveals that final score in the discipline is not an intervening factor on undergraduates´ knowledge on anatomy.

Table 5. Comparison of undergraduates´ knowledge on HALA according to final score in the subject

KNOWLEDGE ON ANATOMY	Final score in the subject			*P*
	Lower than 6.0 (n = 15)	6.0 – 7.0 (n = 120)	Above 7.0 (n = 37)	
	Md (Q1-Q3)	Md (Q1-Q3)	Md (Q1-Q3)	
Muscular System	30.0 (20.0-41.7)	40.0 (26.7-53.3)	40.0 (26.7-56.7)	0.179
Articular System	20.0 (13.3-33.3)	26.7 (13.3-33.3)	26.7 (16.7-40.0)	0.320
Skeleton System	30.0 (25.0-48.3)	40.0 (26.7-53.3)	40.0 (26.7-53.3)	0.766
Total	26.7 (20.0-35.0)	33.3 (22.2-44.4)	35.6 (26.7-50.0)	0.220

* Significant difference: $p<0.05$ – *Kruskal-Wallis* test

Md: median; Q1- Q3: quartiles; n: number of undergraduates.

Since there was no significant co-relationship ($p>0.05$) when the relationship between HALA and undergraduates´ age was analyzed, undergraduates´ age group was not an intervening factor on HALA.

DISCUSSION

Above data demonstrate that percentile median of undergraduates´ knowledge on muscular and skeleton systems was low and, consequently, indicated an unsatisfactory knowledge with regard to contents. Cardinot et al.[3] show that knowledge on the locomotive system has a paramount importance for the intervention practice of the Physical Education professional. Since it is actually a complex curricular subject matter with a great number of concepts and structures, the undergraduates failed to learn the terms or did not give the proper importance when lectures on the subject were given. Since HALA provides an idea of the structure and function of the human body, anatomy is pinpointed as a critical study area for several health professions[14].

Undergraduates´ low learning percentage or interest may be explained by the contents´ complexity, but also by the way the curricular component is taught in most institutes of higher education. In fact, the systems of human anatomy are lectured as a closed and compact subject matter, far from the daily demands of the profession. Consequently, the students have difficulties in applying their scientific knowledge within their professional intervention[6].

The relationship is only perceived by students when they enter the labor market after graduation or during the mandatory or non-mandatory traineeships. Cardinot et al.[3] and Oliveira et al.[8] explained that the importance of anatomy for students is perceived when they have to cope with professional situations that demand their knowledge taught at the university or when contents are systematized practically and effectively, taking into account that the body is one and interacts with the environment.

These are actually the demands that may be discussed in the classroom by the HALA professor through theoretical and practical lectures. Schemes with anatomical items, examples applied to professional practice and studies based on problems are some of the activities that enhance the professor-undergraduate and student-student interactions [8] so that knowledge on HA may be applied and understood through concrete problem situations in the professional´s day-to-day interventions.

Albuquerque Filho et al.[6], Silva Junior et al.[9] and Alves et al.[10] underscore that professors are facilitators of learning, mediating knowledge to empower the recovery of previous knowledge and the undergraduates´ participation and autonomy. They provide new alternatives for the assimilation of the proposed contents and a greater motivation for the solution of problem-situations, coupled to an effective learning of concepts and updating after the end of the subject matter.

Within the context of the skeleton, articular and muscular systems of HALA, it may be perceived that the learning level of the articular system had the lowest index (percentage). This was perhaps due to its being an intermediate content between the skeleton and muscular systems, with low teaching load. In fact, the articular system has the lowest relationship with the daily demands of the Physical Education professional even though it is important for the execution of the other systems. There is no movement by the muscles that traction the bones without articulation allowing or impairing the movements.

The articular system is, consequently, of great importance for the practice of the Physical Education professional since the execution of all movements depends on it. The difficulty lies in the assimilation of its complex contents that involve three types of articulations and their sub-types, in a very short period. Further, one has to investigate whether the hour load of the subject matter is sufficient to have an in-depth knowledge in all the items involved.

