

Cell biology and histology in medicine: perception on education and student performance

Biologia celular e histologia em medicina: percepção sobre o ensino e desempenho de estudantes

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RESUMO | INTRODUÇÃO: As disciplinas de Biologia Celular e Histologia, que fundamentam a área microscópica da Morfologia e fazem parte da grade curricular do início do curso de Medicina, são pilares da educação médica e para o raciocínio clínico dos futuros profissionais. **OBJETIVOS:** Este estudo teve por objetivo traçar um perfil do ensino das disciplinas de Biologia Celular e Histologia em cursos de graduação em Medicina, que tiveram participantes no processo seletivo para preenchimento de vagas por transferência para o curso de Medicina da Faculdade de Medicina de São José do Rio Preto (FAMERP), em 2017. **MÉTODOS:** Este foi um estudo transversal quantitativo e qualitativo e participaram 132 acadêmicos. **RESULTADOS:** Os resultados evidenciaram que, na maioria das Instituições de Ensino Superior (IES), estas disciplinas são ministradas de forma teórico-prática. Na comparação do desempenho teórico dos alunos da metodologia de ensino-aprendizagem tradicional versus ativa, observou-se maior número de acertos de Histologia e nota final para os do método tradicional. A deficiência no ensino apontada pelos alunos foi falta de aulas práticas com a observação de lâminas em microscópio de luz. Além disso, os quesitos prática pedagógica dos docentes e produção de aulas dinâmicas se mostraram fundamentais para maior interesse dos discentes, bem como para melhor índice de satisfação no aprendizado destas áreas. Ademais, integração dessas disciplinas com a prática clínica da Medicina se mostrou relevante para os acadêmicos, que se sentem mais instigados ao conhecimento. **CONCLUSÕES:** No presente estudo, detectou-se um melhor aproveitamento em relação à Histologia pelos alunos dos cursos de metodologia tradicional, comparados aos da metodologia ativa e, desta forma, a análise realizada pode colaborar para o enriquecimento e reafirmação dos frutos da comparação de metodologias de ensino-aprendizagem.

PALAVRAS-CHAVE: Avaliação médica. Educação médica. Biologia celular. Histologia.

ABSTRACT | BACKGROUND: The subjects areas of Cellular Biology and Histology, which underpin the microscopic field of Morphology and are included in the first years of the curriculum in a Medical course, are the pillars of medical education and for the clinical reasoning of future professionals. **OBJECTIVES:** This study aimed to trace a teaching profile of Cellular Biology and Histology in the Medical courses which had participants in the selection process to fill vacancies by transfer, for the undergraduate course in the Medical School of São José do Rio Preto (FAMERP) in 2017. **METHODS:** This was a quantitative and qualitative cross-sectional study and 132 academics participated. **RESULTS:** The results showed that, in most Higher Education Institutions, these disciplines are taught theoretically and practically. In the comparison between the theoretical performance of the students of traditional and active teaching-learning methodology, a higher number of hits in Histology and a better final grade were observed in the traditional. The deficiency pointed out by the students was a lack of laboratory sessions with viewing histological glass slides with light microscopes. Also, the aspect of teachers' pedagogical practice and dynamic classes was shown to be fundamental to the students' interest, as well as to better satisfaction's index in learning these areas. Furthermore, integrating these disciplines with the clinical practice of Medicine has proved to be relevant for academics, who feel more instigated to knowledge. **CONCLUSIONS:** In the present study, it was detected a better use in relation to the Histology by the students of the courses of traditional methodology, compared to those of active methodology and in this way the analysis done can to collaborate for the enrichment and reaffirmation of the fruits of the comparison of teaching-learning methodologies.

KEYWORDS: Medical assessment. Medical education. Cell biology. Histology.

Introduction

In 2017 Brazil had 219 medical courses. Every year hundreds of medical students from several institutions spread across the country disputing vacancies to transfer to other schools. These transferring from one school to another is allowed by the Brazilian Law 9,394/96 that authorizes students transferring during the undergraduate course in the hypothesis of the existence of vacancies and through a selective process¹. The Medical School of São José do Rio Preto – FAMERP is one of the most sought-after colleges for students' transferring. Regarding the college transfer process, Federal Council of Education Resolution No. 12/1984 recommends in its Article 2 the authorization, use and recognition of disciplines of the minimum curriculum of every undergraduate course studied, by the school that receives the student, attributing to her/his credits, notes, concepts and workload obtained in the establishment of origin².

The medical courses are structured in three bases: basic, clinical and internship. This model exists since the creation of the first Brazilian college, more than 180 years ago³.

