

HOW WE TEACH | *Classroom and Laboratory Research Projects*

Student perceptions of “doing” hematology physiology practicals

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D S, A T. Student perceptions of “doing” hematology physiology practicals. *Adv Physiol Educ* 44: 65–71, 2020; doi:10.1152/advan.00147.2019.—Although hands-on experience in hematology practical work has been an integral part of physiology education, the students’ perception on the importance of the same has remained largely unexplored. The objective of this study was to explore students’ perception on the importance of “doing” hematology experiments. The first-year medical students of the 2017–18 batch filled out a semistructured questionnaire at the end of the course of hematology practicals. The questionnaire captured their perception of the importance of doing hematology practicals on their own blood, the assessment of the same, and its value in medical training. Students indicated that doing practicals individually by pricking themselves was a necessary part of physiology teaching ($n = 126$ responses: 43 men, 83 women; 86%). They felt that it not only improved their knowledge ($n = 120$: 39 men, 81 women; 82%) and fine-motor skills ($n = 107$: 41 men, 66 women; 73%), but also molded their attitude ($n = 101$: 41 men, 60 women; 69%), gearing them to become empathetic and confident doctors. They felt that some practicals were unnecessary/outdated; this needs attention. While suggesting a few modifications in the practical curriculum, almost all students felt that the practicals should be continued for future batches. Students felt that doing hematology practical work was a necessary part of their training. It improved their knowledge, skills, and attitude, making them more empathetic and confident doctors.

empathetic doctors; experiments; hematology practicals; physiology; student perceptions

INTRODUCTION

Laboratory work has an important role in physiology education during medical training (3). The broad objectives of laboratory exercises in science education, as described by Modell (10), are to provide an environment in which the student can actively participate in an exercise that results in learning. Additional goals are familiarizing students with technical issues, experimental design, and data analysis issues; demonstration of basic physiological principles; and providing students with first-hand experience with a living system (9, 10). The Medical Council of India has clearly defined the objectives of laboratory work in physiology (8), and this has been endorsed by the respective state universities across India. The overall goal of the curriculum in physiology is “to provide the student with comprehensive knowledge of the normal functions of the organ systems of the body to facilitate an understanding of the physiological basis of health and disease.” The

laboratory work is designed to aid in achieving this goal. The rationale behind introducing practical work is to improve skills so that, at the end of the course, the student can conduct experiments designed for study of physiological phenomena, interpret experimental/investigative data, and distinguish between normal and abnormal data derived from tests that he/she has performed and observed in the laboratory.

Performance of practical (laboratory) work is intrinsic to science education. The rationale behind “doing” practical work in science education has been explored in the past. Doing practical/laboratory work illustrates and simplifies the complex concepts of science. It leads to actual collection of data and analysis, allows student to appreciate the spirit and methods of science, which are learned by doing, improves their psychomotor skills, and motivates them (18). These rationales have been subjected to critique by many researchers who have questioned the role of laboratory work as an educational tool. There is, for instance, a criticism that the advantage of spending time in doing practical work is small in comparison to the time, energy, and money spent on it. An added finding is that it may increase manipulative behavior among the students (6).

As far as medical education is concerned, the time spent in the laboratory must be effectively and efficiently used. In a recent study that investigated the influence of laboratory work on student motivation in physiology, it was reported that students felt laboratory work (all aspects of physiology practicals) was very important for learning difficult concepts and physiological processes, as the hands-on experiences gave a more concrete idea of learning and helped in memorizing contents. This study suggested that laboratory work should not be replaced by other nonpractical approaches, for example, video demonstrations or computer simulations (3). The role and deep concerns about the decline of animal laboratories in physiology curriculum were discussed in yet another study, which highlighted the fact that students would acquire a more thorough understanding of concepts in physiology through the experience of an animal laboratory (14). Practical work when merged with theory in the physiology curriculum in medical schools demonstrated no additional benefits. Yet introduction of theory and practicals as separate curricular subjects had added benefits (17).

