# Effect of self-learning by digital histology catalogue on examination score of Undergraduate Medical students

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**ABSTRACT**

**Objective:** To evaluate the effect of using the Digital Histology Catalogue as an adjunct to conventional microscopic tissue slides on the examination score of undergraduate medical students.
**Study Design:** Descriptive Observational Study
**Place and Duration:** CMH Multan Institute of Medical Sciences from 2nd January 2017 to 28th February 2020
**Methodology:** Data was collected retrospectively from the summative module exam results of 1st and 2nd-year MBBS for Batch 2018-23 (Group A) and Batch 2017-22 (Group B). Group A was introduced to the online histology catalogue in their 2nd year of MBBS. In contrast, Group B was not introduced to any such intervention. Modular results of 1st and 2nd-year MBBS were compared for both Group A and B. To further support our results, modular results of Group A and Group B were compared with each other, for 1st-year MBBS (when no group was introduced to online catalogue) and 2nd-year MBBS (when only Group A was introduced to the online catalogue).
**Results:** For Group A, students scored higher marks in module exams of Second Year (after the intervention) as compared to their First Year ($p < 0.001$). There was no significant difference between the mean marks of two years for Group B. Although students of both groups had similar marks in their first-year MBBS, during their second year of study, Group A (exposed to intervention) performed better as compared to Group B ($p < 0.001$).
**Conclusion:** Self-Learning by online digital histology catalogue had a positive effect on the academic performance of the undergraduate medical students in their summative histology practical exams.
**Keywords**: Virtual microscopy, Computer Assisted Learning (CAL), Pakistan, Medical education, Microscopy, Teaching/methods, E-learning, Digital histopathology, Whole slide imaging, Teaching histopathology

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## INTRODUCTION

Today we live in an age of digital revolution. In developed and developing countries, people spend a significant part of their day using one electronic screen or another. A survey conducted by Common Sense Media in 2015[1] reported that teens' mean screen time in the United States is 6 hours and 40 minutes, out of which 2 hours 42 minutes is spent on cell phones. It highlights the impact of digital screens in the life of today's youth.

While this overuse of technology is frowned upon by many, some people are struggling to put it to good use. Recently electronic media is gaining popularity in medical education as a part of computer-assisted learning (CAL)[2] since most undergraduate students are confident in using technology and the internet[3]. The use of pictures and videos to enhance the learning of clinical skills as an adjunct to bedside experience is rapidly becoming a norm[4,5].

In the field of histology, microscope technology has come a long way from the 'primitive' stage of the seventeenth century with Robert Hooke's optical instruments to the technically sophisticated scanning electron and acoustic microscopes, representing a shift from analogue technologies to digital ones. One of the most important innovations of this age in terms of the teaching of Histology and Pathology is Virtual Microscopy[6]. In this technique, scanning microscopes take a detailed digital picture of a tissue slide. These images are then made available

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on various online databases (e.g., Virtual Microscopy Database). Students can access these images using some specialized software on mobile phones and computers. A poll conducted among medical students of the University of Queensland, Australia, found an overwhelming response in favor of Virtual Microscopy, and the majority of students even preferred it to traditional optical microscopy[7]. In another research conducted in China, actual improvement in test results was found by utilizing virtual microscopy[8].

In Pakistan, there is still a lack of computer-assisted learning in most medical colleges;[9] however, some of the leading institutes are trying to adopt technological advancements[10]. The concept of Virtual Microscopy is still new in Pakistan, and its induction in the system with a paradigm shift from the conventional methods is very difficult. As an alternative to Virtual Microscopy, Bellina et al[11] introduced a concept for countries where scanning microscopes are scarce; laboratory technicians can be trained to use mobile phones to take pictures from the microscope. They used this technique in the clinical practice of pathology with promising results. McDaniel et al[12] used instructor-directed video streaming of microscopic elements and found significant improvement in post-test results. Still, there is a huge research gap in evaluating the efficacy of such cost-effective techniques, which may facilitate the traditional system's technological advancement.

Inspired by these projects, we planned to introduce such technology in our undergraduate medical Histology course that may provide a stepping stone for future advances. We took photos of microscopic tissue slides shown in histology practical class and uploaded them to an online album. It was an instant hit, with more than half of the class joining and actively participating within the first two months.

After witnessing the acceptance and popularity of this technique among students, we decided to analyze if this innovation had any significant effect on students' performance. We aimed to evaluate the effect of using the Digital Histology Catalogue as an adjunct to conventional microscopic tissue slides on the examination score of undergraduate medical students. We hypothesized that the introduction of this digital histology catalogue would have a positive effect on their exam results. So, this study was conducted with an objective to evaluate the effect of using the Digital Histology Catalogue as an adjunct to conventional microscopic tissue slides on the examination score of undergraduate medical students.