Regarding the type of teaching-learning methodology used by the medical schools, in the traditional one the teacher has the fundamental function of transmitting the content through expositive means, concentrating on the disease as the main biological process; since the active methodology relies on concentrated learning in practice, where from the experiences, integrations and construction of knowledge through connections, the student can master the theory based not only on the disease but its ability to solve an imbalance in the process of health-disease⁴.

Among the compulsory subjects of the course, Cellular Biology and Histology are considered as a basis for learning and sedimentation of subjects throughout the entire graduation, so they are taught more frequently in the first semesters in traditional and active methodologies courses.

Cellular Biology is the discipline that studies cells, their structure, morphology and functions, which is considered the fundamental unit for the formation of living beings⁵. Histology, in addition to studying the cell, addresses the extracellular matrix and its

association in a mesh organized with the cell surface, to form tissues and organs (Alberts et al, 2004)⁶. These disciplines are evaluated in the transfer process, making it possible to analyse the quality of the teaching dedicated to them in the different medical schools.

In most colleges, the first two years or the first four periods are known as the basic cycle and correspond to the study of the fundamental disciplines, among them Cellular Biology and Histology. These are usually taught with theoretical lectures, with the support of rear projection, the projection of slides, presentation of schemes and the like, besides the blackboard in class and with practical classes, by means of an extensive workload, that occurs in the laboratories with use of microscopes and slides prepared with specific tissues⁷.

However, in the first two years of the course, a dissociation between the basic and vocational cycles is present in the students' mentality, regardless of the moment they are being studied, generating a great dissatisfaction on the part of the students, who often cannot understand the importance of the basic disciplines in their training. Often they are lost or do not give their due value to the contents taught, which can hinder the appropriation of the knowledge that is fundamental in the base of their formation⁵.

At the beginning of the course, students are confronted with the traditional model of teaching, with a great drop in expectations and many contents to be learned in theory, reflected in the small practical workload linked to the basic cycle of medicine. The lack of linkage of the classes with the practice, already pointed out, is seen as responsible for the lack of preparation that the students⁸.

Thus, a poor theoretical and practical base is created, due to lack of stimuli of the students and the lack of correlation with the practice of Medicine, allowing difficulties of understanding and lower sedimentation index of contents essential for the construction of the knowledge throughout the course.

This study aims to outline a profile of the teaching on Cellular Biology and Histology in students of Medicine that had participants in the selection process to fill vacancies by transfer, for the Medicine course of FAMERP, in 2017.

Materials and methods

This is a quantitative and qualitative cross-sectional study to trace the profile of Cellular Biology and Histology disciplines teaching in Medicine undergraduate courses that had participants in the selection process to fill vacancies by transferring for the undergraduate course in Medicine of the FAMERP, in the year 2017. The subjects of this research were 132 medical students of both sexes and any undergraduate year. A semi-structured questionnaire composed by objective closed questions and dissertations, as well as an image to be analysed and was applied on the day of the transferring exam. The present study was previously approved by the Ethics Committee on Research in Human Beings of the Medical School of São José do Rio Preto (FAMERP) according to the SISNEP/CAAE 55755616.6.0000.5415.

Statistical analysis

The exploratory data analysis included mean, median, standard deviation and variation for continuous variables and number and proportion for categorical variables. The normal or non-normal distribution of continuous variables was verified by asymmetry and kurtosis. In the comparison between groups, the homogeneity of the variances was verified by the Levene test. The comparison of numerical variables between two groups was performed by the Student test. Statistical analysis was performed using the IBM-SPSS Statistics version 24 software (IBM Corporation,

NY, USA). All tests were two-tailed and P-values <0.05 were considered significant.

Results

One hundred and forty-one students were included in the study, of which 9 (6.4%) were FAMERP students and 132 (93.6%) were students of medical courses from other institutions. All 9 FAMERP students were in the 2nd year of medical school. Among the students of other Medical Schools, the distribution by each year course is 16.70% in the first, 73.50% in the second, 8.30% in the third and only 1.50% in the fourth year of the course. The clear majority that participated in the process, 73.50% of the students from other Medical Schools, were in the second year of graduation. The three main reasons why students from other medical schools sought to participate in the selective transfer process for FAMERP were financial matters (41%), being closer to home (15%) and FAMERP status (15%).

Among the students of other Medical Schools, the discipline of Cytology had already been studied by 79/131 (60.3%) students, the discipline of Cellular Biology had already been studied by 102/131 (77.9%) students and the discipline of Histology had already been studied by 132/132 (100%) students. The distribution per year of course among those who have already studied these subjects can be found in Table 1.

