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Attitude, perception, and feedback of graduate medical students on teaching–learning methodology in pathology courses: A call for curricular modernization in Morocco

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Abstract:

BACKGROUND: The difficulty of understanding the pathology courses and the student's dissatisfaction with the pathology modules is a universal problem. The principal aim of our survey was to assess the perception and satisfaction of teaching pathology by graduate medical students from nine Moroccan faculties of medicine.

MATERIALS AND METHODS: This study was conducted among graduate medical students regarding their preferences in pathology teaching modalities, their satisfaction with the current lecture-based courses, their perception of pathology as a specialty, and their thoughts on whether and how such curricula should be modernized. A qualitative and comparative analysis was performed. The differences in modalities of teaching used were investigated.

RESULTS: We received 274 completed surveys from graduate Moroccan medical students. Seventy-five (27.9%) students were dissatisfied with the actual lecture-based courses. A total of 131 students (48.5%) considered that the methodology of teaching and learning used in their faculty is insufficient for learning, understanding, and memorizing pathology courses. Additionally, 233 students (86.3%) considered that the curriculum should be modernized. The majority supported the implementation of case reports (74%), hospital-based rotation in the pathology department (68.7%), and virtual slides (60%) as the most preferred didactic methods.

CONCLUSIONS: This survey based-study highlighted the limits of the current pathology teaching curriculum in Morocco, insufficiently in line with the aspirations of students. Furthermore, students' responses regarding their knowledge of the pathology laboratory functioning as well as their opinions toward considering pathology as a future career were very surprising, converging toward a huge lack of attractiveness of this discipline.

Keywords:

Medical students, pathology curriculum, perception, satisfaction, teaching

Introduction

Pathology has developed from an autopsy and macroscopy-based discipline to a technically finessed histological and molecular field. It was for a while the central pivot in medical education in

the 20th century and earlier. It has lost its once-held status in the past decades. Increasingly, thoughts are being voiced that pathology is not important to medical education,^[1] whereas some believe that it is central to the understanding of diseases and critical to the development of a fine

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physician,^[2] as is our opinion. For medical students, the importance of the subject should lie in the basics of disease and not focus exclusively on histological and molecular details, which are often misunderstood and hardly memorized. In our experience, we note that medical students feel an increased interest in clinical practice in specific medical fields and less in pathology where contact with patients is almost absent. Moreover, the majority of medical students do not understand the importance of pathology as an interdisciplinary field and a cornerstone of disease knowledge.

In Morocco, teaching pathology in medical faculties is taught between the 3rd and the 5th years of the second cycle of medical studies. The curriculum covers two modules: general pathology (GP) in the 3rd year, the beginning of the clinical studies, and special pathology (SP) intensively in the 4th or 5th year. In Moroccan medical faculties (MMF), the number of teachers, the theoretical course modalities, their hourly volume, and the conduct of tutorials or practical works vary from one faculty to another. Outdated teaching methods, such as lectures with minimal student–teacher interaction, are still being used worldwide in pathology teaching.^[3] Modern teaching methods including problem-based learning and computer-based methods such as virtual slides (VS) with online cases in Moroccan curricula are yet to be fulfilled.^[4]

Hypothesizing that medical students were unsatisfied with traditional teaching methods, as demonstrated in several papers, the student judgment is a strong and valid tool for curriculum development and changing teaching methods in pathology curricula. As it has been shown, for a successful general improvement of the curricula, the involvement of both student and teacher in the process is essential. Although the perceptions of medical students on the methodology of teaching and learning pathology courses were probably assessed in some foreign universities, they were never evaluated in ours. Therefore, we set out to survey medical students from the 4th year and internal doctors of nine public and private medical faculties. We aimed to assess the student's satisfaction with pathology teaching methods. We also investigated students who had received classes in the COVID-19 era versus those who had got them outside this period. This survey was underpinned by the interest in modernizing the curricula and the value of modifying or improving the teaching methodology of pathology courses toward models of better teaching approaches and practices.

Materials and Methods

Study design and setting

It was a descriptive and analytic study. Jamovi software (version 1.6.23) was used for statistical analysis.

