

## Current Achievements of Histology Science in Evaluating the Quality of Students of Medical Universities

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### Abstract

Modern histology science is progressively employed for the assessment of medical students' learning experience, academic performance, and clinical competence. This grading system is used to identify and address the gaps in medical education. Histology enables the assessment of the quality of the learning experience of medical students and can highlight the weaknesses in the current academic curriculum. New imaging techniques and molecular biology developments have allowed for more detailed and higher resolution histological studies, leading to a better understanding of pathological diseases and enhancing the use of this discipline as an evaluation tool. Despite the limitations of histology as an isolated tool, its employment in conjunction with advanced techniques could overcome these limitations and aid in evaluating medical students' skills comprehensively.

### 1. Introduction

Histology, the microscopic study of cells, tissues, and organs, is often regarded as a scientific discipline

reserved for medical pathology courses. However, recent advances in technology have made histology an important tool in medical education, enhancing the understanding of both physiological mechanisms and

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pathological diseases (Shields et al., 2016). The role of histology in medical education has evolved, and it is now used as a means to evaluate the quality of medical students' academic knowledge and clinical competence.

Assessing the quality of medical education is crucial to identify gaps that need to be filled in the academic curriculum to produce competent and skilled doctors. It is challenging to evaluate academic performance accurately, as traditional grading systems employed in medical schools based on written and oral examinations are often insufficient. Clinical evaluations, where medical students are evaluated based on their interactions with real patients, can be time-consuming, subjective, and often require experienced clinicians to facilitate (Fulop et al., 2014). Histology assessment circumvents these issues as student samples can be evaluated objectively, with the grading system reflecting the corresponding knowledge base expected at each level of medical education.

Recent advances in histological techniques like fluorescence microscopy, electron microscopy, and molecular biology have revolutionized the histological evaluation of biological samples, including those in medical education. Innovative histology protocols, such as immunohistochemistry, have facilitated the detection of cellular, molecular, and genetic alterations associated with different pathological states (Rudzki et al., 2017). Histology is now instrumental in fundamental research, translational, and clinical applications, such as personalized medicine, cancer diagnosis, and cancer therapy (Howard & Becker, 2019).

Histology is also uniquely suited for the assessment of medical students' practical skills in laboratory procedures, such as tissue preparation, microscopy, and data analysis. In this context, histology has been increasingly used in the evaluation of medical students in universities, and the assessment of their practical laboratory skills, competency and professionalism (Renner et al., 2018).

The limitations of histology, such as its reliance on expensive equipment, stringent technical skills, and access to tissue samples, have often hindered its comprehensive integration into medical education evaluations (Fulop et al., 2014). However, the ability of

histology to provide detailed information on cell and tissue structure highlights the potential for in-depth assessment of medical students' practical and theoretical knowledge, particularly when used in combination with radiology and clinical evaluations (Tshila et al., 2019).

The evolution of histology science can revolutionize medical teaching and provide a comprehensive evaluation of medical students. Histology has the potential to provide an important contribution to the medical curriculum, particularly with its exceptional ability to examine cellular and subcellular structures, evaluate students' practical skills, and confirm or highlight theoretical concepts. Future advancements in histology science may enable the evaluation of medical students' clinical competency based on objective evidence and supplement clinical evaluations by putting the emphasis on student-centered education models.

## 2. Methods

Histology is a branch of biology that deals with the microscopic structure of tissues and organs of plants and animals. In medical education, histology is an essential subject as it helps students understand the structure and function of different human tissues and organs. The evaluation of medical students' knowledge and practical experience in histology is crucial for their future clinical practice. To assess the quality of medical students in histology, several methods have been developed in recent years (Garrido-Gomez et al., 2017). These methods combine traditional histological techniques and digital technologies, resulting in more accurate and objective evaluations. This article will discuss the current achievements of histology science in evaluating the quality of students of medical universities.

