

The Impact of Various Factors on the Difficulties in Learning and Teaching Strategies for Histology

El Impacto de Diversos Factores en las Dificultades en el Aprendizaje y las Estrategias de Enseñanza de Histología

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SUMMARY: Histology is considered one of the most important but challenging topics in health sciences. Deficiencies in teaching and general histology directly affect the student's understanding, performance and promote dynamism and integration while covering the primary curriculum. The goal of the current study was to assess and provide a better experience of difficulties in learning histology, examine some standard teaching strategies, and determine how to implement suitable changes to improve the curriculum from students' perspectives. The study comprised of a self-administered questionnaire that included descriptive questions. Data was collected based on the survey conducted via 100 students studying histology. Data was analyzed further qualitatively and quantitatively to elaborate on the difficulties in this area. Many of them strongly agreed that the lack of essential comprehension regarding using light and electron microscopes resulted in challenges with comprehending and identifying tissue samples for image identification due to inadequate anatomical knowledge. Moreover, according to students, some difficulties understood the topic, perception of new terminologies, and insufficient teaching strategies to grasp students' interests. They also agreed that improvement was needed in terms of the modes of teaching employed by histology teachers; they felt that modern education techniques based on practical tasks should be incorporated to stimulate student interest and make understanding histological concepts easier. The Institution should modify the teaching system to allocate more time to relevant subjects to make this subject matter more interesting. This survey-based study evaluated that students faced some challenges while studying the current curriculum of histology. From the student's perspective, it is identified that some changes are needed to improve the course curriculum and way of teaching to make it more understandable.

KEY WORDS: Histology; Tissue types; Learning; Student difficulties; Teaching strategies.

INTRODUCTION

Histology is the study of delicate structures of animal and plant cells and tissues. It is a significant unit in medicine, veterinary, biological, and health science studies. According to Garcia *et al.* (2019), histology, also known as microscopic anatomy or microanatomy, is the branch of biology that focuses on studying the microscopic anatomy of biological tissues. The biologically related degrees in any institute require students to learn to develop a broad understanding of the nature of living things from molecules, cells to organisms up to biomes level. Traditional methods of learning histology involve studying theoretical lectures and related materials comprised of photomicrographs and practical sessions in the laboratory. In these sessions, the students rely on light microscopes to observe, identify, and interpret slides containing histological specimens (Chapman *et al.*, 2020; Yoshiya *et al.*, 2020). However, the learning

model has changed over the last few decades with the introduction of Information Communication Technology, which provides exciting and inspirational strategies to motivate histology students. However, despite the integration of technology, the study of histology still presents several difficulties for students across the world (Sung *et al.*, 2016). However, the learning model has changed over the last few decades with the introduction of Information Communication Technology, which provides interesting and inspirational strategies to motivate histology students. Several online courses like histology laboratory survey course, histology techniques course, identification of tissues course, chemistry and techniques of staining course can aid in learning histology more better. Moreover, introduction to basic principles of light microscopy, before concentrating on the structure and function of human tissues, and the relationships

between them help students to understand histology. Virtual microscopy and availability of microtomes also facilitate students in a better way (Cotter, 2002). However, despite the integration of technology, the study of histology still presents several difficulties for students across the world (Sung *et al.*, 2016).

Histology is considered one of the most difficult and neglected by students (Burute & Singhal, 2017). Many researches emphasize the importance of the knowledge a teacher hold, underlining that along with assimilation of academic knowledge, students and teachers also required to integrate information imitate from the experiential and practical involvements in the classroom. (Blomeke & Delaney, 2012). Teachers of both histology and anatomy can emphasize the value to understand the basic knowledge in order to explain the complex terms. In every laboratory/practical demonstration class, students should be provided with worksheets/quizzes that defined the learning objectives of histology and provided a basic framework to interpret complex information. During lectures and lab demonstrations, teachers should initially provide introductory comments of lecture to class then emphasize students to work independently and then review what they had learnt during the discussion of cases or mentioned histology topics. Teachers should make an effort to contest students by subscribing multiple clinical presentations and querying them to match the most suitable one to the slide of cells or tissues provided (Kumar *et al.*, 2006). A series of subconscious processes must occur for the received or observed information to become accessible to the mind of the learner by improving teaching styles, lowering the histology curriculum, increasing the duration of the course and number of practical cases during study, and also by increasing the knowledge of anatomy that help to learn histology in a better way (Malau-Aduli *et al.*, 2020; Grover *et al.*, 2020). In general, effective learning occurs when instructional conditions are aligned with the learner's cognitive architecture. The intrinsic aspects of the cognitive load should be reduced in order to achieve effective learning by initially providing the actual examples, followed by completion problems, and then complete problems (Millin *et al.*, 2020).