Percentages were performed for data qualitative analysis. The mean value and the standard deviation (SD) were determined for the age parameter.

The Methodological Support Unit for Research (MSUR) confirmed the legitimacy of the described statistical approach.

The outcome variable was the degree of satisfaction and was graded as follows: 1, not at all satisfied; 2, slightly satisfied; 3, moderately satisfied; 4, quite satisfied; and 5, extremely satisfied. Graduates who responded with 1 and 2 were considered dissatisfied, and those who checked 3, 4, and 5 were considered as satisfied. For all statistical tests, a *P* value less than 0.05 was considered a statistically significant difference or change.

Study participants and sampling

Our study included graduate students and also internal doctors from nine Moroccan faculties of medicine of public and private sectors of Morocco. We considered only those students' responses, who, at the time of the survey, had already finished all parts of the pathology courses. Dental medicine and pharmacy students were not allowed to fill out the questionnaire. The survey consisted of 44 items that had been well-structured and elaborated in a comprehensive and relevant manner. It was previously approved by the MSUR at Mohammed VI University of Health Sciences (UM6SS).

The first page of our survey included the title of the study and an introduction summarizing its objectives and defining the population of students eligible for the survey. This survey focused on theoretical teaching and also practical works of this discipline taught to medical students who had already completed all courses in general and special pathology.

It consisted of five sections. The first one investigated student satisfaction demographics (age and gender), the faculty of medicine, the year of student study, the lecture-based pathology curriculum, and the materials used. The second section assessed the status of teachers and their faculty of origin. The third section contained topics related to the assessment of satisfaction with modalities of pathology teaching and the current didactic program adopted in Moroccan faculties. Section four collected information regarding any internships undertaken in the pathology laboratory. The fifth section assessed the students' knowledge of a pathologist's duties, the pathology role in modern medicine, and their responses toward considering pathology as a future career. It should be noted that some questions in the questionnaire may have had several answers to check.

Data collection tool and technique

A questionnaire was used to collect data. It was sent, in October 2021, by an electronic link to the representatives of Moroccan medical students and the intern deans of nine Moroccan faculties. We received 290 responses; however, 16 questionnaires were omitted as they did not have complete data or were performed by students who had not yet finished the whole program.

Ethical consideration

It was an anonymous and strictly confidential survey. We mentioned on the first page that filling out the questionnaire was an indication of the student’s consent to take part in this study. The participants were also informed that all recorded data were to be used for curriculum development and scientific study.

Results

A total of 274 responses were selected for our statistical analysis. The mean age of participants was 24.7 years (standard deviation [SD]: 1.51), 56.9% (N: 156) of the participants were female, and 43.1% (N: 118) were male. All students received GP in the 3rd year and 90.1% taught SP in the 4th year. A total of 161 students (59.2%) preferred teaching GP in the 3rd year; however, 19.9%, 9.9%, 7.7%, and 3.3% would have preferred this teaching, respectively, in the 2nd, 4th, 5th, and 1st years. For the SP module, 54.5% preferred this teaching during the 4th year, and 28.9% and 16.5% would have preferred it, respectively, in the 3rd and 5th years. For faculties information and year of study see Figure 1.

Teachers

A total of 15 students (5%) reported having received their teaching from teachers from abroad, 46.1% (N: 123) from teachers related to other national medical faculties, and 84.6% (N: 226) from the same faculty. A total of 129 students (78.7%) preferred teaching by professors within their faculty. Courses were taught by assistant professors to 60.7% (N: 164), by associate professors to 63.9% (N: 172), and by professors in higher education (PHE) to 76% (N: 203).

Differences in modalities of teaching used and perception for practical tutorials [Table 1]

At Moroccan medical faculties, lectures are the main mode of teaching pathology courses (82.6%). Seventy-one students (26.3%) found SP harder than GP and for 57%, both were difficult. A total of 211 (78.1%) (N: 4 omitted this question) benefited from tutorial sessions (100% of students from Abulcassis Faculty of Medicine and Pharmacy (FMP), Rabat FMP, and Fès FMP) knowing that only 11.9% of students claimed that tutorial sessions had not been maintained during the COVID-19 era. Forty-two students (51.9%) preferred in-person classrooms during the COVID-19 period.