In India, the perception of students regarding the role of laboratory work in physiology curriculum in medical education has remained largely unexplored. As per the state university guidelines (15), physiology practicals during the first year of the undergraduate course (preclinical year) involve ~20–30 h dedicated to hematology. These practicals have been designed such that the students perform several experiments to measure hematological parameters using their own blood with a capil-

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lary puncture. A few experiments require a greater amount of blood and are conducted using blood samples obtained from the hospital. All of the experiments are designed with a rationale of strengthening the understanding of physiology of blood. At the end of the hematology practicals, we attempted to capture the perceptions of students on the importance of doing hematology experiments through a questionnaire.

Aim. The aim of this study was to capture the perceptions of students on the importance of doing hematology experiments in physiology practical work.

METHODOLOGY

The program was introduced in a private, not-for-profit, Catholic medical college in Karnataka State of South India. At the time of this study, the college admitted students from all over India through a common National Entrance Eligibility Test. Of these, 10% of students were admitted under All India General Open Merit, 7% under the Institutional Staff Quota, 70% under reservation for Catholics, and the remaining 13% were religious sisters (nuns). All first year Bachelor of Medicine, Bachelor of Surgery (MBBS) students of the academic year 2017–18 ($n = 150$) were included in the study. The study was approved by the Institutional Ethics Committee (IEC Study reference no. 167/2017 vide, IEC letter no. IEC/1/533/2017, dt. 10.07.2017), which granted waiver of consent. The students underwent hematology practicals, conducted as per the state university guidelines, the details of which are given below.

The hematology practicals commenced concurrently with theory classes in hematology. Each practical class lasted for 2.5 h. The students were first given brief instructions, enumerating the objective, principle, description, and demonstration of each experiment with explanation of applied aspects by the faculty. This took ~45 min to 1 h per session. In the next 1.5 h, students performed the experiments to measure various hematological parameters, using either their own blood, obtained by pricking themselves, or blood samples provided to them.

There were 12 hematology experiments that students performed individually, and 4 were only demonstrations. The practicals were conducted in consecutive weekly sessions over a period of 3 mo. Following this, the students attended an internal assessment, which included a practical examination with hematology experiments. In a single session, following the assessment, the students were briefed on the aims and objectives of the study and were requested to fill in a feedback questionnaire. Before the commencement of the study, the questionnaire was validated by peer review and administered as a pilot to 10 students. The internal consistency of item analysis showed good correlation (Cronbach's $\alpha = 0.76$).

The broad areas covered in the questionnaire were as follows: 1) How do students see the importance of "doing" hematology practicals? 2) Does it add to their understanding of the physiology of blood? 3) Do they think they would gain as much if there were only demonstrations of the same practicals? 4) If not, what value does it add to their knowledge, skill, and attitude: why should they "do" rather than simply observe. 5) Do they think practical time could be better used for some other activity, e.g., clinical case discussions, problem-based learning in the same subject area? 6) Are they aware of the objectives of the hematology practical classes? 7) Was it important to perform the experiments with their own blood obtained by pricking themselves? 8) Was it important to test the skills obtained during hematology practicals in the form of assessments? There were 16 questions that were framed to cover the above areas: 2 open ended and 14 fixed response (yes/no). Of the fixed-response questions, 13 required enumeration of reasons for the response, with 1 of them having 3 subquestions. The questionnaire was administered by staff who were not directly involved in future assessments and

examinations for the students. The feedback was made voluntary and anonymous.

Analysis. Quantitative data have been expressed as number and percentage, with sex differences. Data that emerged from open-ended questions were clustered into themes manually by the investigators. For each theme expressed in RESULTS, the values in parentheses indicate the number of responses with sex distribution. Numerical values have not been provided, if responses in line with the theme were too few. Some overlap of responses was observed between themes. Therefore, numerical values under subthemes do not add up to the total responses. The difference in fixed responses was compared using binomial test. The differences in responses across sex were compared using χ^2 test. P value < 0.01 was considered significant.