### Traditional Histological Techniques:

Histology has long been evaluated through conventional histological techniques, including light and electron microscopy. These techniques enable visualizing the structure of tissues and organs in detail, providing crucial information about their functions. Light microscopy, being the most commonly used technique, allows for the observation of stained tissue sections under a microscope (Khan MA et al., 2018). This approach requires student's vivid knowledge in the

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identification of different types of tissues and their cellular components. Electron microscopy provides a deeper insight into the subcellular structure of the tissue or organ, highlighting the ultrastructure of cells and organelles. These traditional techniques have served as a standard evaluation tool of histology knowledge for many years.

## Digital Histology Techniques:

The emergence of digital technologies has revolutionized the way medical students learn and the way teachers evaluate their knowledge. Digital histology techniques, such as virtual microscopy and computer-based histological analysis, have changed the traditional evaluation methods of histology knowledge. Virtual microscopy allows for the examination of high-quality digitized images of histological sections, providing a user-friendly and interactive approach to evaluate histology knowledge. Computer-based histological analysis tools, such as image analysis and morphometry, allow for an objective evaluation of the tissue or organ structures (Odeid Z et al., 2020). These techniques provide the medical students with an opportunity to evaluate their knowledge and practical skills in histology in a more objective and interactive manner.

## Integrated Methods:

A combination of traditional and digital histological techniques has proved to be more beneficial in evaluating the quality of medical students in histology. During the histology sessions at medical universities, students are taught both theories and practical aspects, and both traditional and digital histology techniques are used in the process (Sivapathasundharam Bet al., 2021). Therefore, an integrated evaluation method that incorporates both techniques can ensure a more comprehensive assessment of knowledge and practical skills of medical students. For instance, the use of both light microscopy and virtual microscopy can provide a well-rounded evaluation of students' theoretical knowledge and practical skills.

## E-Learning and Histology:

E-learning has significantly influenced medical education, including the teaching and evaluation of histology. E-learning provides online resources and materials that are readily available to medical students, facilitating their learning process. Web-based

interactive computer-aided learning tools, such as histology quizzes, have been powerful tools to evaluate the knowledge of medical students. Many medical universities have adopted e-learning techniques, particularly during the COVID-19 pandemic, to allow students to learn and evaluate their knowledge remotely. E-learning has been successful in providing medical students the opportunity to practice and evaluate their knowledge in histology, thereby improving the quality of medical education for students (Miri SM et al., 2020).

Histology is an essential subject in medical education, and evaluating medical students' knowledge and practical skills is critical to their future clinical practice. The current achievements in histology science have resulted in the development of more accurate and objective evaluation methods, such as traditional and digital histological techniques and e-learning. The integration of these methods has significantly improved the quality of medical education, providing medical students with a well-rounded evaluation of their knowledge and practical skills. The continual advancements in histology science and technology will continue to benefit medical education by improving the evaluation methods and consequently the quality of future medical practitioners.

## 3. Results and Discussion

The evaluation of students' performance in medical universities is an important aspect that requires rigorous assessment methods. Histology is one of the sciences that contribute significantly to the evaluation of students' performance through the analysis of cellular and tissue structure. The advancements in histology techniques have improved the reliability and accuracy of assessments, leading to better evaluation of students' knowledge and skills. This article aims to highlight the current achievements of histology science in evaluating the quality of students of medical universities.

Firstly, histology has played a crucial role in assessing the competence of medical students during practical sessions. Histological examination of tissue sections allows instructors to evaluate how well students can identify and differentiate different tissues and cell types. The use of immunohistochemistry techniques has also been useful in assessing students' understanding of disease processes through the analysis



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of cellular and molecular markers. Several studies demonstrate the utility of using histology assessments to evaluate the performance of medical students accurately (Shrestha et al., 2012). For instance, a study by Shrestha and colleagues found that histology practical exams were reliable in evaluating students' knowledge and skills, reflecting their competence in diagnosing tissue samples.

Secondly, histology has contributed significantly to the assessment of medical students' knowledge of anatomy. The ability to identify different tissue and cell types is an essential prerequisite for understanding the functional anatomy of organs and tissues. Histology offers a unique opportunity to examine the histological organization of different organs and tissues and provides a foundation for understanding the structural basis of physiological and pathological processes (Sulaiman et al., 2017). Consequently, histology assessments have been employed in the evaluation of anatomy knowledge and understanding in medical students. A study by Guo et al. found that histology practical sessions were effective in assessing medical students' anatomy knowledge, providing better insight into the complexity of organ and tissue structure.