One hundred eighty-five students (69.8%) found tutorial sessions interesting. The use of virtual microscopy was noted in 48.6% (N: 101), optic microscopy (OM) in 60.3% (N: 132), and projected presentations in 82.6% (N: 176). VS were appreciated by 76.0% of students (N: 190) as well as reading slides under the microscope (78.9%; N: 194).

Regarding improving their understanding of pathology, 73 students (27%) confirmed that more important time devoted to pathology teaching was not useful in improving their understanding. However, 92.6% of students affirmed that the integration of clinical cases entities in lectures and tutorial sessions was very helpful in improving their understanding of pathology courses. When asked about their lectures’ attendance, 29.0% (N: 78) of students always attended them, 32.7% (N: 88) often, 11.9% (N: 32) from time to time, 17.1% (N: 46) rarely, and 9.3% (N: 25) never.

Students were also asked about their goals when preparing for pathology courses. The main objective, which was found to be most important to students, was ascertaining basic knowledge in pathology in 70.3% of students (N: 189), followed by understanding histopathological connections and passing the course exam in 52.4% of students (N: 141). To be pathology adept for clinical rotations was checked in 49.6% of students (N: 134).

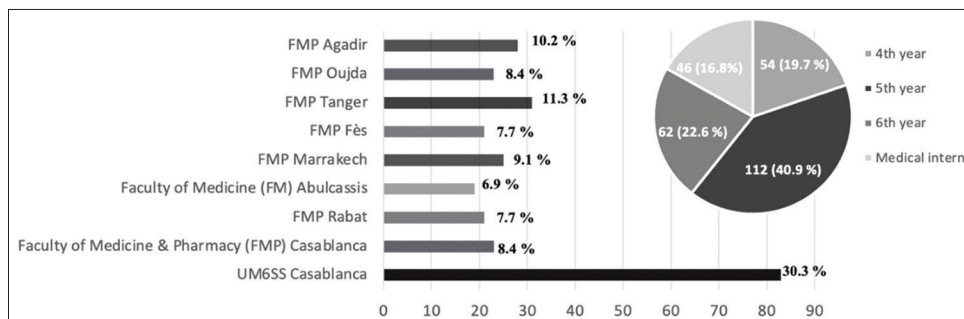


Figure 1: Faculties of the surveyed medical student population (%) (the left), year of study (the right)

Table 1: Modalities of teaching used during the COVID-19 era and comparison between the pathology knowledge at the beginning and the end of modules

	<i>n (%)</i>	
Modalities of practical sessions	113 (41.8)*	
Distance learning	52 (19.3)	
Hybrid	19 (7.0)	
In-person	42 (15.6)	
Modalities of lectures	113 (41.8)*	
Distance learning	67 (45.3)	
Hybrid	8 (5.4)	
In-person	4 (2.7)	
Which mode would you have preferred?	113 (41.8)*	
Distance learning	12 (14.8)	
Hybrid	25 (30.9)	
In-person	42 (51.9)	
Pathology knowledge at the beginning of the module	270	McNemar test
Null	220 (81.5)	
Moderate	46 (17.0)	
Perfect	4 (1.5)	<i>P</i> : 0.001, (df**): 3
Pathology knowledge at the end of the module	270	
Null	208 (14.1)	
Moderate	38 (77)	
Perfect	24 (8.9)	

n: Number. *Students who had never received practical works or had attended pathology courses before the COVID-19 era (before March 2020) were not concerned (157 [58.1]). **Degree of freedom

Preferred modalities of teaching/Internship at the laboratory of pathology

In our survey, 86.3% of students (*N*: 233) stated that the current curriculum should be modernized. These students who judged that the pathology curriculum should be changed were invited to share their propositions and preferences for teaching modalities. This question concerned 11 different tools and modalities of teaching, for which multiple answers were allowed. The students most strongly supported clinical cases overlapping with slides on the microscope (74.0%) [Table 2].