The study by Crochemore & Marques[16] on the opinions of professionals in Physical Education with regard to the subject Anatomy underscores that most had difficulties in remembering the contents due to the professor´s lack of didacticism, with de-contextualized technical questions from professional practice and the short time dedicated for the great amount of information.

Difference in knowledge related to the skeleton system in which males had a better knowledge when compared to females ($p=0.010$) may have occurred because male students have greater learning facilities in visual learning than females[13,15,17,18]. A hypothesis may be raised: since the skeleton system is first among other anatomy subjects in Health Courses, where the visual style learning predominates, the learning style of the other systems allies itself to the sensorial and sequential strategy and makes learning easier for female undergraduates.[16]

There was a significant difference ($p=0.045$) only with regard to the muscular system in which undergraduates within the 30-39-year-old group had a lower knowledge rate when compared to those in other groups (18 - 29 years old and 40 years old or more). The above result may reflect the teaching process or responsibilities undertaken. Whereas the former group is more focused on studies for the development of their professional career[19], the older undergraduates (above 30 years old) have to reconcile study and other family and employment issues. Older students normally undertake higher education as a personal commitment since they have to actively exploit opportunities offered by the market. Undergraduates are responsible for their final formation and have to work differently to cope with their academic responsibilities[20].

Results also revealed that last-year undergraduates had a better knowledge on the locomotive system that those in the second and third years. In fact, HA and LA are basic for the understanding of most subjects within the instrumental technical area. Last-year students are immersed in practices and body activities that may be articulated with the locomotive apparatus since in the subject matters that involve body practice and training issues, the locomotive apparatus system is employed as a basic principle.

Consequently, data showed that last-year students had a greater knowledge since they were at the end of their undergraduate formation and on the threshold of becoming professionals. Damasceno & Cória-Sabini[21] demonstrate that the professor and the successful professional are people who reflect on their activities and review the theoretical foregrounding of their practice, their successes and failures, with subsequent changes in their teaching methods.

The undergraduates start reflecting on the importance of a determined subject in their professional practice, which, due to several factors, failed to occur.

According to research by Igue, Bariani and Milanesi[20], results suggest that being an undergraduate in the first or fourth year affects the undergraduates´ academic experience since the accumulation of experiences by last-years students and their maturity provides them with better academic habits.

Data have also shown that undergraduates who did not need to sit for the final examination in HA had a better knowledge on the locomotive apparatus. This performance is perhaps due to their choice of the right course which makes learning easier in all subjects, including HA. These undergraduates may have had a greater affinity for the theme, whilst those who had to sit for the final examination found greater difficulties in understanding the theme.

The strongest factors of current study comprise 1) sample composed of all undergraduates who had studied HA in the course of Physical Education of the institution of higher education under analysis; 2) use of a questionnaire elaborated by the authors, some of whom are professors of HA, since no specific questionnaire is extant on the subject matter investigated.

In spite of its relevant results, current research had its limitations. Since it is a transversal study, causality cannot be established; data refer to the profile of undergraduates of a single private institution of higher education in the municipality, with no possibility in generalizing results; the age group and gender of undergraduates who did not obtain a pass mark in the subject (younger undergraduates tend to develop only gradually a certain maturity with regard to the subject and learning methods); lack of data whether the student had previously revised or not the contents since collection was undertaken in different days and periods.

Further studies should be undertaken on the same theme that would follow up longitudinally the undergraduates and their knowledge on HA during the course and their professional life.

CONCLUSION

Indexes for responses indicate an unsatisfactory level in the knowledge on HALA in all undergraduates. Male and older undergraduates and those who did not need to sit for the final examination had better knowledge indexes respectively on the skeleton and muscular systems.

Current analysis shows that institution of higher education should rethink their methodological strategies in the teaching and learning processes and the importance of greater pedagogical investments in the subject HA. Restructuring would make more feasible the employment of active methodologies and a greater professor-undergraduate and student-student interactions. The activities for Physical Education professionals require a qualification that would make them capable of in-depth knowledge on human movements in all subareas for the solution of problems concerned.

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