RESULTS

All 150 students (53 men, 97 women) admitted to the MBBS course were enrolled in the study. All students were Indian residents with a mean age of 19.63 ± 2.3 yr. The regional domicile of the students was as follows: Karnataka (South Indian state where the medical college is situated) = 28, the rest of South India = 93, North India = 13, Central India = 6, East and North East India = 8, West India = 2. Of these, 146 (51 men, 95 women) students filled the feedback questionnaire.

Hands-on versus demonstration. Most of the students ($n = 127$: 46 men, 81 women; 87%; $P < 0.01$) felt that hematology practicals needed to be hands-on, for the "major experiments" (red blood cell count, white blood cell count, absolute eosinophil count, peripheral smear with differential leucocyte count). Some students wished to perform the "minor experiments" (hemoglobin estimation, bleeding time, clotting time, erythrocyte sedimentation rate, blood grouping, osmotic fragility, platelet count, reticulocyte count) as well. The reasons given were as follows: doing hands-on was always more beneficial ($n = 88$: 32 men, 56 women), concentration increased during hands-on practicals ($n = 9$: 2 men, 7 women), learning the technique helped for practice in rural areas ($n = 1$: 1 woman). However, some students favored demonstrations ($n = 17$: 5 men, 12 women; 12%), particularly with the minor experiments, the reasons being that demonstrations were brief and, from an exam point of view, it saved time and blood. Only results mattered for their profession, and not technique.

Understanding physiology of blood. Ninety-six percent of the students ($P < 0.01$; $n = 140$: 49 men, 91 women) felt that "doing" hematology practicals added to the understanding of physiology of blood, as visualizing blood constituents aided better understanding ($n = 52$: 14 men, 38 women), ensured practical application of theory knowledge ($n = 27$: 13 men, 14 women), and enhanced learning ($n = 8$: 4 men, 4 women).

Influence on domains of learning. The students were asked if doing hematology practicals improved their knowledge, psychomotor skills, and attitudes. The responses are detailed in Fig. 1, with the reasons and quotes enumerated in Table 1.

Is pricking necessary? Most students ($n = 126$: 43 men, 83 women; 86%; $P < 0.01$) felt that it was necessary to perform experiments on their own blood obtained by pricking themselves, for which they expressed several reasons: gaining knowledge and skills that help in patient management ($n = 42$: 26 men, 16 women), knowing one's own blood counts first ($n = 23$: 9 men, 14 women), experiencing patients' pain ($n = 19$: 8 men, 11 women), increasing their enthusiasm and eager-

