

Evaluation of Laboratory Medicine Teaching and Learning by Medical Students in Hybrid Integrated Curriculum. Data from Public Malaysian University

Muhamed Osman^{1*}, Ariza Adnan², Methil Kannan Kutty³, Redhwan A. Al-Naggar⁴

^{*1} Associate Professor, Department of Pathology, Faculty of Medicine & Defence Health, University Pertahanan National Malaysia (UPNM), Kem Sungai Besi, 57000, Kuala Lumpur, Malaysia.

² Associate Professor, Cluster of Laboratory Medical Sciences, Faculty of Medicine, Universiti Teknologi MARA (UiTM), Malaysia.

³ Professor, Cluster of Laboratory Medical Sciences, Faculty of Medicine, Universiti Teknologi MARA (UiTM), Malaysia.

⁴ Associate Professor, Population Health and Preventive Medicine Department, Faculty of Medicine, Universiti Teknologi MARA (UiTM), Malaysia.

Received: April 14, 2014

Accepted: May 20, 2014

ABSTRACT

There is an opinion states very little attention paid to laboratory medicine subjects in medical school curricula. The curriculum at Faculty of Medicine, UiTM Malaysia was recently modified to become an integrated hybrid curriculum. This study was conducted to assess the teaching and learning processes of laboratory medicine subjects (Pathology, Medical Microbiology, and Parasitology) in model of hybrid integrated curriculum through an analysis of perceptions of individual medical student at the end of the preclinical years (Year2). 191 students out of 235 Year 2 medical students of batch 2012-2013 were participated in this study. The mean age of the participants was 20.97 ±0.50. Majority of the students agreed that there are clear objectives for pathology, microbiology, and parasitology subjects in year 1 and year 2 and the teaching of these subjects enhanced their motivation to learn (89.5%, 92.7%, 93.2%, 82.2%, 73.3%, 86.9%; respectively). Furthermore, the majority of the students were satisfied with the organizational structure of the integrated approach of pathology, microbiology and parasitology (71.7%, 73.8%, and 83.2%; respectively). In the current study, majority of UiTM students reported that laboratory medicine in the new integrated curriculum used a variety of learning strategies that worked for them and more than 80% of participants agreed that the distribution of laboratory medicine classes helped them to understand concepts of basic pathological processes which helped them to better understand and it was reflected in their good performance in their progress tests at the end of the Year 1 and Year2. Our results revealed that majority of the students (77.5%) were satisfied with the integrated structure of laboratory medicine teaching, and majority of participants reported that they understood and learnt a good deal of pathology, microbiology and parasitology subjects in year 1 and year 2 (73.8%, 71.7%, 82.2%; respectively).

KEYWORDS: Pathology, Microbiology, Parasitology, laboratory medicine, integrated curriculum.

INTRODUCTION

A burgeoning body of education research has indicated that incorporating active learning strategies improves understanding and learning [1-3].The major benefits include fostering development of critical thinking, communication, and cooperative learning skills and attitudes and values [4]; promoting concept formation; providing an avenue for discovering misconceptions ; and enhancing motivation. [1, 5]

Laboratory Medicine is the field of study that applies and utilizes the scientific investigation to diagnose, treat or better understand disease processes. However, there is an opinion states very little attention paid to laboratory medicine subjects in medical school curricula, because these subjects remain entrenched in standard medical school curricula, while modern medical education has moved in paradigm shift toward the molecular basis of disease and toward more refined methods of diagnosis and therapy. [6]

Faculty of Medicine, Universiti Teknologi MARA (UiTM) Malaysia, is a relatively new public medical school in Malaysia, founded in 2003 with an intake of 20 students. The intake dramatically increased over the years to 235 students in the academic session 2012/2013 which is one of the largest intakes among other Malaysian public medical schools. From its inception in 2003 until 2010, the medical training begins with the basic sciences