A total of 258 students (95.6%) have never had a practical activity in a pathology laboratory during their medical curricula. Six students from the FMP of Casablanca described their experience during a rotation in the pathology department of Ibn Rochd University Hospital Center. They have had the opportunity to see the different techniques of the frozen section, histological, and cytological samples examination; macroscopic and microscopic study of surgical specimens, immunohistochemistry, and histoenzymology. They described having had an interesting and excellent experience.

Table 3 shows the integration of a systematic internship to the pathology laboratory and those who have approved this point [Table 3].

Student satisfaction and support for change

For assessing the satisfaction of students with the current form of teaching, which mainly consisted of

Table 2: Preferred modalities of teaching

Levels	Checked by students <i>n (%)</i>
Clinical cases overlapping with slides on the microscope	196 (74.0)
Training at the laboratory of pathology	182 (68.7)
Virtual slides	159 (60.0)
Online cases	137 (51.7)
Animated sessions with short demonstrative videos	133 (50.2)
Tutorials	112 (42.3)
Inter-university teaching portal	100 (37.7)
Seminar	86 (32.5)
Online platforms	77 (29.1)
Massive open online course (MOOC)*	71 (26.8)
Podcast	50 (18.9)

*Explained by a short sentence in the form

lectures, we used a scale from 1 to 5 corresponding, respectively, to the following levels of satisfaction: dissatisfied, slightly satisfied, moderately satisfied, very satisfied, and extremely satisfied. No one was extremely satisfied with the current curriculum, 54.3% of students (*N*: 146) were dissatisfied (1+2), and 45.7% (*N*: 123) were satisfied (3+4+5) [Table 4]. When questioned to know if the teaching and learning methodology used in their faculty was useful in learning, understanding, and memorizing pathology courses, 50.4% (*N*: 136) of students stated that it was insufficient, 31.1% (*N*: 84) said yes, and 18.5% (*N*: 50) stated it was not useful.

We studied different factors that may influence the satisfaction level: We did not note any significative

Table 3: Preferences for the internship. The timing preferred for the guided visit

	Counts (%)
Preferences for the internship	
Internship from the 2 nd cycle	86 (37.2)
Short passage at the time of GP tutorials	78 (33.7)
Short-guided tour of the pathology laboratory in small groups	20 (8.6)
Internship from the 2 nd cycle + short passage at the time of GP tutorials	17 (7.3)
Internship from the 2 nd cycle + short passage at the time of GP tutorials + short guided tour of the pathology laboratory in small groups	12 (5.2)
Short passage at the time of GP tutorials + short-guided tour of the pathology laboratory in small groups	9 (3.9)
Internship from the 2 nd cycle + short-guided tour of the pathology laboratory in small groups	9 (3.9)
Guided visit: timing preferred	
In conjunction with practical sessions of GP	125 (50.8)
No special preference	71 (28.9)
In conjunction with special pathology lectures	33 (13.4)
In conjunction with general pathology lectures	17 (6.9)

Table 4: Satisfaction degree with the current curriculum, knowledge of pathologist's roles, functioning of the pathology laboratory, and interest in anatomy-clinical confrontation

	n (%)
Exact role of the pathologist	
No	34 (13.0)
Not really	60 (23.0)
Yes	167 (64.0)
Functioning of the pathology laboratory	
No	190 (70.4)
Not really	56 (20.7)
Yes	24 (8.9)
Interest in anatomy-clinical confrontation	
No	9 (3.3)
Not really	7 (2.6)
Yes	254 (94.1)
Degree of satisfaction	
Dissatisfied	75 (27.9)
Slightly satisfied	71 (26.4)
Moderately satisfied	63 (23.4)
Very satisfied	60 (22.3)

difference between the sex, tutorial sessions sustained or not, teachers' statute, and satisfaction level. On contrary, we notified a statistically significant difference between the proportions of students' faculties ($P < 0.001$), lectures attendance ($P < 0.001$), modalities of tutorials teaching ($P: 0.002$), teaching-learning methodology ($P < 0.001$), and satisfaction level. However, there was no significant difference between groups of students who received classes in the COVID-19 era and those who got them outside this period regarding their satisfaction level ($P: 0.83$).