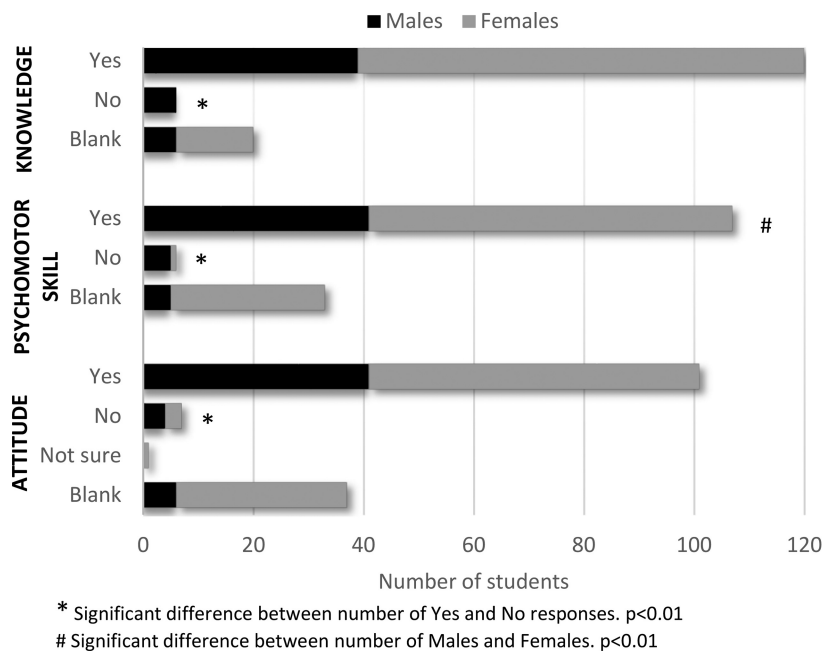


Fig. 1. Responses to the question: Do you think the following areas improve more by doing rather than observing experiments? *Top*: knowledge. *Middle*: psychomotor skills. *Bottom*: attitude.

ness to learn ($n = 8$: 4 men, 4 women), overcoming fear and becoming more confident ($n = 11$: 3 men, 8 women), and being safer than when handling others' blood ($n = 4$: 2 men, 2 women).

Eighteen students preferred blood samples to their own blood, as it did not necessitate pricking and reduced experimental errors.

Relevance of hematology practicals in clinical practice. Eighty-six percent of students ($P < 0.01$; $n = 126$: 45 men, 81 women) believed that the skills they acquired during hematology practicals would prove useful in their careers. The most recurring themes were that their skills could be used in situations where advanced equipment was unavailable ($n = 39$: 13 men, 26 women), and that it would make interpretation of laboratory reports easier ($n = 16$: 2 men, 14 women). Some students believed that the skills would come in handy during emergencies, when there was lack of assistance, in comparison with other techniques, or simply to practice aseptic precautions. Sixteen (6 men, 10 women) students either believed that

the skills acquired during hematology practicals would not prove useful or were unsure.

“You might be working in some rural areas. These simple tests and analysis would better help in diagnosis with minimum costs and technical requirements.”

Female student

Fifty-eight percent of students ($P < 0.01$) felt that the experiments taught in their hematology practicals were not on par with the current laboratory practices.

Continuation for future years. Almost all students ($P < 0.01$; $n = 142$: 50 men, 92 women) wanted hematology practicals to be continued for future batches of first-year MBBS students because it improved theory knowledge ($n = 39$: 8 men, 31 women); it increased practical skills and confidence ($n = 11$: 5 men, 6 women); practicals were “fun” ($n = 7$: 5 men, 2 women); it was useful for future years ($n = 9$: 7 men, 2 women); they wanted their juniors to have the experience of pricking themselves ($n = 7$: 5 men, 2 women); and it

Table 1. *Reasons for improvement in domains of learning*

Knowledge ($n = 120$: 39 men, 81 women; 82%)	Psychomotor Skills ($n = 107$: 41 men, 66 women; 73%)	Attitude ($n = 101$: 41 men, 60 women; 69%)
<ul style="list-style-type: none"> • Deepens the understanding of theoretical concepts • Longer retention in memory: “seeing” and “doing” better than “listening” and “reading” • Repetition of theoretical concepts with greater clarity on practical application • Increased ability to analyze and correlate theory knowledge <p>“When you know how to do a practical there is an obvious increase in knowledge.” (Male student)</p>	<ul style="list-style-type: none"> • Learn fine motor skills • Move beyond merely assuming theory concepts • Learn clinical relevance • Time management • Adapt to phobia of pain due to pricking • Get exposed to different apparatus <p>“Since you prick, pipette, etc. and it all needs to be before the blood clots, it teaches you how to manage time efficiently.” (Female student)</p> <p>“These practicals ... they improve our practical skills [and] will help us in our clinical postings.” (Female student)</p>	<ul style="list-style-type: none"> • Understand the suffering of patients • Become more confident doctors • Develop calmness • Improved concentration • Overcome the fear of pain and blood • Appreciate the work of other professionals like laboratory technicians • Appreciate the clinical relevance of the subject <p>“It helps us to understand the pain that patients undergo during these kinds of tests and help us to empathise with them, we also become more confident...” (Male student)</p>

The no. (n) and percentage of responses is shown, along with the no. of male and female students responding.

allowed for learning manual techniques before learning automated ones.