* **Corresponding Author:** Muhamed Osman, Associate Professor, Department of Pathology, Faculty of Medicine & Defence Health, University Pertahanan National Malaysia (UPNM), Kem Sungai Besi, 57000, Kuala Lumpur, Malaysia. Email: mtosman2004@gmail.com Tel:0060390513400

disciplines where the students studied the basic subjects in Human Anatomy, Biochemistry and Physiology in Phase I (Year 1) for two semesters lasting 12 months, and Pathology, Medical Microbiology, Medical Parasitology, and Pharmacology in Phase II (Year 2) for another two semesters of 12 months. From 2010 onwards, the curriculum was modified to become an integrated hybrid curriculum. At present, the Year 1 and Year 2 students are taught all basic medical sciences subjects including laboratory medicine subjects. Examinations are conducted at the end of semester 1 and semester 2 (year 1) and at the end of semester 4 (Year 2); which is known as the Pre-Clinical Professional Examination.

Cluster of Laboratory Medical Sciences is a modern academic department in the Faculty of Medicine, UiTM based at Sungai Buloh Campus, Selangor, Malaysia. The cluster encompasses teaching of Pathology, Medical Microbiology, and Medical Parasitology as well as Forensic Medicine. The total number of academic staff in the cluster is 42, and contributes significantly to the new undergraduate integrated hybrid curriculum in medical education in way of lectures, practicals, tutorials, and museum sessions in addition to problem based learning (PBL) sessions and elective projects.

As educators involved in the integration curriculum which was introduced four years ago; we worked hard to render laboratory medicine subject a core part of our school curriculum. We tried to recognize and acknowledge that omitting the topic from the curriculum creates a major gap in the knowledge and competency of medical students.

Pathology and laboratory medicine developed rapidly during the 20th century and are likely to develop even more rapidly in the 21st century. Laboratory physicians are expected to provide the best in patient care in addition to teaching and research.

Needless to rectify that laboratory medicine subjects are crucial for physicians, but it is invariably perceived as dry, volatile by the medical students. Active teaching-learning techniques in laboratory medicine disciplines are required to increase the interaction and interest among the students. Therefore; as laboratory medicine educators we are face in the question; "Does this integrated model enhance the teaching and learning environment by providing the continuum that help students to recognize and appreciate the value of the unique role of laboratory medicine as an underlying foundational knowledge of the pathogenesis, diagnosis, and management of diseases before proceeding to the clinical years?" In order to answer this question, we conducted this study with main objective is to assess the teaching process of laboratory medicine subjects in our model of hybrid integrated curriculum through an analysis of perceptions of individual medical student at the end of the preclinical years (Year 2) in the Faculty of Medicine, UiTM. The specific objectives are to assess the teaching process of each subject of three disciplines (Pathology, Microbiology, and Parasitology) of laboratory medicine cluster in this model of hybrid integration curriculum.

MATERIALS AND METHODS

A convenience sampling was used in the study. A self-administered questionnaire was used. All Year two medical students (batch 2012-2013) of the Faculty of Medicine from Universiti Teknologi MARA (UiTM) Malaysia were invited to participate in this study.

The questionnaire comprises three parts: Part A; a list of general questions about laboratory medicine teaching and learning in general (11 questions); Part B; a list of specific questions about each one of the three major subjects of laboratory medicine, e.g. Pathology (including Anatomical Pathology, Haematopathology, and Chemical Pathology), Medical Microbiology, and Medical Parasitology (21 questions); and Part C; there were open ended questions (3 questions) about each subject of the laboratory medicine being surveyed in order to gather more in depth perspectives in depth of the participant's thoughts. The study protocol was approved by Cluster of Laboratory Medical Sciences at Faculty level.

Verbal consent was taken from each student participating in the study after explaining the purpose of the study. Participation in the study was voluntary and the identity of each student was anonymous. Inclusion criteria: All Year 2 medical students at the end of semester 4 (last semester before proceeding to clinical years), and willing to participate in the study. The questionnaire was administered during class time. A slot of self directed learning (SDL) class was chosen after a lecture to ensure compliance and completion of the task.