By ordinal logistic regression, we noted that satisfaction level and students' perception of the teaching-learning methodology were linked to an R^2 McFadden's rank correlation coefficient at 0.07 ($P < 0.001$).

Perception of the pathology specialty and its place in modern medicine/knowledge of a pathologist's roles [Table 4]

Pursuing a career in pathology and reasons for not choosing it in future career [Table 5].

Twenty-one students (7.8%) reported being able to choose pathology as a specialty at the end of their curriculum of general medicine compared to 119 students (44.1%) who admitted not opting for this specialty. Sixty-six (24.4%) students stated that they could choose pathology but not as their first choice and 23.7% (64) of them said perhaps. Moreover, students were questioned on their reasons for not considering pathology for their future careers [Table 5]. We noted that 31 students (15%) left other comments such as the use of formalin, lack of medical prescription and limited clinical information on samples to be analyzed, a lot of knowledge required, little recognition by colleagues and patients, and no action.

Discussion

The purpose of teaching pathology is to provide students with the morphological, macroscopic, and microscopic basics to enable them to understand the major pathological processes and diseases.^[5] Among students, the reputation of pathology has not always been the best. In our opinion, learning the basics of pathology should be the aim of current pathology teaching and the way such content is taught is important as it influences students' views of the discipline and what they retain.

The aim of our study was to evaluate the students' judgment on pathology teaching in Moroccan faculties, to adapt and, if necessary, to improve even modify current teaching methodology for best pedagogical approaches and practices.

Theoretical teaching

The teaching of pathology in its current formula does not seem to provide the sufficient basis and prerequisites desired by the students because 50.4% of them stated that the teaching and learning methodology used in their faculty was insufficient to learn, understand, and memorize pathology courses. More than 70% of students preferred the implementation of clinical cases overlapping with slides on the microscope, 68.7% preferred training at the laboratory of pathology, and 60% encouraged the use of VS in pathology courses.

Table 5: Reasons why students did not consider pathology for their future career

Reasons for not choosing the pathology specialty	Checked by students (PS: Multiple-choice question) n (%)
Prefer another specialty	204 (80)
Absence of direct patient contact	175 (67.3)
Think pathology is difficult	57 (67.1)
Insufficient experience during medical studies	150 (54.5)
Think pathology is boring	107 (43)
Misunderstanding of courses	98 (39)
Negative impression due to difficulty in pathology exams	95 (38.8)

As can be inferred from our qualitative data, students' satisfaction with an almost purely lecture-based curriculum was not very high with 54.3% of students showing dissatisfaction and 86.3% of students supporting the modernization of the curriculum [Table 4]. Using only lectures has been identified as an archaic model of teaching in our faculties and should be changed.^[6,7] When in a lecture, most students sit and try to listen but many end up experiencing "task-unrelated images and thoughts".^[8] In our study, with a medium cohort of students, we were able to show that there was no statistically significant difference in the improvement of the pathology knowledge at the beginning and at the end of the module in accordance with students who attended lectures and those who did not. Subsequently, this raises the question: "What is the use of the lecture?"^[9] as in the title of Donald Bligh's 1998 book on the topic. As our study was the first one in Morocco, we think that is why so many pathology curricula still base their education mainly on lectures.^[3] A possible explanation for the perseverance of lectures in pathology education is the fact that medical school class sizes have been increasing in the past decades making a "mass lecture" a financially attractive teaching option.^[10,11] Donner and Bickley suggest that novel methods such as problem-based learning are only financially feasible with a class size below 60.^[12] With class sizes exceeding 200 students and a minority number of pathology teachers, one can no longer assume that there is a teaching method more financially feasible than the lecture. One must also not forget that lectures do play an important role as an introduction to a field or course and that there are learning types, which benefit from lectures but are insufficient. As shown in our study, we noticed that students' pathology knowledge was surprisingly improved at the end of courses [Table 1].