## METHODOLOGY

This Descriptive Observational Study was carried out in CMH Multan Institute of Medical Sciences, Multan. The data was collected from the Anatomy summative module exams' results of two Batches, Batch of 2018-23 (hereafter referred to as 'Group A') and Batch of 2017-22 (hereafter referred to as 'Group B'), for their first two academic years, conducted from 2nd January 2017 to 28th February 2020. All the students of the aforementioned classes were included. Any student who had missed any module exams over two years was excluded from the study. As per this criterion, there were 90 students in Group A, and 96 students in Group B included in this study. Informed consent was taken from the students and the confidentiality and anonymity of the results was ensured.

At CMH Multan Institute of Medical Sciences (CIMS), histology is taught in the first two years of MBBS. In routine, the students are shown histology tissue slides during the scheduled practical classes. They do not have free access to microscopes outside this schedule. There are three module exams in each academic year of 1st and 2nd-year MBBS. In the practical examination, there are stations with histology tissue slides focused on microscopes for identification, each carrying equal marks.

We introduced the online picture catalogue to the 2nd-year MBBS Batch of 2018-23 at the start of their academic year. We took photographs of the tissue slides in the practical histology class, with a mobile phone mounted on a microscope with a specialized stand. An experienced histology teacher, as a subject expert, checked the quality of the photographs, and their relevance and alignment with the current syllabus. We then uploaded these to the online platform of Google Photos, made the album public, and shared its link with the students. As opposed to virtual microscopy, it was easily accessible and required no special software. Students regularly viewed and even commented on the pictures to ask questions. This online catalogue was our personal project and was neither compulsory for passing the exam nor a coursework requirement. Histology teaching practices continued in routine, and this online catalogue was just available as an adjunct study material.

Online microscopic image catalogue, on Google Photos (herein referred to as 'intervention'), was introduced only to Group A at the beginning of their Second Academic Year. No such intervention was introduced to Group B. The students of both groups were taught the same course by equally qualified and experienced teachers and tested by similar examination techniques.

**Data analysis:** Data were analyzed using IBM SPSS Statistics version 26. The percentage of marks obtained were expressed as mean ± standard deviation unless mentioned otherwise. The year-wise mean of three module exams was taken for each group. We compared the results of the practical component of histology module exams conducted before and after this intervention was introduced (i.e., First Year vs Second Year) in Group A. As a control against bias in course and exams of two academic years, the mean results of two years of Group B were also compared. A comparison was also made among the two Groups for both years of study to rule out any inherent differences between them.

The normality of data was tested by the Shapiro-Wilk test. Within one group, the mean percentage marks of two years were compared using Paired-Sample t-Test. For year-to-year comparison among two Groups, Independent-Samples t-Test was used.

## RESULTS

Data was normally distributed for both Groups. There were 90 students in Group A who fulfilled the inclusion criteria. For Group A, students scored higher mean marks in module exams of Second Year (84.56 ± 14.49 %) as compared to their First Year

(68.08 ± 12.83 %), when they had not been exposed to the intervention, a statistically significant increase of 16.47 (95% CI, 13.54– 19.39%), t(89) = 11.18, p < 0.001, with large effect size, Cohen's d = 1.18. In Group B (n = 96) there was no difference between their mean marks in First Year (71.06 ± 10.97 %) and Second Year (70.39 ± 13.75 %), t(95) = -0.42, p = 0.677, (Figure-1).

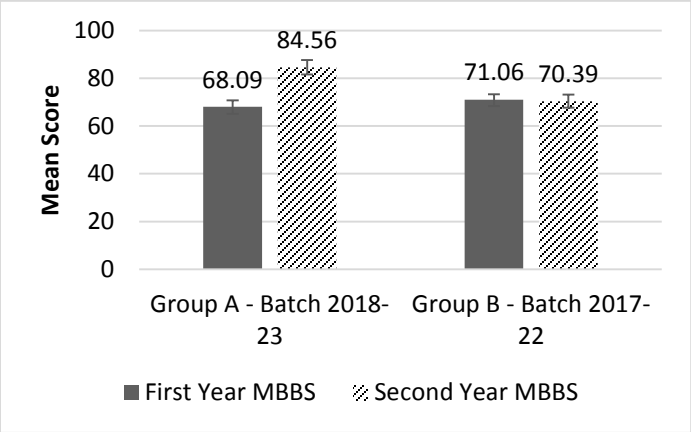


**Figure-1: Difference in mean module score of First-Year vs Second Year MBBS for Groups A & B**

(Group A-Interventional Group i.e., used digital histology catalogue in 2nd year, Group B- used no such digital histology catalogue in both the academic years. Whiskers indicate 95% confidence interval)

In their first academic year, there was no statistically significant difference between Group A (68.08 ± 12.83 %) and Group B (71.06 ± 10.97 %), -2.97 (95% CI, -6.43 - 0.50), t(175.52) = -1.70, p = 0.09. Whereas, in the second academic year, Group A (students exposed to intervention) scored higher (84.56 ± 14.49 %) as compared to the Group B (70.39 ± 13.75 %), a statistically significant difference of 14.17 (95% CI, 10.08-18.26), t(184) = 6.841, p <0.001, with a large effect size, d = 1.00, (Figure-2).

