Histology and Histopathology
From Cell Biology to Tissue Engineering

HistoTutor: Artificial Intelligence-Based Virtual Assistant for Histology Teaching in Health Sciences Students

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Background: Histology is a core discipline in Health Sciences education, enabling students to understand tissue organization, microscopic structure, and the relationship between morphology and function. However, students frequently encounter difficulties in integrating theoretical knowledge with microscopic interpretation and clinical reasoning. Traditional teaching approaches remain essential but may benefit from complementary digital resources that provide continuous and personalized support [1,2]. **Objectives:** To describe the development of HistoTutor, an artificial intelligence-based virtual assistant designed to support Histology learning in Health Sciences students, and to justify its implementation using preliminary data derived from previous digital educational support strategies. **Methods:** A teaching innovation project was designed to develop HistoTutor as a virtual assistant specialized in Histology. The assistant will be configured using pedagogical instructions and subject-specific materials to provide explanations adapted to the students' academic level. Preliminary evidence supporting this implementation was obtained from a previous digital communication experience involving 117 Health Sciences students (mean age 18.3 ± 1.2 years). Data collected included usability, communication patterns, perceived utility, interaction frequency, and cooperative learning indicators. **Results:** Most students reported that the digital support tool was easy to install and use (83.7%), while 94.3% stated that they would use similar resources to improve academic performance. Compared with traditional email communication, digital interaction increased substantially, with 1532 recorded messages versus 84 emails during previous academic periods. Students highlighted several benefits, including improved participation, rapid doubt resolution, enhanced communication between students and teachers, and increased collaborative interaction. Correlation analysis demonstrated significant associations between digital tool integration and cooperative learning dimensions, including social skills (Rho = 0.472), promotive interaction (Rho = 0.389), and global cooperative learning (Rho = 0.437). A summary of the preliminary findings is presented in Figure 1. **Conclusions:** Preliminary findings suggest that digital educational environments promote communication, student engagement, and collaborative learning. Based on these results, HistoTutor is proposed as a pedagogical evolution capable of extending digital support beyond communication. Unlike conventional communication tools, HistoTutor would incorporate personalized tutoring, adaptive explanations, self-assessment, immediate feedback, and clinical–histological integration. This approach may complement traditional Histology teaching by supporting autonomous learning and reinforcing microscopy-based education [2,3].

[1] Bloodgood R.A. and Ogilvie R.W. (2006). Trends in histology laboratory teaching in United States medical schools. Anat. Rec. B New Anat. 289, 169–175. [2] Ellaway R.H. and Masters K. (2008). AMEE Guide 32: e-Learning in medical education. Med. Teach. 30, 455–473. [3] Chan K.S. and Zary N. (2019). Applications and challenges of implementing artificial intelligence in medical education. Med. Educ. 53, 965–971.

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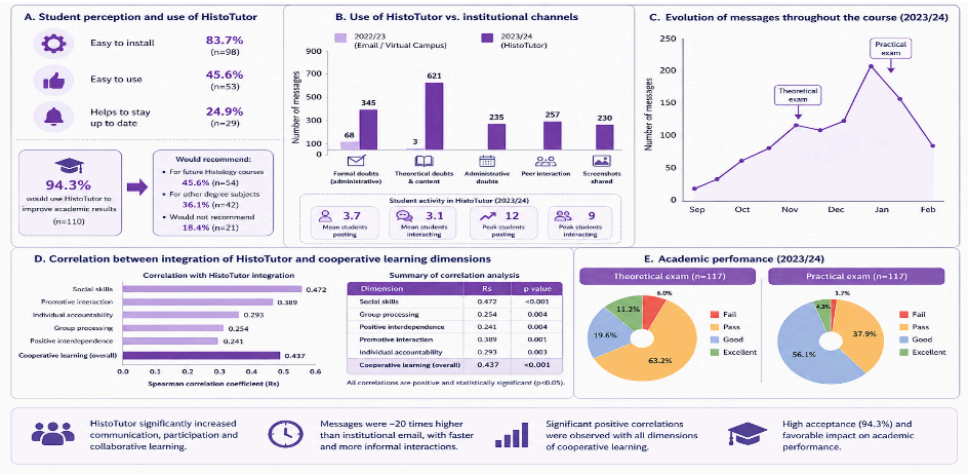

Figure 1. Preliminary findings supporting the implementation of HistoTutor in Histology education.

Table 1. Summary of preliminary quantitative findings associated with HistoTutor implementation in Health Sciences students.

Variable	Results
Students included	117
Mean age (years)	18.3 ± 1.2
First use of digital educational tool	100%
Easy installation/use	83.7%
Would use to improve academic performance	94.3%
Messages generated through HistoTutor	1532
Messages generated through email	84
Student activity rate	8.13
Improved student–teacher communication	31.3%
New learning opportunities reported	24.8%
Social skills correlation (Rs)	0.472
Cooperative learning correlation (Rs)	0.437
Significant associations	$p < 0.05$