The initial introduction and brief explanation of the study was done by the researchers that the research instrument is mainly devised to improve course construction, course delivery and student learning environment with active student input, and it is not the intent to have any specific information in data file to link with specific participants. After the brief explanation, the researchers left the lecture hall for the students to complete the questionnaire. A designated personnel was responsible for the final collection of all questionnaires, that were then delivered to the researcher's office for detailed analysis.

Participants were not being asked questions that are personal or sensitive. The research questionnaire procedure were not likely to induce embarrassment, humiliation, lowered self esteem, guilt, conflict, anger, distress,

or any other negative emotional state. There was no social risk and was not infringe on the rights of participants by restricting access to education. Participants did not receive compensation of any type.

All data were analyzed using the Statistical Package for Social Sciences (SPSS) version 15. Descriptive analysis was used in this study.

RESULTS

191 students out of 235 students which is the total number of Year two medical students of batch 2012-2013 at Faculty of Medicine, UiTM Malaysia, were participated in this study. The mean age of the participants was 20.97 ±0.50; the minimum age was 20 years and maximum was 25 years. The majority of the students were 21 years old (89.5%) (Table 1).

Table 1: Sex and age of the year two medical students participated in this study (n=191)

| | Year | No. | % |
|-----|--------|-----|------|
| Sex | Male | 53 | 27.7 |
| | Female | 138 | 72.3 |
| Age | 20 | - | - |
| | 21 | 16 | 8.4 |
| | 22 | 171 | 89.5 |
| | 23 | 2 | 1.0 |
| | 24 | 1 | 0.5 |
| | 25 | 1 | 0.5 |

For teaching of laboratory medicine in general, the majority of the students (72.8%) agreed that laboratory medicine teaching used a variety of learning strategies that worked for them. In addition, the majority of them (80.6%) agreed that laboratory medicine teaching helped them to understand the concepts of basic pathological processes in relation to their physiological and anatomical basis. A majority of them agreed that laboratory medicine teaching encourage them to study independently, to be an active participant in their learning and provided them with opportunities for interpersonal learning activities (61.3%, 60.7%, 70.7%; respectively). Meanwhile, less than half of the participants (34%) reported that laboratory medicine teaching in the integrated curriculum increase their stress (table2)

For the assessment, the majority of the participants (62.8%) agreed that the organizational structure of integrated laboratory medicine teaching helps them to better understand and solve Progress Test questions at the end of each modules in year1 and year2. (table2)

Regarding the satisfaction of the students about laboratory medicine, the majority of the participants (77.5%) were satisfied with the integrated structure of laboratory medicine teaching.

Overall, students agreed that Laboratory medicine teaching provides them a better understanding of the career proposals in laboratory medicine and agreed that what they learn at present will be relevant in their future training (60.7%, 77.5%; respectively). (table2)

Table 2: Student's assessment for the laboratory medicine subjects in general (n.191)

| Q. | Items | Yes n (%) | No n (%) | Not sure n (%) |
|----|---|--------------|-------------|-------------------|
| 1 | Laboratory medicine teaching uses a variety of learning strategies that work for me. | 139 (72.8) | 14 (7.3) | 38 (19.9) |
| 2 | Laboratory medicine teaching helps me understand concepts of basic pathological processes in relation to their physiological and anatomical basis. | 154 (80.6) | 14 (7.3) | 23 (12.0) |
| 3 | Laboratory medicine teaching has contributed to my overall educational growth and development in Y1 & Y2. | 142(74.3) | 9 (4.7) | 40 (20.9) |
| 4 | Laboratory medicine teaching encourages my independent study. | 117 (61.3) | 23 (12) | 51 (26.7) |
| 5 | Laboratory medicine teaching provides me with opportunities for interpersonal learning activities. | 135(70.7) | 15 (7.9) | 41 (21.5) |
| 6 | Laboratory medicine teaching in integrated curriculum encourages me to be an active participant in my Y1 &Y2 learning. | 116 (60.7) | 17 (8.9) | 58 (30.4) |
| 7 | Laboratory medicine teaching provides me an opportunity of the choice in the work to be done in clinical years. | 116 (60.7) | 23 (12) | 52 (27.2) |
| 8 | Laboratory medicine teaching in this integrated curriculum has increased my stress load. | 65 (34) | 76 (39.8) | 50 (26.2) |
| 9 | The organizational structure of integrated laboratory medicine teaching helps me to better understand and solve Progress Test questions of all Y1 & Y2 modules. | 120 (62.8) | 22 (11.5) | 49 (25.7) |
| 10 | Laboratory medicine teaching has shown me how much of what I learn today seems relevant to my future training for a career as doctor. | 148 (77.5) | 13 (6.8) | 30 (15.7) |
| 11 | Overall I am satisfied with the integrated structure of laboratory medicine teaching as an independent with other subjects in integrated curriculum. | 133(69.6) | 12 (6.3) | 46 (24.1) |