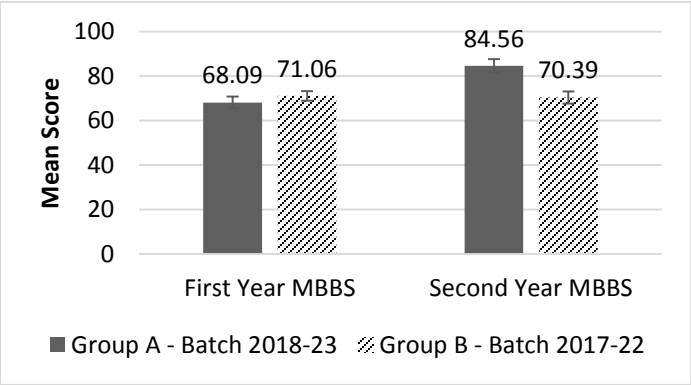


**Figure-2: Difference in mean module marks of Group A vs Group B, in First and Second Year MBBS**

(Group A-Interventional Group, i.e., used digital histology catalogue in 2nd year, Group B- used no such digital histology catalogue in both the academic years. Whiskers indicate 95% confidence interval)

## DISCUSSION

Our results showed improved academic performance of undergraduate medical students after using the digital Histology catalogue. It is increasingly emphasized that the use of technology is better able to capture students' attention of this era. Online sharing of clinical skills videos is rapidly gaining popularity due to their established benefits[4,5]. Similarly, virtual microscopy is drawing the students' attention and teachers of histology and pathology[13-15].

In our study, Group A students scored higher marks in their second year of MBBS as compared to the 1st year, when they were not introduced to this digital histology catalogue. One explanation for the improved results could be their increased maturity and experience over time. To address this bias, our study also compared the 1st and 2nd-year histology results of Group B, who were not introduced to the Digital Histology Catalogue throughout two years. No significant difference was found between the academic performances of two years of study for Group B.

This implies that improvement in results after intervention in our study have occurred because of better recognition and understanding of histology slides among Group A students. This improvement can be attributed to their use of the online catalogue of Histology slides shared via Google Photos.

Results were further reinforced by year wise comparison between the two Groups. Both the groups obtained similar marks in their 1st year of MBBS, showing that neither of the Group was inherently better than the other. Whereas, after the introduction of digital Histology Catalogue in their 2nd year of MBBS, students of Group A outperformed Group B in that year. Marked improvement of Group A students' academic performance can again be attributed to the introduction of Digital Histology Catalogue.

Tian Y et al[8] found similar results in China, where they noticed an improvement in histology tests score after the introduction of Virtual Microscopy in the curriculum. There were seen similar improvements in the work of pathologists using Virtual Microscopy [13,14]. A few studies showed that the researcher could not find a statistically significant improvement in test results after such interventions[16,17]. However, a meta-analysis conducted in 2016[18] analyzed data of 5928 students from 12 studies, comparing virtual to conventional microscopy, found a small positive effect in favor of Virtual Microscopy. Similarly, in survey-based researches, most students preferred virtual microscopy over conventional methods[15,17,19]. Also, a recent review article in 2019 concluded that the academic performance of medical students was enhanced by adopting virtual microscopy technique in curricula[20].

This study has a few limitations, like small sample size of exclusively MBBS students from a single center and sole analysis of the practical component of the exam. However, there was an improvement in the students' identification skills after implementing this small yet effective practice. If such a scheme is formally implemented at the institutional level, much better results can be achieved. Once there is a widespread acceptance of these learning modalities, we can devise our syllabi and practical demonstrations on various Virtual Microscopy forums.

## CONCLUSION

Self-Learning by online digital histology catalogue had a positive effect on the academic performance of the undergraduate medical students in their summative histology practical exams.

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## AUTHOR'S CONTRIBUTION

**Rabbani MA:** Conceived idea, Designed research methodology, Manuscript writing, Final proofreading, Manuscript writing
**Syed HBS:** Data **i**nterpretation, Critical review, Final proofreading
**Faiza:** Statistical analysis, Data interpretation, Manuscript writing
**Eyman S:** Data collection, Literature Review
**Irfan A:** Data collection, Literature Review
**Rabbani MW:** Data Interpretation, Critical review

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