"Let them also enjoy pricking."

Male student

Take-home message. When asked to state a "take-home message," the students mentioned the following: theory knowledge could be applied to their practicals and clinics ($n = 9$: 1 man, 8 women); attention to details like aseptic precautions and errors in the procedure was necessary ($n = 6$: 2 men, 4 women); "doing" practicals made them experience pain and overcome their fear of needles and provided an insight into patients' experience ($n = 7$: 2 men, 5 women); practicals were like an introduction to blood; and skills learned could be used in rural areas. Twenty-three students (16%, 13 men, 10 women) claimed they did not have any messages. A significant number of students did not respond to this question ($P < 0.01$; $n = 79$: 25 men, 54 women).

"Doing Hematology practicals gives better understanding about the blood and its physiology though it is painful."

Female student

Apart from themes discussed above, the summary of other responses that emerged from analysis have been outlined in Table 2.

DISCUSSION

As per regulations laid down by the Medical Council of India (8), the hematology experiments enable students to interpret results and to distinguish between normal and abnormal values. Not only do these experiments allow for a direct application of the knowledge obtained by students in their hematology theory classes, but they also introduce the students to blood work-ups, on which students rely as they progress to their senior years of medical education. The intent of this study was to explore the effect of the curriculum on the student, which would provide a feedback, allowing us to reflect on the current practices in the curriculum as educators. The study is not intended as a validation of the curriculum or an argument against it.

The feedback from the students uncovered their understanding and opinions about hematology practicals. At the outset, it must be mentioned that this is a compilation of the reflections of students from a single medical college and needs to be further explored across other medical colleges. Yet this is valuable pilot data in an area that was largely unexplored.

On being probed about how "doing" the experiments themselves proved more useful than "simply watching," students believed they had improved on all three domains of learning. Doing experiments had a distinct advantage of improving their knowledge of the subject. It has been found that, with increasing experience, motor skills can be fine-tuned to make one more organized (13). Hematology practicals helped the students become more cautious and confident about handling delicate apparatus. They learned to pay attention to detail and manage time, thus improving their technique. It gave them an insight about errors that could be committed during routine blood tests, affecting their decisions as medical practitioners. There was also a distinct effect on their attitudes, as many students overcame the fear of blood and learned to be calm. More importantly, they understood the value of cooperation

between medical professionals and began to relate to patients' suffering. This is in concurrence with the findings from other studies that conducting practicals as part of a teaching curriculum is aimed at improving knowledge, psychomotor skills, and attitude of students (2).

The most persistent theme that emerged through the students' feedback was that experiments in hematology added to their understanding of the theory, especially if they were doing it themselves. They appreciated the fact that it allowed them to apply their knowledge first hand, validating what was being taught in their classrooms. Visualizing the constituents of blood increased their interest in the subject and eagerness to learn. It helped them retain their concepts better and understand their applications clinically. It was encouraging to find that most students valued their practical knowledge beyond the purview of examinations. They appear to have grasped the importance of first knowing what is "normal" before learning the "abnormal," which forms the basis of teaching physiology (1). This was evident in them wanting to apply ideas gained from their hematology practicals during their clinical training, rural service, or further on in their careers, or simply to help someone interpret laboratory reports. However, it must be highlighted that there were some students who were averse to the idea of pricking themselves, suggesting the use of blood samples. Hence, the practicals could be planned in a way that retains the current format of collection of blood by pricking the fingertip, but reduces the number of times the students need to prick themselves.