A questionnaire is a research instrument comprised of a set of questions to gather information from respondents. Questionnaires can be considered as a type of written interview. It can be conceded out by telephone, face to face, via computer or other electronic source. This procedure provides a comparatively low-cost, rapid and well-organized way of obtaining large amounts of information from a large number of participants. Via this procedure data can be collected comparatively rapidly

because the researcher would not need to be present at the spot/location when the questionnaires were accomplished (Chin & Osborne, 2008). As a result, the relevant questionnaire with closed questions was included in this study to collect data that will aid in the proper understanding of the factors that influence learning and teaching practices in histology. As a direct consequence, the focus of this study was primarily on the difficulties that the students encountered while learning the histology course.

MATERIAL AND METHOD

Based on the five research objectives, a descriptive study was designed to collect the viewpoints of 112 students. This methodology entailed creating a questionnaire and distributing it to the sample population for comments in response.

Research Objectives. The purpose of this study was to determine the critical factors influencing students' difficulties in learning histology, examine some standard teaching strategies, and determine how to implement appropriate changes.

It also aims to accomplish the following:

1. Determine how students had difficulty learning about each tissue type.
2. To investigate potential issues with learning about specific tissues.
3. Identify and investigate the most difficult histological topics
4. Identify potential factors that make image identification of tissue types difficult
5. To look into ways to improve the course curriculum from the students' standpoint.

The Institution and its students. The research was carried out at the Department of Medical Laboratory Technology, Faculty of Applied Medical Sciences, University of Tabuk, Saudi Arabia. A self-administered questionnaire with closed-ended questions was used in the study. The questionnaire was distributed to 102 students. The closed questions consisted of multiple-choice answers that directed how the majority of the respondent provided their personal views, which ranged from (strongly agreed to strongly disagreed). Each student had the opportunity to make a single selection from the choices given for a particular question. This questionnaire's questions are mainly based on the student's attitude, the instructor's impact on simplifying the curriculum, and the learning resources used to modify the problematic points.

Ethical considerations. The questionnaires were distributed to the participants by the researchers. Prior to distributing the questionnaires, the students were informed of the study's goals and objectives. The students verbally agreed to participate in this study. Students were instructed to fill out the questionnaires based on their understanding and refrain from consulting one another or the literature. We only included students who agreed to engage voluntarily in the questionnaire; those who declined were not included in the findings.

Data collection and statistical analysis. Tool (I): Influence learning and the teaching strategies questionnaire developed by García *et al.* (2019).? The formulated questionnaire consisted of some relevant questions regarding the factors that influence learning and teaching strategies in terms of histology. The researchers collected the necessary information by reviewing the current local and international literature in the form of books, articles, and periodicals. After the data was collected, it was entered into Excel and analyzed utilizing SPSS version 21. Frequencies, mean values, and percentages were introduced via statistical analysis of the studied students.

Validity and reliability. The content validity was determined by a panel of five experts in medical laboratory fields who reviewed the questionnaire for clarity, relevance to the nature of the students, understanding, applicability, and ease of administration. The alpha value for the questionnaire's reliability for the total student sample was 0.68.

RESULTS

Difficulty in learning about tissue. Students were asked about the difficulty level of learning about the different types of tissues during the survey, like surface epithelial tissue, glandular epithelial tissue, connective tissue, nervous

tissue, muscular tissue, bone tissue, and adipose tissue. These types were part of their curriculum of histology. Most students feel difficulty in learning about the nervous tissue (81 %), followed by surface epithelial tissue (73 %), bone tissues (61 %), glandular epithelial tissue (57 %), connective tissue (53 %), muscular tissue (42 %), adipose tissue (26 %) (Fig .1).