Table 1. Distribution per year of medical course among students of other Medical Schools, according to subjects already studied

Taken discipline	1° year	2° year	3° year	4° year
Cytology	13 (16,5)	55 (69,6)	9 (11,4)	2 (2,5)
Cellular Biology	20 (19,6)	70 (68,6)	10 (9,8)	2 (2,0)
Histology	22 (16,7)	97 (73,5)	11 (8,3)	2 (1,5)

Categorical variables are described in number (percentage).

In relation to the evaluation of the students of other schools about these three disciplines, Table 2 presents the results.

Table 2. Evaluative aspects of Cytology, Cellular Biology and Histology disciplines, according to the vision of the students of other School of Medicine.

	Cytology	Cellular biology	Histology
Course evaluation, n (%)			
Excellent	14 (17,72)	20 (19,61)	49 (37,12)
Good	32 (40,51)	38 (37,25)	58 (43,94)
Fair	22 (27,85)	34 (33,33)	18 (13,64)
Poor	7 (8,86)	7 (6,86)	5 (3,79)
No answer	4 (5,06)	3 (2,94)	2 (1,52)
Practical classes, n (%)	58/77 (75,3)	58/102 (56,9)	128/130 (98,5)
Practical/theoretical classes, n (%)			
Higher number	6/56 (10,7)	4/56 (7,1)	23/129 (17,8)
Lower number	31/56 (55,4)	42/56 (75)	28/129 (21,7)
Equal number	19/56 (33,9)	10/56 (17,9)	78/129 (60,5)

Categorical variables are described in number (percentage).

Another aspect addressed was regarding the use of microscopes in class. All 132 students said they had already handled a microscope. The proportion of the number of microscopes per student reported was as follows: individual 62 (47%); one for every two students 48 (36.4%); one for a group of three students or 20 (15%) and one for all students 2 (1.6%). In addition, 111 (84%) students reported having taken a class on how to prepare the material to be observed under the microscope. The content taught only in theory was reported in 53/109 cases (48.7%) and in theory and practice was reported in 56/109 cases (51.3%).

When asked about the materials already observed by students from other Medical Schools in practical classes under the microscope cited more frequently: blood smear, liver, intestine, blades, muscular tissue, cardiovascular system, nervous tissue, ovary, skin, bone tissue and lung.

Regarding the opinion of the students from other Medical Schools about the three disciplines, it can be observed that 127 (96%) considered the existence of these disciplines in the medical course important.

In addition, they stated that their importance is due to: being the basis for the understanding of several disciplines that integrate the course (66-52%); understanding the cellular mechanisms microscopically, relating them to the macroscopic reality (30-24%), and to know the cellular machinery and its morphology (27-21%). Of all these students, 103 (78%) stated that they liked the subjects and, as a suggestion to make them more attractive, they described: to link theory with macroscopic medicine practice (16- 55.1%), to have teachers with better didactics (9-31%) and take more dynamic classes (4-13.8%). In the evaluation of students' performance in the tests of the competition, it can be observed, throughout the sample, that the average number of correct answers in Cellular Biology was $3,36 \pm 1,53$ questions; in Histology was $8,6 \pm 2,97$ and the final average of the test (overall score) was $4,76 \pm 0,89$ points.

In the comparison of the performance of the FAMERP students and students of other Medical Schools, in both questions of the subjects concerning Cellular Biology and Histology, as well as in the final grade of the test (general score), a statistically significant difference was observed, as shown in Table 3.

Table 3. Comparative analysis of the performance of FAMERP students and students of other Medical Schools

	FAMERP N = 9 (6,4%)	Other Medical Schools N = 132 (93,6%)	p-value
Score in Cellular Biology	5,44 ± 1,23	3,22 ± 1,4	<0,001
Score in Histology	13,11 ± 2,02	8,29 ± 2,77	<0,001
Final Score (general escore)	5,68 ± 0,82	4,70 ± 0,87	0,001

Continuous variables are described as mean ± standard deviation.

The performance of the student who reached first place in the selective transfer process, as well as the FAMERP students, in Cellular Biology and Histology, was score 7 in Cellular Biology, score 18 in Histology, with mean ± standard deviation 5,44 ± 1,23 and 13,11 ± 2,02, respectively.

The performance of the students from other Medical Schools in Cellular Biology and Histology disciplines was compared between those who had already studied Cytology and Cellular Biology. Regarding the discipline of Histology, as all the respondents had already done, there was no comparison. Table 4 show these results.