Tutorials and practical works

At the Moroccan medical faculties, tutorials or practical works sessions in pathology are continued in 78.1% of cases. Students found these sessions interesting (83.7%).

In all, 89.4% and 83.7% of students showed an interest in observing slides under an optical microscope and virtually on a computer screen with more than 60% of students who checked the implementation of clinical cases overlapping with slides on OM. Fred Dee describes that by 2009, 50% of the pathology departments in the United States (US) were using virtual microscopy.^[13] In Morocco, the use of virtual techniques has not yet been expanded to laboratories, and digitized slides are not yet generalized at medical faculties. We should develop these tools and issues to improve the understanding and assimilation of pathology courses. In addition, the current problem in our faculties lies mainly in the increasing evolution of student demography (150 students and more) and university-hospital (only one teacher to supervise the practical work in some medical faculties) responsible for repetition and increase in the hourly volume of practical sessions. Thus, this displays a key limitation of curriculum development, namely its link to faculty support (which can often be difficult to gain) and the financial resources required to achieve positive changes.

Internship in the pathology laboratory

As shown in our study, 81.9% agreed with the integration of a systematic internship in the pathology laboratory. These results objectify a probable medical curiosity, interest, and superb collaboration from the students.

The future of our specialty probably lies in the reception of a greater number of students in pathology departments as they begin their clinical rotations. Our experience with medical interns and residents who have passed in the pathology laboratory showed that they can actively and very quickly participate in the macroscopy study and are generally motivated to examine microscopically the samples they have realized.

Preferred modalities of teaching/student satisfaction and support for change

In all, 54.3% of students included in our study were dissatisfied with the current curriculum in Morocco, and 86.3% supported modernized tools, suggesting that by experiencing traditional pathology teaching one develops the feeling that something important is missing. However, we must keep in mind that implementing such interactive teaching requires major time and dedicated staff who might even need to invest time outside of the regular teaching time.

Motivations behind improving curricula can be student satisfaction and their perception of the teaching-learning methodology. Our survey data suggest that the two are linked to an R^2 McFadden's rank correlation coefficient at 0.07 ($P < 0.001$), and thus improving the teaching-learning methodology would increase satisfaction

with the pathology course. This hypothesis must be viewed critically as Kumar *et al.*^[14] present data that suggest changing curricular methods do not correlate with pathology testing performance and satisfaction.^[15] For course hours in pathology, another previous study showed that high course hours do not lead to better performance and comprehension for the discipline as seen in our study.^[16] On the contrary, we have surprisingly remarked that 92.6% of students judged the utility of clinical case integration either in lectures or practical tutorials. Also, we noticed that the use of online clinical cases or overlapping with slides' lectures were checked off among the proposed tools for a program change (respectively 74%, and 51.7%).

A massive open online course (MOOC) allows one to teach and communicate very widely through the webcast. This tool was supported only by 26.8% of students. The use of computer-based methods as well as remote learning is a very attractive approach. The experience reported by Charlotte *et al.*^[17] "MOOC on cancer diagnosis: assessment and evaluation of the impact on the pathology perception" illustrated the stock of the first French applied experiment to the pathology and painted the picture of an ideal curriculum.

Perception of the discipline

In the American study of Holland and Bosch, the proportion of potential students interested in pursuing a career in pathology did not exceed 4% compared to 7.8% in our study.^[6] One of the major problems of our discipline remains its lack of visibility and unfamiliarity among students. The current curriculum does not facilitate things because pathology appears as a watermark, dissolved in a very dense curriculum. Our study pointed this out, showing that 70.4% of students do not know how a pathology department is operated. This result is similar to that of the French study of Chatelain *et al.*^[18]

As a community of pathologists, by working hand in hand, we can assure better communication and land occupation, by ensuring more visibility of pathologists in staff, multidisciplinary consultation meetings, and scientific conferences. These interventions, certainly time-consuming, require high availability and a large number of pathologists, something that is hard to set up because of the current low number of pathologists practicing in Morocco.