Reporting factors behind the difficulties. Table I showed that the studied students experienced difficulties with various tissues. More than half of them reported that this course required too much memorization. They also said that comprehension of fixation bone tissue technique posed a challenge and muscular tissue samples were hard to interpret. From Table I it is also noted that while studying various tissue types of students experience that interpretation of histological diagnosis is complicated, sometimes tissue samples are hard to interpret, in some cases comprehension of its fixation tissue technique poses a challenge, understanding of tissues' structural function is also challenging, in some cases study requires too much memorization and during lectures or demonstration complex tissue designs are used.

Difficulties in image identification. Table II shows that the majority of students strongly agreed that a lack of essential comprehension regarding the use of light and electron microscopes, difficulty in comprehending and identifying tissue samples for image identification due to inadequate anatomical knowledge, and lack of knowledge on the subject of cell delimitation made image recognition of different tissues difficult. From results mentioned, it was notices that majority of students feel difficulty due to lack of anatomy knowledge (92.15 %), lack of effective essential histological section orientation (74.5 %), inadequate knowledge about microscopic staining (57.83 %).

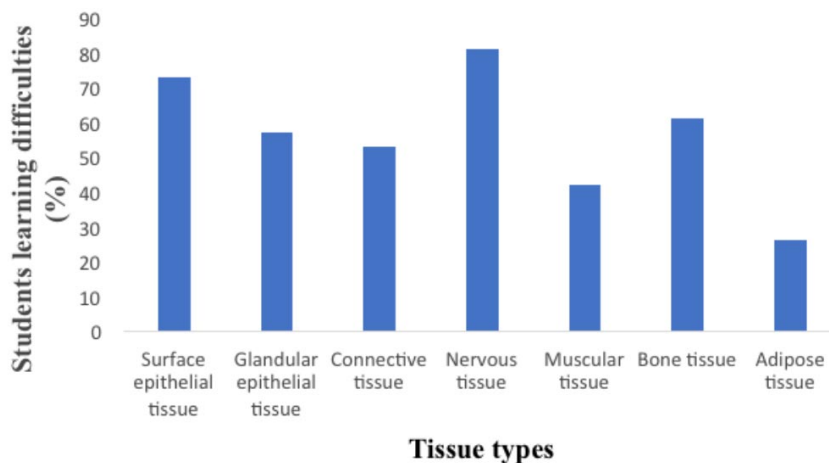


Fig. 1. Difficulties faced by students during learning of different tissue types.

Suggestions of the students for the improvement of the Histology curriculum.

According to most students, curriculum changes are needed; additionally, improvements in the modes of teaching used by histology teachers should be prioritized, as should the incorporation of modern education techniques to stimulate student interest and make understanding of histological concepts easier (Fig. 2). Majority of students strongly suggest the incorporation of modern techniques to stimulate interest in students and make the histological concepts easier and more apparent. Students also recommend practical

synchronization of theoretical learning techniques. The majority of students also endorse that teaching time should be increased or course content of histology curriculum

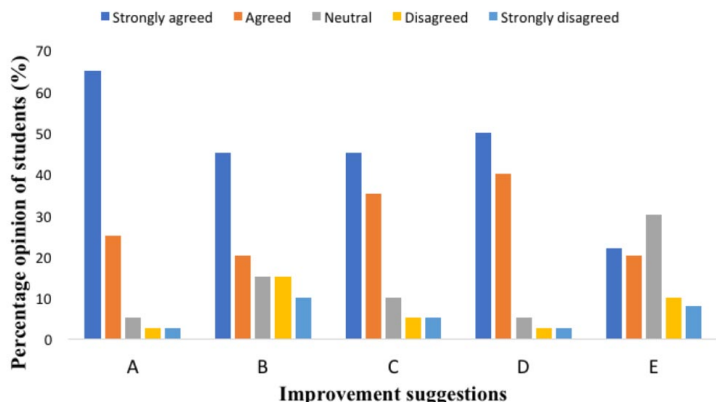


Fig. 2. The ways to improve the course curriculum concerning students' viewpoints. A: Modern education technique should be incorporated; B: Synchronization of theoretical learning techniques with practical examples; C: Increase the length of course teaching or decrease the course content of histology curriculum; D: Improvement in the modes of teaching employed by histology teachers; E: Increasing knowledge of anatomy.

should be decreased to make the curriculum easier to understand. Modes of teaching employed by histology teacher should be improved. Some also noticed that prior to learning histology of a particular tissue, one should increase his/her knowledge of anatomy.