Majority of the students agreed that there are clear objectives for pathology, microbiology, and parasitology subjects in year 1 and year 2 and the teaching of these subjects enhanced their motivation to learn (89.5%, 92.7%, 93.2%, 82.2%, 73.3%, 86.9%; respectively). Furthermore, the majority of the students were satisfied with the organizational structure of the integrated approach of pathology, microbiology and parasitology (71.7%, 73.8%, and 83.2%; respectively), (table 3).

For the contact teaching time, majority of the participants agreed that teaching time of microbiology and parasitology was adequate (72.8%, 81.2% ; respectively). However, only 60.7% of participant agreed the time for pathology was adequate (table3).

About 39.8%, 36.6% and 47.6 of the participants reported that they rarely felt bored in pathology, microbiology, and parasitology classes respectively.

With regards to the progress test at the end of each module, majority of the students reported that pathology, microbiology and parasitology progress tests questions for all modules emphasize application of knowledge rather than simple recall of factual knowledge (64.9%, 61.3%, 66%; respectively).

Overall, majority of the students reported that they understood and learnt a good deal of pathology, microbiology and parasitology subjects in year 1 and year 2 (73.8%, 71.7%, 82.2%; respectively) (table3).

Table 3: Student's assessment for each subject of laboratory medicine (n.191)