In addition to the fact that most students associated the doing of hematology practicals with an increase in knowledge and skill, as described in earlier studies (10), they also stated that experimenting on their own blood obtained by pricking themselves forced them to dwell on the ethical aspects of medical practice and made them more empathetic toward patients. This was a novel finding from our study, revealing that students are trying to relate to patients, through the hematology practicals of their preclinical years, even before having to interact with patients themselves. Although empathy training has been mandated for medical staff in establishments around the world, the debate rages on if empathy is a necessity, since it reduces the chances of dealing with patients objectively (16). Studies have proven that empathy improves quality of life, not only for patients but also for doctors (4). It is a positive sign then that students are open to experiencing what patients go through. However, systematic reviews have shown decline in empathy among medical students as they progress to senior years, and this decline tends to persist through their professional lives (12). Hence it could prove useful to formally include the emphasis on empathy as part of teaching techniques implemented during the senior (clinical) years of the MBBS course.

A recurring theme that emerged as a reply to many questions, although put forward by a minority of students, was the idea that the experiments that they need to perform as part of their hematology curriculum were unnecessary. They believed that they would rarely have the need to perform these tests in their clinical practice, needing only the results. Thanks to the plethora of investigations available to the medical community, there is an increasing reliance on laboratory results among clinicians, reducing their emphasis on intuition and experience (19). It now seems that medical students are conditioning

Table 2. *Description of other related themes*

Question	Responses	
<i>Recall of objectives (open-ended question)</i>		
What do you recall as the university objectives of the hematology practical course? Responders = 72: 29 men, 43 women; 49% Nonresponders = 74; 51%†	<ul style="list-style-type: none"> • To learn the concepts of hematology theory better through hands-on practical experience ($n = 46$: 18 men, 28 women) • To study the composition, principles and properties of blood through experiments ($n = 10$: 3 men, 7 women) • To show the normal and the abnormal (disease) ($n = 6$: 3 men, 3 women) • To equip the students with manual techniques ($n = 5$: 3 men, 2 women) • For the sake of exams 	
<i>Logistics (fixed response with reasons)</i>		
Do you think the time allotted for hematology practicals is sufficient to understand principles used in experiments and theoretical concepts behind them? Nonresponders = 20	Yes ($n = 103$, 34 men, 69 women) <ul style="list-style-type: none"> • Theory background is taught in theory class, so practical time is sufficient. 	No ($n = 23$, 13 men, 10 women)* <ul style="list-style-type: none"> • Major experiments needed more time to understand and perform. • More revision classes were needed. • Slow learners generally needed more time.
Do you think practical time could be better used for some other activity, e.g., clinical case discussions, problem-based learning, in the same subject area? Nonresponders = 9	Yes ($n = 0$)	No ($n = 137$: 49 men, 88 women) <ul style="list-style-type: none"> • Practical time was required to do practicals, which provided a strong foundation ($n = 93$: 34 men, 59 women). • Other activities like clinical case discussion could be added toward the end of practicals ($n = 44$: 15 men, 29 women).
<i>Role of assessments (fixed response with reasons)</i>		
Do you see the usefulness of assessments of these practicals in the university examinations? Nonresponders = 11	Yes ($n = 113$: 37 men, 76 women) <ul style="list-style-type: none"> • To assess subject knowledge and experimental concepts ($n = 8$: 1 man, 7 women) • To assess practical skills and experience ($n = 7$: 4 men, 3 women) • To improve focus, professionalism, seriousness, and confidence. • To refine technique, improve interpretation skills <p>“There are tests that are important for us in clinical practice. So, the university assessment will make us more serious about understanding the experiments.” (Female student)</p>	No ($n = 22$: 11 men, 11 women)* <ul style="list-style-type: none"> • Skills obtained not useful in future ($n = 3$: 3 women). • Knowledge cannot be judged in this manner • Assessments increase anxiety, falsifying of results, and silly mistakes. <p>“Faking results is far easy to do. And errors in present lab conditions are many and therefore these assessments become irrelevant.” (Female student)</p>
During the university examination, do you think you must be assessed based on the “results obtained” at the end of the experiment? Nonresponders = 5	Yes ($n = 35$: 13 men, 22 women) <ul style="list-style-type: none"> • Results do matter ($n = 6$: 1 man, 5 women) • Better way to assess knowledge and skill • Improves accuracy <p>“An experiment without a result doesn’t make much sense.” (Male student)</p>	No ($n = 106$: 37 men, 69 women)* <ul style="list-style-type: none"> • Knowledge of procedure and effort put are more important than the results ($n = 29$: 10 men, 19 women) • Incorrect results using manual methods, despite proper procedure due to: anxiety, phobia of blood, faulty equipment ($n = 29$: 9 men, 20 women). • Encourages manipulation <p>“...[W]hat matters is whether the students know how to do these tests, the theory behind it. ...” (Female student)</p>
If the hematology practical classes were not mandated by the university for the practical exams, would you still think it is necessary to perform the hematology experiments “individually by yourself”? Nonresponders = 4	Yes ($n = 116$: 44 men, 72 women) <ul style="list-style-type: none"> • To gain first-hand knowledge, reinforces theoretical concepts ($n = 42$: 15 men, 27 women) • Improved skills ($n = 13$: 2 men, 11 women) • To learn simple techniques for rural practice ($n = 12$: 6 men, 6 women) • To suggest and interpret investigations ($n = 21$: 7 men, 14 women) • Other/no reasons ($n = 28$: 17 men, 11 women) <p>“Medicine is not just about passing the university exam. It involves someone’s well-being. So, it is definitely necessary to know and do hematology experiments”. (Female student)</p>	No ($n = 26$: 7 men, 19 women)* <ul style="list-style-type: none"> • Practical unnecessary unless mandated • Outdated manual methods unnecessary due to availability of modern techniques • To avoid the pain of pricking • Performing practicals not required to become doctors <p>“First of all, all experiments demonstrated or given were used to perform in earlier days and are irrelevant now. Now we are living in an era of modern scientific experiments which are easy and fast. . .” (Male student)</p>