Students' suggestions to advance the course curriculum. The majority of the students (74.5 percent) strongly agreed that the coordinator of the histology department should take notice of the issues that students are facing, that the Institution should modify the teaching system to allocate more time to relevant topics (65.68 percent), that the coordinator of the histology course should install new technological applications (64.7 percent), and that the course curriculum should be analyzed to identify challenging terminologies (61.76 percent). These were deemed to the students the most suitable changes needed to improve the course curriculum from a student perspective. Moreover, some students strongly agreed (46.07 %) to allocate more time to complex units and devoted to

Table I. Reasons and the percentages of the difficulties faced by students while studying various tissues in histology.

Reasons for difficulties	Number of participants (n)	Percentage of participants (%)
Nervous tissues		
Interpretation of histological diagnosis is complicated	42	41.17
Drawing tissue specimens is problematic and complicated	40	39.21
Examination of the tissue sample using a light microscope proves challenging	20	19.60
Muscular Tissue		
Tissue samples are hard to interpret	62	60.78
The use of improper teaching techniques further complicates understanding	15	14.70
The complexity of histological features makes comprehension difficult	25	24.50
Bone tissues		
The number of laboratory sessions for the study is inadequate	10	9.80
Comprehension of its fixation tissue technique poses a challenge	67	65.68
Techniques employed for tissue staining are hard to comprehend	25	24.50
Adipose tissue		
Its functional relationships are hard to comprehend	40	39.21
Understanding its structural function is challenging	47	46.07
The cell morphological features of these tissues are not easy to grasp	15	14.70
Surface epithelial tissue		
Incomprehensible biological jargons were used	20	19.60
Manner of subject analysis is complicated	25	24.50
The study requires too much memorization	57	55.88
Glandular epithelial tissue		
I don't study it regularly	35	34.31
I find it abstract	42	41.17
The analysis of this tissue doesn't include sufficient practical examples	25	24.50
Connective tissue		
Complex tissue terminologies are used	40	39.21
There are insufficient practical lessons	15	14.70
Complex tissue designs are used	47	46.07

theoretical and practical sessions related to these complex topics. (Table III). Some suggestions were also noticed like more pictures should be included in the histology course to assist students in making a relation between theoretical facts discussed in class compared to practical

implementation (58.82 %). 35.29 % of students strongly agreed to increase the duration of histology course to aid students learning, while 54.9 % of participants strongly recommend learning histology via realistic experiences (Table III).

Table II. Data from students on their difficulty in correctly identifying images of various tissues (N=102).

Complexities in the identification of images of various tissue types	Strongly N (%)	Agreed N (%)	Neutral N (%)	Disagreed N (%)	Strongly N (%)
1. Difficulty in comprehending and identifying tissue samples for image identification due to inadequate anatomical knowledge.	76 (74.50)	18 (17.64)	4 (3.92)	2 (1.96)	1 (0.98)
2. Lack of effective histological section orientation during theoretical sessions.	43 (42.15)	32 (31.35)	11 (10.78)	7 (6.86)	6 (5.88)
3. Inadequate understanding of the use of light and electron microscopes.	13 (12.74)	11 (10.78)	26 (25.49)	43 (42.15)	9 (8.82)
4. Lack of knowledge on cell delimitation made image recognition of different tissues problematic during practical lessons.	70 (68.62)	15 (14.70)	8 (7.84)	3 (2.94)	2 (1.96)
5. Inadequate understanding of staining and mounting techniques necessary for image identification.	22 (21.56)	37 (36.27)	27 (26.47)	6 (5.88)	5 (4.90)

Table III. Distribution of the implementation of changes needed to improve the course curriculum from a student perspective.