We should also continue our efforts to raise awareness and disseminate the discipline to students by further expanding our welcoming policy to medical and surgical students during their school days. Here again, the difficulty lies in the availability and the low number of pathologists working in the university-hospital setting

and in the time needed to supervise students, which also requires the involvement and active participation of the department's secretaries and technicians.

The data presented here consisted of a mixed qualitative and quantitative method approach both descriptive and analytical. Although it seemed appropriate to answer our purpose, we are aware of some methodological limitations of our study. First of all, the use of an anonymous questionnaire for a survey is always questionable; however, for our study, it was the most suitable and easiest method to implement. This questionnaire method has already been used in the literature by two teams, American (Holland and Bosch) and Danish (Holk *et al.*), to assess the perception of pathology by medical students (6,7).^[19,20] (6) The formulation of questions and the nature of answers proposed in our study were intended to be neutral and objective. The choice of the population interviewed, only students who, at the time of the survey, had already finished all parts of the pathology courses, was justified by their larger university hospital experience, more extensive medical knowledge, and a sufficient decline to judge the defects and qualities of pathology teaching. In addition, although this would be a preferable and more comprehensive way of data collection, it was difficult in our setting to have a wide cross-section with complete questionnaires. This might be explained by the student's lack of interest in the discipline and/or their disregard for surveys or it may reflect a lack of student motivation. This low rate of participation necessarily leads to a bias in the nature of the information collected, reflecting probably only the opinion of the most motivated and interested students or, on the contrary, that of the most disappointed by the discipline.

In 2006, Professor Paola Domizio of the University of London wrote that "the profile of pathology must once again be raised" and that "its loss in the modern curriculum must be corrected".^[21,22] Our data showed the limits and the insufficiency of the current pathology teaching and also highlighted the lack of attractiveness of the discipline. The comparison of our survey results with the best practice model of a modernized curriculum is supported by students who found an interest in tutorials/practical sessions with the wide use of virtual slides, integration of clinical cases in lectures, and application of an internship in the pathology department. Ensuring a good pedagogical alignment between a docimological relevant examination and an adapted pedagogical method is a priority for each discipline. The development of innovative pedagogical interventions, especially the use of VS, has gradually upgraded the pedagogical quality of our discipline as demonstrated in the experience of Paris Descartes medical faculty.^[23]

Despite challenges related to the exponential increase in student promotions, the decline in university hospital teachers' profiles, also given the increase in pathologist activities, and the emphasis placed on improving the pathology teaching-learning methodology, the results of this survey encourage us to keep practical assignments and tutorials. It is one of the rare moments when students get acquainted with the practical work of pathologists and are able to understand their duties and their contribution to the management of a patient. Additional slide reading may be offered as an optional extra session to volunteer students.

These data also showed a low knowledge of the role of pathology and pathologist duties with huge lack. It supported the implementation of a modernized pathology curriculum with supplementary computer-based learning tools with VS software. It is time for the pooling of teaching resources on a regional or even national scale with a call for developing a virtual learning environment and space dedicated to the production and exchange of inter-academic content among teachers.

Finally, we hope that many schools will soon be working to modernize their pathology curricula and beyond to better support student-focused learning moving forward.

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Abbreviations

GP: general pathology, SP: special pathology, MMF: Moroccan medical faculties, VS: virtual slides, MSUR: Methodological Support Unit for Research, UM6SS: Mohammed VI University of Health Sciences, SD: Standard deviation, FMP: Faculty of medicine and pharmacy, OM: Optic microscopy, DF: Degree of freedom, MOOC: Massive Open Online Course, POPS: Patient-oriented problem-solving system

Authors' contributions

OK was involved in the conception and design, data acquisition, statistical evaluation and interpretation of

the data, and drafting of the article. MB was involved in the conception and design, and data acquisition and helped in drafting the article. AbS was critical to the initiation of the study and was involved in the conception and technical initiation of the study. CS was involved in the study approval. AN and AhS helped conceive and design the study; were involved in survey validation, data interpretation, manuscript revision and study approval.

All authors read and approved the final manuscript.

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Conflicts of interest

There are no conflicts of interest.

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