The no. (n) and percentage of responses is shown, along with the no. of male and female students responding. Note: Number or responses have not been provided if responses in line with the theme were too few. Some overlap of responses is also observed between themes. Therefore, numbers do not add up to the total responses. *Significant difference between “yes” and “no” ($P < 0.01$). †Significant difference between responders and nonresponders ($P < 0.01$).

themselves to be results driven right from their preclinical years. It must be impressed on them that the principle of the experiments and the rationale behind ordering such tests for patients are as important as the technique and the results (20). It would also do well to reassess the present collection of experiments in the syllabus and consider introducing the students to newer techniques used in laboratories, along with the basic set of experiments currently practiced.

The majority of students believed that practical skills acquired during hematology practicals could be utilized in situations where resources were scarce, the rural service for example. In a medical education system that mandates service in rural areas, it is a welcome sign that students are priming themselves for the same, right from the early days of their training, although this could be a result of the importance given to rural service by the educators. On the contrary, another recurring idea was that the experiments were "outdated," as students would rely on improved techniques in their careers. However, this was, once again, quoted by a minority of students.

When asked about the objectives of doing the hematology practicals, 52% of students responded to this question. Of these, most linked doing hematology practicals to "understanding of the physiology of blood," which serves as one of the main objectives of conducting hematology practicals in the first year of MBBS. This implies that these responders did understand the objectives and goals of doing laboratory work in physiology curriculum, as described by earlier educators (9, 10). Notably, 48% did not respond to this question, which could imply that they were unsure of the objectives. This calls for a reinforcement of the objectives by the faculty during the introductory class to hematology practicals, so that learning becomes more meaningful.