Table 4. Performance of the students of other Medical Schools in the subjects of Cellular Biology and Histology according to the disciplines studied

Taken Discipline	Performance*			
	Cellular Biology	P-value	Histology	P-value
Cytology				
Yes	3,18 ± 1,57	0,616	8,52 ± 3,04	0,330
No	3,31 ± 1,26		8,08 ± 2,13	
Cellular Biology				
Yes	3,08 ± 1,44	0,025	8,21 ± 2,81	0,278
No	3,76 ± 1,38		8,83 ± 2,32	

Continuous variables are described as mean ± standard deviation.

* Rated in average scores from Cellular Biology and Histology issues.

Regarding the teaching-learning methodology, it was observed that 85/135 (63%) students came from other Medical Schools with active methodology ("PBL"), while 50/135 (37%) students came from traditional teaching. The comparative analysis of the general score (final mean of the test), as well as the specific performance in the subjects of Cellular Biology and Histology, in relation to the teaching-learning methodology, is shown in Table 5. A significant difference was observed in Histology and in the final mark of the competition, with a higher score among traditional method students.

Table 5. Comparative analysis of student performance, according to the teaching-learning methodology

	Traditional education N = 50	Active methodology N = 85	P-value
Score in Cellular Biology	3,56 ± 1,58	3,22 ± 1,51	0,222
Score in Histology	9,36 ± 3,04	8,13 ± 2,94	0,022
Final Score (general escore)	4,98 ± 0,99	4,65 ± 0,85	0,044

Continuous variables are described as mean ± standard deviation.

Discussion

In this study on Cytology, Cellular Biology and Histology disciplines we see that, in general, most Medical Schools teach disciplines based on theoretical and practical classes using a microscope. However, there was a significant difference in results related to the type of methodology applied, in which the students of the traditional methodology presented a greater number of correct answers in Histology and general score, in relation to the students of the active methodology.

Analysing the teaching profile of colleges that host Medical courses, three points were observed as their main structural problems: the lack of laboratory sessions with viewing histological glass slides with light microscopes, the absence of teachers' pedagogical practice in the theoretical classes through the teachers responsible and the lack of dynamic classes with teaching strategies focused on students, which would facilitate the teaching-learning process.

In this sense, Coll (2006)⁹ says that when the student is faced with some content to be learned, she/he seeks concepts that have already been studied in order to make connections and interrelationships in order to establish a line of reasoning that facilitates the assimilation of content. In the case of Cellular Biology and Histology that have many concepts and new words that are not learned in High School, the difficulty of appropriation of the content is even greater, since these are disciplines that present exclusively microscopic contents and complex visualization⁶.

According to Pechliye and Trivelato (2005)¹⁰, the union of theory and practice is essential, because with the theory one has the necessary references to observe the practice and to assimilate it⁷. Fogaça

(2006)¹¹ demonstrates that students' main difficulty is to visualize the object of study, saying that through theory students should improve their knowledge and be motivated to overcome difficulties¹¹. Thus, for the learning relationship to occur, there must be meaning in the information presented and the student must adopt an active posture in the process of knowledge appropriation^{12,13}.

At present, it is observed a lack of correlation of the content learned in the disciplines that deal with microscopic areas and the reality of the environment and the relationships that are lived; in addition, teachers teach disciplines as if education were justified by itself¹⁴. Lewontin (2001)¹⁵ says that the interest and curiosity of academics for the discipline are influenced by how the teacher presents it. Currently, it is possible to observe a great lack of interest of the students that are part of the basic cycle of the medical course due to the lack of of teachers' pedagogical practice in the theoretical classes and of dynamic classes with teaching strategies focused on students.

The great impact of the lack of correlation between theory and practice and the scarcity of hours devoted to practical content in the subjects of Cellular Biology and Histology is related to the way in which the contents of Sciences are approached in the secondary schools, which have a traditional method¹⁶ and leading to a structural problem that follows the students to higher education and makes it difficult to learn the theory without the visualization of the practice linked to everyday life.

Currently, the teaching of Biology in High School remains macroscopic and aiming at the accumulation of fragmented knowledge, destined only for learning to be able to enter a Higher Education Institution, allowing the student of Medicine, without prior

knowledge about the subject of study with which may evoke relations. It can presents a lot of difficulty in understanding the microscopic and intrinsic nuances of the cell.