Implementation of Change	Strongly agreed N. (%)	Agreed N. (%)	Neutral N. (%)	Disagreed N. (%)	Strongly disagreed N. (%)
1. The coordinator of the histology department will take notice of the issues being faced by the students.	76 (75.50)	20 (19.60)	4 (3.92)	1 (0.98)	-
2. The Institution will modify the teaching system to allocate more time to relevant subjects to enhance learning.	67 (65.68)	21 (20.58)	7 (6.86)	5 (4.90)	-
3. The coordinator of the histology course will install new technological applications to make it more interesting.	66 (64.70)	17 (16.66)	10 (9.80)	5 (4.90)	4 (3.92)
4. The faculty will analyze the amount of time allocated to complex units, and more time will be devoted to theoretical and practical sessions.	47 (46.07)	17 (16.66)	21 (20.58)	9 (8.82)	2 (1.96)
5. To provide learning alternatives to students, the course coordinator for histology will analyze the course curriculum to identify challenging terminologies.	63 (61.76)	17 (16.66)	8 (7.84)	5 (4.90)	4 (3.92)
6. Practical sessions of the histology course will include more pictures to assist students in comprehending the theoretical facts discussed in class.	60 (58.82)	19 (18.62)	9 (8.82)	8 (7.84)	-
7. The duration of the histology course will be increased to assist and enhance student learning.	36 (35.29)	16 (15.68)	23 (22.59)	12 (11.76)	8 (7.84)
8. The histology program will be modified to provide realistic experiences to students that they can apply to their daily lives for enhanced understanding.	56 (54.90)	21 (20.58)	8 (7.84)	10 (9.80)	7 (6.89)

DISCUSSION

The current survey-based study was aimed to assess the main factors affecting students' difficulties in learning histology, examine some standard teaching strategies, and determine how to implement suitable changes to enhance students' understanding, learning and memorization of histology (McLean, 2001).

It was noticed that the majority of participants strongly agreed that a lack of essential comprehension regarding the methods of using light and electron microscopes, difficulty in comprehending and identifying tissue samples for image identification due to inadequate anatomical knowledge, and lack of knowledge on the subject of cell delimitation made image recognition of different tissues difficult. Histology is also known as microscopic anatomy and through this microscopic anatomy students can learn about the structure of cells and how they relate to each other. Learning detailed anatomy of particular tissue help student to understand the finer details of cells and smaller structures of the body before studying histology course or during lab demonstration. If a student has little/no anatomical knowledge of tissues the difficulty to understand and identify a specific tissue during histological studies remains the same. However, prior anatomical knowledge can overcome this problem of learning. In this respect, reported terminologies are critical for learning and understanding the basic concepts in histology. Students need to know the correct spellings and understand the meaning and the proper demonstration and practical session (Bell & Ainsworth, 2020; Halvorson-Bourgeois *et al.*, 2020).

Lack of essential comprehension regarding the use of light and electron microscopes led to difficulty comprehending and identifying tissue samples for image identification during teaching sessions (Goldsmith & Miller, 2009). Ali & Syed (2020) and Plekhanov *et al.* (2020), noticed a complex correlation between tissue structure and its function that potentially may be the reason that histology is such an intriguing and readily understandable subject while, Diederich *et al.* (2020) and Spreckelsen & Juenger (2017) added that the students must have appropriate knowledge regarding the use of the microscope. The light microscope is essential for the study and understanding of cellular structure of tissues and organs in courses like histology. Light microscope is considered as major tool for learning histology at every medical school. Virtual microscopy does not use the microscope but it is essential that a student should learn some of the basics of the microscope to better understand the cell and tissue structures. Light microscope basically relies on glass lenses and visible

light to magnify tissue samples. Light microscope has many parts that need to be handled with care to successfully identify a clear image of a given cell or tissue. Therefore, the students should be subjected to intensive training to boost their knowledge and skills in handling and to use the microscope. Meanwhile, prior knowledge related to tissue type and its anatomy helped a lot to identify, understand and memorize the details of tissues.

The current study also reported that most of the participating students agreed on ways to improve the modes of teaching employed by histology teachers, believing that modern education techniques should be incorporated to stimulate student interest and make understanding histological concepts easier (Felszeghy *et al.*, 2017). The coordinator of the histology department should therefore take notice of the issues being faced by the students and modify the teaching system to allocate more time to relevant subjects and make the course more interesting. Furthermore, in the light of students' responses, the study of histology could be improved by increasing the number of histology instructors, time allocated for practical demonstration, and the number of light microscopes as modern learning and teaching strategies increase the interest level of students learning (Retamero *et al.*, 2020).