The majority of students seemed satisfied with the time allotted for their hematology experiments. Other than some suggestions of extra activities, like case discussions and problem-based learning notwithstanding, most believed the practical hours were best utilized performing experiments after a demonstration of the same. The insistence of students to retain the practicals as experiments to be performed instead of turning them into demonstrations only, especially when it came to experiments that are regarded as difficult (for example: differential count), emphasizes the finding that students would rather spend time doing the experiments themselves. There was a small population of students who found the time allotted insufficient when it came to the difficult experiments. This calls for an evaluation of the current distribution of classes and planning of a schedule involving repetition to improve practical skills.

Studies have proven that assessment in the form of end tests enhances learning in students of medicine as it encourages recall and improves retention (7). The concept that "assessment drives learning" has been widely documented in the education of health sciences (11). Most students were in support of their skills being assessed as part of university examinations for the same reasons. On the flip side, certain students pointed out the disadvantages of having such assessments, most importantly anxiety, leading to forgetfulness and manipulation to obtain ideal results. These have been seen as common faults in conventional methods of laboratory teaching and assessments, which often result in superficial learning (5, 10). Even among

those in favor of examinations, many believed that the assessment must not be based on the end results alone, but also on the application of theory knowledge and the methods practiced. Fortunately, most of the students' concerns can be addressed with the current state university pattern for practical examinations (15), as the system has points allotted for the performance of the practicals and viva voce during the practicals. The final marks do not depend only on the reporting: the skills and knowledge employed by the students to obtain the result are also assessed.

It is interesting to note that, when asked if they had any take-home message, the students gave the same importance to an improvement in their skills and attitude as they did to the attainment of knowledge. It must be noted that around two-thirds of the students either did not respond to the question, or stated that they did not have any take-home message. This could be taken to indicate that some students consider the hematology practicals/physiology as just another subject to learn in the vast curriculum, treating it with an objective indifference.

Almost all students wished for the hematology practicals to be continued for future MBBS batches, which can be taken as an indication of positive acceptance of the course as a useful part of their curriculum. Several students were specific that the practicals must be continued in the same pattern in which students do experiments by themselves using blood obtained by pricking. Although this may be perceived as a means of retribution, most reasons stated by students imply that they wanted future medical students to enjoy the same advantages they experienced through the course of their hematology practicals.

Limitations. Since this study involves obtaining perceptions about a part of the university curriculum, there is a tendency among students, who are a vulnerable population, to modify their responses as is expected and favorable (21). To minimize this effect, the investigators took several measures. The feedback process was kept voluntary and anonymous, and students were encouraged to give honest opinions. There were certain questions that had a significant number of nonresponders. This may be due to a lack of clarity in the questions (e.g., the responses when students were asked if they had any take-home message) or simply for the sake of not responding. There were many nonresponders to the question on recall of the objectives of the hematology practical course. However, their responses to other questions were remarkably in line with the objectives behind the practical. For instance, in response to more than one question, the recurring theme that emerged was that the hematology practicals helped students increase their knowledge of physiological phenomena. This suggests that the lack of response to the above-mentioned question may have been since students were unable to reproduce the objectives verbatim.

As stated earlier, these findings explore the mindset of students from only a single medical college. As a continuation to this study, similar data could be pooled from more than one college to look for common trends and differences. Even so, a bias may exist if perceptions of only first-year students are considered. Hence it may be worthwhile to capture feedback from students in senior years of medical college to have a more unbiased opinion about the importance of hematology practicals.

Conclusion. The study provided both positive and negative reflections on the importance of “doing” hematology experiments from a single institution. Majority of the students felt that doing hematology practical work was necessary, as it not only improved their knowledge and skills but largely molded their attitude toward being empathetic and confident doctors. A timely relook at the course details may be necessary for further refinement of the course work.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

S.D. conceived and designed research; S.D. and T.A. performed experiments; S.D. and T.A. analyzed data; S.D. and T.A. interpreted results of experiments; S.D. and T.A. prepared figures; S.D. drafted manuscript; S.D. and T.A. edited and revised manuscript; S.D. and T.A. approved final version of manuscript.

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