The content of the disciplines that integrate this area of Morphology is strictly dependent on visualization and, in the absence thereof, the classification and recognition abilities of the object of study become impossible, making it difficult not only to understand¹⁷, but also the use of these skills for future activities, as in the integration with other disciplines of the basic cycle of medicine that need microscopic knowledge, taking as an example the pathology and its application in the clinical cycle of medicine, since histology is an important tool that uses the essential experiences that the academics construct in the use of the microscope¹⁸, to aid in the clinical diagnosis¹⁹.

The microscope, an instrument used in the observation of histological slides, coupled with photomicrographs and electron micrographs, illustrates the theoretical classes, being that generally half of the hours of the subjects of Cellular Biology and Histology are used in practical activities¹⁷. However, as observed in the present study, the majority of undergraduate courses in Medicine presents a reduced time for both the subjects that integrate the area of Morphology and the laboratory practices related to them.

In addition, it has been proven that the student's motivation positively influences the teaching-learning process and those disciplines labelled as relevant have a better rate of achievement²⁰. According to Souza et al (2010)²¹, the molecular and cellular contents are difficult to transmit in order not to arouse interest in the students, since such subject may be vague and insignificant if the teacher develops only lectures. This is one of the great problems faced by Higher Schools that has a traditional methodology; the lack of dynamics, often associated with the absence of didactics of teachers, prevents knowledge from being transmitted effectively to academics. Thus, teaching the subjects of Cellular Biology and Histology becomes a great challenge to teachers, who must be willing to make their presentations more didactic, dynamic and practical²².

The adoption of active teaching methodologies has been shown to be responsible for increasing students' interest in the study object and facilitating the learning process of detailed contents that are difficult to visualize²². The development of atlases of Cellular Biology and Histology have also helped in the understanding of the students and made possible a better acquisition of theoretical-practical knowledge¹⁷.

However, one of the possible disadvantages of the active methodology is the lower performance of its students in the subjects of the basic area^{23,25}. And in agreement with the literature, in the present study, it was detected a better use in relation to the Histology by the students of the courses of traditional methodology, compared to those of active methodology.

Albanese et al.²³ analysed in 1993 that, despite difficulties in comparing such methodologies, students in the basic cycle who belonged to traditional methodology courses performed better when compared to students of active methodologies. This panorama was reversed during the clinical cycle of the undergraduate course in Medicine. This same perspective was later found by other authors²⁵.

Recent studies show that the objective of evaluating the differences in students' performance of traditional methodology compared to those of active methodology, they were more satisfied and motivated for the study, besides acquiring a greater capacity of communication and of teamwork²⁴.

Although with some caveats, it can now be said that the results obtained by Albanese et al. are still valid. Nouns et al. (2012)²⁵ observed that while active methodological students showed steady progress during undergraduate study, traditional methodological students had a peak of knowledge during the basic cycle, where they excelled, but their progress declined over time.

In this way it is possible to observe that the results obtained in the present study agree with the reported in the literature, allowing the analysis done to collaborate for the enrichment and reaffirmation of the fruits of the comparison of teaching-learning methodologies.

Conclusion

Through the present study, the teaching profile of the subjects of Cell Biology and Histology can be traced in the courses that had participants in the selective process to fill a vacancy by transfer, as already described in the results. In addition, it can be concluded that there was a better performance in the discipline of Histology by the students of the traditional methodology, when compared to those of the active one, demonstrating influence of the type of methodology in the final result of the learning. However, there is a need for further studies on the methodology applied to Cytology, Cell Biology and Histology, which are highly visual disciplines.

Regarding the limitations of the present study, it should be mentioned that the data were obtained only from participants of the selective transfer process for FAMERP in the year 2017; thus, analysed only Colleges that host medical courses, which had students participating in the exam.

Thus, as recommendations for future studies, the following proposals are indicated: research the topic with larger sample space, involving all Colleges that contain Medicine courses in Brazil; analyse the methodology of the subjects of Cytology, Cellular Biology and Histology and its effectiveness; expand the research to other disciplines of Medicine course; propose and apply possible strategies to face the difficulties encountered and thus improve the college teaching and learning.

Author contributions

Mantovani ALS contributed to design and acquisition of data and was involved in drafting the manuscript and revising it critically for important intellectual content; Lima ARA, Brienze SLA and Santos ER was involved in drafting the manuscript and revising it critically for important intellectual content; Fucuta PS contributed to analysis and interpretation of the data and was involved in drafting the manuscript; André JC contributed to conception, design, acquisition of data, drafting of the manuscript and revising it critically for important intellectual content and gave the final approval of the version to be published. All authors read and approved the final product.

Competing interests

No financial, legal or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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