Chapman *et al.* (2020) concluded that there are many difficulties on the teaching side due to a relatively small number of instructors teaching histology and the demonstration of tissue types. Therefore, students should put more effort into studying general histological concepts to alleviate the strain on teachers. Conversely, Lee *et al.* (2020), recommended that the number of histology instructors be increased to supervise better students studying histology.

Thompson & Lowrie Jr. (2017) added that the information presented to learners and the learning activities are relevant factors that can also impose an extraneous cognitive load. Many instructional procedures impose an unnecessary burden and interfere with schema acquisition of knowledge (Park *et al.*, 2020). Another recommendation given by Lee *et al.* (2020), involved an increase in the number of light microscopes in the laboratories to be more accessible to histology students for proper interpretation of studies material. Sweller *et al.* (2019) suggested that effective instructional material facilitates learning by directing cognitive resources toward activities relevant to learning. Therefore, reducing extraneous cognitive load through a more effective instructional design might free up working memory capacity.

CONCLUSION

Considering the results of this research study, it is evident that most of histology students face many challenges in learning the various topics of histology. Some of the factors that hinder histology in terms of both learning and teaching include an inadequate number of the light microscopes in the learning organizations, and low training on modern equipped facilities for the students, lack of knowledge about cell delimitation made image recognition of different tissues difficult due to inadequate anatomical knowledge. The students also faced many challenges regarding understanding histology's basic concepts, such as tissue identification techniques and staining. Results manifest that modifying the teaching system and technological applications to allocate more time to histology can overcome students' challenging terminologies and difficulties to learn histology.

Recommendations. The legislative government and relevant non-governmental bodies and institutions should devise strategies to encourage the study of histology by motivating students who perform best in science. This form of motivation will encourage more students to pursue histology as a career. The educational Institution should devise a method for encouraging significant collaboration between histology students and instructors. Students should also practice and study histology regularly before and after lessons to clarify tissue types and histology concepts.

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RESUMEN: La histología se considera uno de los temas más importantes pero desafiantes de las ciencias de la salud. Las deficiencias en la enseñanza y en la histología general afectan directamente la comprensión, el desempeño del estudiante y promueven el dinamismo y la integración al abarcar el currículo primario. El objetivo del estudio actual fue evaluar y proporcionar una mejor experiencia de las dificultades en el aprendizaje de histología, examinar algunas estrategias de enseñanza estándar y determinar cómo implementar cambios adecuados para mejorar el plan de estudios desde la perspectiva de los estudiantes. El estudio constaba de un cuestionario auto administrado que incluía preguntas descriptivas. Los datos se recopilaban a partir de una encuesta realizada a 100 estudiantes de histología. Los datos se analizaron más a fondo de forma cualitativa y cuantitativa para

profundizar en las dificultades en esta área. Muchos de ellos estuvieron totalmente de acuerdo en que la falta de comprensión esencial sobre el uso de microscopios ópticos y electrónicos resultó en desafíos para comprender e identificar muestras de tejido para la identificación de imágenes debido a un conocimiento anatómico inadecuado. Además, según los estudiantes, algunas dificultades en la comprensión del tema, percepción de nuevas terminologías y estrategias de enseñanza insuficientes para captar los intereses de los estudiantes. También coincidieron en que era necesario mejorar los métodos de enseñanza empleados por los profesores de histología; sintieron que deberían incorporarse técnicas educativas modernas basadas en tareas prácticas para estimular el interés de los estudiantes y facilitar la comprensión de los conceptos histológicos. La Institución debería modificar el sistema de enseñanza para asignar más tiempo a materias relevantes para hacer esta materia más interesante. Este estudio basado en encuestas evaluó que los estudiantes enfrentaron algunos desafíos mientras estudiaban el plan de estudios actual de histología. Desde la perspectiva del estudiante, se identifica que se necesitan algunos cambios para mejorar el plan de estudios del curso y la forma de enseñar para hacerlo más comprensible.

PALABRAS CLAVE: Histología; Tipos de tejidos; Aprendizaje; Dificultades de los estudiantes; Estrategias de enseñanza.

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