| N | Items | Yes n (%) | No n (%) | Not sure n (%) |
|----|--|--------------|-------------|-------------------|
| 1 | There are clear objectives of Pathology classes in Y1 & Y2 | 171 (89.5) | 6 (3.1) | 14 (7.3) |
| 2 | There are clear objectives of Microbiology classes in Y1 & Y2 | 177 (92.7) | 4 (2.1) | 10 (5.2) |
| 3 | There are clear objectives of Parasitology classes in Y1 & Y2 | 178 (93.2) | 4 (2.1) | 9 (4.7) |
| 4 | Pathology teaching classes enhance my motivation to learn. | 157 (82.2) | 5 (2.6) | 29 (15.2) |
| 5 | Microbiology teaching classes enhance my motivation to learn. | 140 (73.3) | 21 (11) | 30 (15.7) |
| 6 | Parasitology teaching classes enhance my motivation to learn. | 166(86.9) | 13 (6.8) | 12 (6.3) |
| 7 | I am satisfied with the organizational structure of the integrated approach of Pathology teaching. | 137 (71.7) | 15 (7.9) | 39 (20.4) |
| 8 | I am satisfied with the organizational structure of the integrated approach of Microbiology teaching. | 141 (73.8) | 15 (7.9) | 35 (18.3) |
| 9 | I am satisfied with the organizational structure of the integrated approach of Parasitology teaching. | 159 (83.2) | 7 (3.7) | 25 (13.1) |
| 10 | The contact teaching time of Pathology classes is enough. | 116 (60.7) | 38 (19.9) | 37 (19.4) |
| 11 | The contact teaching time of Microbiology classes is enough. | 139 (72.8) | 22 (11.5) | 30(15.7) |
| 12 | The contact teaching time of Parasitology classes is enough. | 155(81.2) | 17 (8.9) | 19 (9.9) |
| 13 | I am rarely bored in Pathology classes in integrated curriculum. | 76 (39.8) | 71 (37.2) | 44 (23) |
| 14 | I am rarely bored in Microbiology classes in integrated curriculum. | 70 (36.6) | 69 (36.1) | 52 (27.2) |
| 15 | I am rarely bored in Parasitology classes in integrated curriculum. | 91 (47.6) | 62 (32.5) | 38 (19.9) |
| 16 | The Pathology Progress Test questions for all modules emphasize application of knowledge rather than simple recall of factual knowledge. | 124 (64.9) | 26 (13.6) | 41 (21.5) |
| 17 | The Microbiology Progress Test questions for all modules emphasize application of knowledge rather than simple recall of factual knowledge. | 117 (61.3) | 32 (16.8) | 42 (22) |
| 18 | The Parasitology Progress Test questions for all modules emphasize application of knowledge rather than simple recall of factual knowledge. | 126 (66) | 28 (14.7) | 37 (19.4) |
| 19 | Overall I am learning with understanding Pathology classes as a great deal in Y1& Y2. | 141(73.8) | 11 (5.8) | 39 (20.4) |
| 20 | Overall I am learning with understanding Microbiology classes as a great deal in Y1& Y2 . | 137 (71.7) | 13 (6.8) | 40 (20.9) |
| 21 | Overall I am learning with understanding Parasitology classes as a great deal in Y1& Y2. | 157 (82.2) | 8 (4.2) | 26 (13.6) |

DISCUSSION

The benefits of this study include active student involvement in the assessment of the laboratory medicine subjects i.e; pathology, medical microbiology and parasitology in UiTM integrated curriculum through their feedback on the learning and teaching of laboratory medicine in general and about each specific subject, in order to get their input into the evolving changes with redesign and realignment of the Faculty curriculum. Student responses in this qualitative evaluation showed that they perceived that their learning of laboratory medicine was aided by different disciplines of delivery. Furthermore the evaluation process itself engaged the students for the betterment of the curriculum. The overall positivity of responses indicates that students had a degree of ownership of the learning tool and that its implementation had been responsive to learner needs [7].

To educate effectively, education must be able to assume that graduates of professional programs have the knowledge and competency to be successful in their programs. Attaining this common body of knowledge is what curricula are designed to provide and tiered examinations are designed to assess. It is also assumed that these curricula, examinations, and degrees are in some way designed in an integrated and cohesive manner to ensure that students receive an education that will prepare them for the current state of training and, eventually, practice [8]. These form the basis of our new integrated curriculum on laboratory medicine, in the faculty of medicine UiTM.

In the current study, majority of UiTM students reported that laboratory medicine in the new integrated curriculum used a variety of learning strategies that worked for them and more than 80% of participants agreed that the distribution of laboratory medicine classes helped them to understand concepts of basic pathological processes which helped them to better understand and it was reflected in their good performance in their progress tests at the end of the Year 1 and Year2 (table 2). This is an important finding since many results from other studies [8-12] reported that residents in clinical specialties do not acquire the necessary knowledge about laboratory medicine to be able to request relevant investigations and interpret laboratory tests in the most effective way, or others thought that their knowledge is so little in all branches of laboratory medicine. Indeed the explanation of this lack of knowledge is probably due to the way in which the residents learn clinical medicine as a separate entity from subjects and focuses only on the care of individual patients in specific clinical specialization. In addition, their learning is largely limited to the use of laboratory tests in the evaluation of specific disorders, without any formal training in the relative strengths and weaknesses of different tests, their comparative performance characteristics and limitations of the test [8]. It is vital that students obtained satisfaction (77.5% of them in this study) about their teaching and learning of laboratory medicine subjects in order for their benefit and utilize the knowledge during their residency years. Hence majority of UiTM students agreed that Laboratory medicine teaching provides them the knowledge required in clinical years and agreed that what they learn now will be relevant to their future training (table2). We are optimistic that our teaching of laboratory medicine in this way will prepare our students to better subjects and they will be able to correlate laboratory medicine and clinical medicine. [9, 13].