Thirdly, histology has been used to evaluate the effectiveness of teaching methods and learning outcomes in medical education. Several studies have demonstrated that histology assessments can provide feedback on the effectiveness of curricular designs and instructional methods. Histology assessments have been valuable in monitoring and evaluating the performance of students in online and hybrid learning environments as well (Xu et al., 2016). The use of virtual microscopy has enabled the assessment of students' competencies in identifying and diagnosing histological samples accurately while providing a flexible and accessible platform for learning.

Furthermore, advancements in histology techniques have allowed for the development of new metrics for evaluating students' performance in medical education. For example, the use of morphometric analysis has enabled quantitative assessments of tissue samples, which has been useful in measuring understanding of specific concepts by students. Additionally, histology assessments have been instrumental in identifying learning difficulties, enabling instructors can provide personalized mentoring to struggling students.

Moreover, histology has contributed to the development of innovative educational tools such as digital atlases, virtual slides, and mobile applications. These educational tools enable medical students to access high-quality histological images and videos, which facilitate visualization and understanding of complex physiological processes. Such innovations have improved histology teaching and, consequently, better evaluation of students' knowledge and skills.

Histology sciences have made tremendous progress in evaluating the quality of students of medical universities over the years. The advancements in histology techniques have improved the reliability and accuracy of assessments, leading to better evaluation of students' knowledge and skills. The use of histology has played a crucial role in assessing students' competencies during practical and theoretical sessions, evaluating knowledge of anatomy, and monitoring the effectiveness of teaching methods and learning outcomes. The use of innovative educational tools such as digital atlases and virtual slides has also improved histology teaching, leading to better evaluation of students' knowledge and skills. As such, histology science will continue to play a significant role in medical education and the evaluation of students' performance.

## 4. Conclusion

In conclusion, the developments in histology science have greatly benefitted medical education in recent years. The use of advanced microscopy techniques has enabled a better understanding of the microscopic structures that make up the human body, leading to more accurate identification of structures and thus better diagnoses. In the context of medical education, the use of histology to evaluate students' knowledge and skills has become an essential tool for educators to assess the effectiveness of their teaching methods, as well as to help students identify areas they may need to improve.

One of the most notable recent achievements in histology science has been the development of virtual microscopy, which allows for the creation of digital images that can be accessed remotely by students and teachers alike. This has not only been a game-changer in terms of accessibility, but also means that institutions can save significant amounts of resources on traditional microscope and slide-handling equipment, while still

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being able to provide high-quality educational experiences.

Another significant advancement in histology science is the development of immunohistochemistry, which enables the identification of proteins and other molecules within tissue samples. This has allowed medical students to gain a more in-depth understanding of various cellular processes and mechanisms involved in disease development, and has given them the opportunity to practice applying this knowledge by analyzing real-world tissue samples.

In addition, the integration of histology with other technologies such as molecular biology has opened up new avenues for researching the inner workings of cells and the human body. Being able to see and understand at a molecular level how diseases develop and progress has potential implications for the development of more effective treatments in the future.

Despite these achievements, there are still limitations to the use of histology in medical education. Firstly, the need for specialized training and equipment in order to conduct histology experiments means that it is not always practical for smaller or under-resourced institutions to implement it as a major component of their curriculum. Additionally, the interpretation of histological images is subjective and there can be significant variation between individuals when it comes to identifying structures, meaning that it may not always be an entirely reliable tool for assessing student performance.

Nevertheless, it is clear that the developments within histology have contributed significantly to improving the quality of medical education, providing students with the skills they need to make effective diagnoses and treat patients. The integration of virtual microscopy and immunohistochemistry has given students the opportunity to develop their knowledge and skills in a practical and accessible way, leading to not only better results in exams, but also a greater understanding of the impact they can have within the medical field as a whole. With further development and refinement of technology, it may be possible to overcome current limitations and continue to further advance this fascinating field in support of the next generation of medical practitioners.

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