As educators, we wanted to be sure that the graduating medical student from UiTM should be able to describe the uses and interpret of metabolic testing; including electrolytes, acid-base balance, osmolality, and blood gases. Meanwhile, graduating students should be able to outline and interpret all hematological tests with ability to evaluate both cellular and chemical of body fluids as part of hematopathology. Moreover graduating medical students should be able to describe the most frequent agents (bacterial, viral, fungal, parasitic) causing infections in different body sites or systems and explain how an understanding of bacterial, parasitic, and viral pathogenesis impacts sample choice and test interpretations. Results from current study revealed that the students were satisfied with the outcomes of the teaching and learning objectives for pathology, microbiology, and parasitology subjects in Year 1 and Year 2 and the teaching of these subjects enhanced their motivation to learn and majority of them were satisfied with the organizational structure of the integrated approach of pathology, microbiology and parasitology (table 3). These results were consistent with many other studies that mentioned the aims from the curriculum of laboratory medicine [14-23]

In the present study, around three quarters of the students reported that contact teaching time is adequate for microbiology and parasitology classes, while 60.7% were satisfied with the allocation for pathology (table 3). This could possibly due to pathology involves all branches of pathology and this affect the ability of students to react well with pathology classes within current contact teaching time. This finding could form a basic increase the contact teaching time for pathology in the future. More time could be allocated for directed self learning, museum sessions and pathology input in problem based learning sessions. This is consistent with other researchers [24-26] who mentioned; to achieve the best result for education, we always have to propose drastic reductions in passive lecture hours and preparing a more problem-based curriculum. Therefore, the strategy of using multiple teaching methods can help students develop different learning preferences and enjoy their learning experience [24].

The present study showed majority of the students reported that they are learning with understanding pathology, microbiology and parasitology subjects in a great deal based on the present curriculum (table3). We believe that to acquire in-depth knowledge in laboratory medicine principles is vital to all future doctors. This knowledge starts from having a solid undergraduate curriculum and having proper implementation. Medical school should establish the goals and objectives of laboratory medicine and experiment with optimal teaching and assessment methods.

Limitation of the Study: In this study we have studied only one batch of one Malaysian medical school, however, for better students assessment results of teaching and learning of laboratory medicine, student feed back from different medical schools would be required.

Conclusions: Majority of UiTM Year 2 medical students (77.5%) were satisfied with the integrated structure of laboratory medicine teaching, and majority of participants understood and learnt a good deal of pathology,

microbiology and parasitology subjects in year 1 and year 2. Results from current study revealed that the students were satisfied with the outcomes of the teaching and learning objectives for pathology, microbiology, and parasitology subjects in Year 1 and Year 2.

Acknowledgements

The authors would like to thank all Year 2 students, Batch 2012/2013, Faculty of Medicine, Universiti Teknologi MARA Malaysia for their highly cooperation to answer study's questionnaire.

Conflicts of interest:

No financial or other relationships that might lead to a conflict of interest.

REFERENCES

1. Anurag Saxena, Raenelle Nesbitt, Punam Pahwa, and Sheryl Mills, 2009. Crossword Puzzles: Active Learning in Undergraduate Pathology and Medical Education. *Archives of Pathology & Laboratory Medicine*, 133 (9):1457-1462.
2. Dunne D, Brooks K, 2004. *Teaching with Cases*. Halifax, NS: Society for Teaching and Learning in Higher Education.
3. Svinicki M, 2004. *Learning and Motivation in the Postsecondary Classroom*. Bolton, MA: Anker Publishing.
4. Bligh D, 2000. *What's the Point in Discussion?* Exeter, England: Intellect Books.
5. Bransford J, Brown A, Cocking R, eds, 2000. *How People Learn: Brain, Mind, Experience, and School*. Washington, DC: National Research Council, National Academy Press.
6. Cooke M, Irby DM, Sullivan W, et al., 2006. American medical education 100 years after the Flexner Report. *N Eng J Med.*, 355:1339-1344.
7. Moira A. L. Maley, Jennet R. Harvey, W. Bastiaan de Boer, Nathan W. Scott & Gina E. Arena, 2008. Addressing current problems in teaching pathology to medical students: blended learning. *Medical Teacher*, 30: e1–e9.
8. Michael L. Wilson, 2010. Educating Medical Students in Laboratory Medicine. *Am J Clin Pathol.*, 133:525-528
9. Smith B, Agüero-Rosenfeld M, Anastasi J, et al., 2010. Educating medical students in laboratory medicine: a proposed curriculum. *Am J Clin Pathol.*, 133:533-542.
10. Green ML, Ciampi MA, Ellis PJ., 2000. Residents' medical information needs in clinic: are they being met? *Am J Med.*, 109:218-223.
11. van Walraven C, Naylor CD., 1998. Do we know what inappropriate laboratory utilization is? a systematic review of laboratory clinical audits. *JAMA.*, 280:550-558.
12. Gottfried EL, Kamoun M, Burke MD., 1993. Laboratory medicine education in United States medical schools. *Am J Clin Pathol.*, 100:594-598.
13. Kumar K, Indurkha A, Nguyen H., 2001. Curricular trends in instruction of pathology: a nationwide longitudinal study from 1993 to present. *Hum Pathol.*, 32:1147-1153.
14. Holland L, Bosch B., 2006. Medical students' perceptions of pathology and the effect of the second-year pathology course. *Hum Pathol.*, 37:1-8.
15. Bezuidenhout J, Wasserman E, Mansvelt E, et al., 2006. Clinical rotation in pathology: description of a case based approach. *J Clin Pathol.*, 59:355-359.
16. Guidi GC, Lippi G., 2008. Undergraduate education in laboratory medicine. *Clin Chim Acta.*, 393:9-12.
17. Bergus G, Vogelgesang S, Tansey J, et al., 2004. Appraising and applying evidence about a diagnostic test during a performance-based assessment. *BMC Med Educ.*, 4:20.

18. Bruns DE., 2008. Improving training in laboratory medicine. *Clin Chim Acta.*, 393:3-4.
19. Elnicki DM, Taylor HL., 1997. An interdisciplinary approach to teaching clinical laboratory skills to medical students. *Acad Med.*, 72(suppl 1):S60-S62.
20. Holck S, Junge J, Hansen U, et al., 2007. Medical students' perception of pathology [letter]. *Hum Pathol.*, 38:384-385.
21. Simon TL., 1989. Comprehensive curricular goals for teaching transfusion medicine. Curriculum Committee of the Transfusion Medicine Academic Award Group. *Transfusion.*, 29:438-446.
22. Jones A, McArdle PJ, O'Neill PA., 2002. Perceptions of how well graduates are prepared for the role of pre-registration house officer: a comparison of outcomes from a traditional and an integrated PBL curriculum. *Med Educ.*, 36:16-25.
23. Park YA, Marques MB., 2007. Teaching medical students basic principles of laboratory medicine. *Clin Lab Med.*, 27:411-422.
24. Chinmay Shah, Shailesh Patel, Jasmin Diwan, Hemant Mehta., 2012. Learning Habits Evaluation of First M.B.B.S Students of Bhavnagar Medical College. *International Journal of Medical Science and Public Health*, 1(2): 81-86.
25. Murphy RJ, Gray SA, Straja SR, Bogert MC., 2004. Student learning preferences and teaching implications. *Journal of Dental Education.*, 68: 859-66.
26. Lujan HL, Dicarolo SE., 2006. First year medical student prefer multiple learning habit advance physiological education., 30: 13-16.