



Original Research Article

Digitalising Urology: Role of Learning Management System (LMS) in Teaching, Learning, and Assessment in Three Urological Modules of Post-Graduate Residents

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Name of Author:

Faiza Hayat¹, Saifullah Khan², Liaqat Ali³, Qudrat Wazir⁴, Brekhna Jamil⁵, Nazma Hayat⁶ and Raza Dawar⁷

Affiliation: ¹Consultant urologist Urology Department Institute of kidney disease Peshawar Peshawar

²Consultant urologist Urology Department Institute of kidney disease Peshawar Peshawar

³Professor of Urology Institute of Kidney Diseases, Hayatabad Medical Complex Peshawar Pakistan

⁴Consultant urologist Institute of kidney disease Peshawar

⁵Associate Professor Director IHPER Khyber Medical University Peshawar Pakistan

⁶Peshawar institute of cardiology

⁷Lecturer Anatomy kohat institute of medical sciences Khyber medical university Peshawar

Corresponding Author:

Saifullah Khan

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Abstract: **Background:** Medical education is an art that crafts the teaching of sciences. The era of COVID has taught us dealing with new challenges and exploring the venues for distant learning. Learning management system in educational environment is an encouraging tool in distant learning in all domains of teaching, learning, assessment and use. **Objective.** 1. To identify the benefits of using LMS in delivering urological modules to postgraduate residents 2. To determine the effectiveness of LMS in the assessment of postgraduate residents' learning. 3. To examine the perceptions of postgraduate residents on the use of LMS in urological modules **Ethics and consent statement:** Ethical approval was taken from ethical committee of Institute of Kidney Diseases, HMC and institute of health professional education and research, IHPER, according to Helsinki declaration. Informed consent was taken from all the subjects including the patients or simulated patients and /or their guardian(s) in the consent for publication of information /images / videos in an online open access publication. **Methods:** It is a descriptive study that was conducted in department of Urology Institute of Kidney Diseases Peshawar Pakistan and IHPER Khyber medical University Peshawar. 188 Urology residents from Pakistan and abroad were registered in the study. Asynchronous method of teaching was adopted in four modules. Formative and summative assessments were carried out in all modules. Perception of residents about effectiveness of LMS from resident was taken as feed back from all residents. All the data was recorded on structured proforma and was analyzed on SPSS. **Results:** Among 188 residents, 161 (86%) were male and 27(14%) were female. 52% of residents were in their final year of residency. 93 percent of residents were from Pakistan while 7 percent were from India and UK. 154 lessons were taught in asynchronous way of teaching. Comparative analysis showed that the mean pre and post course quiz results were statistically significantly different (p -value $t=9.12 <0.001$). Similarly Assignment test were statistically significantly different (t test $2.19, <0.001$). There was no significant difference in pre and post test regarding gender, center of training and year of training ($p>0.05$). The linear regression test showed significant difference in favor of LMS as positive perceptions in form strongly agreed for effectiveness of LMS in teaching, assessment and perception ($p=0.001$) **Conclusion:** The Learning management system in Urology is an effective tool in teaching, learning and assessment of post graduate residents. There is a favorable perception for the use of LMS among residents of Urology

Keywords: Learning management system, Urology, Medical education, Distant learning.

INTRODUCTION

Medical education has had a significant change in recent years towards technology-enhanced learning.

There has been tremendous development in revolutionizing medical education during the last two decades¹This attributes to the inclination towards e-learning in educational institutions due to covid

pandemic. This also includes the performance evaluation which is the most critical component of e-learning². For the first time, all educational activities were halted for a good few years, and the LMS system was introduced. It automates the administration, tracking, and reporting of training events and delivers learning content rapidly³. The emergence of Learning Management Systems (LMS) has greatly changed the way medical education is delivered, providing an efficient and effective platform for online learning, teaching, and assessment. It provides a platform for the efficient delivery of educational content, organization of resources, and facilitation of communication between educators and learners⁴. The pandemic of COVID 19 has taught us several lessons. Keeping in view the fact, that the post-graduate training in Pakistan is time-bound not competency bound, this challenge of COVID-19 has transformed medical education from face-to-face learning to hybrid and then complete online distance learning. During the hard lockdown, physical and social distancing was adopted as measures to decrease the transmission of the virus in dense populations such as higher education institutions⁵. There is an overall 69% effectiveness of LMS in students who achieved their target by utilizing LMS and is an effective tool for enhancing urologic education, improving perceived learning outcomes, and facilitating performance assessment⁶. A single-center survey shows medical students' perception regarding the LMS and provided e-learning tools. LMS is mostly used for study information (68.3%), exam preparation (63.3%), and lessons (54.5%). Clarity (98.3%), teaching-related stuff (92.5%), and friendly use of e-learning offers (92.5%) were ranked the highest.⁷

The term distance education was initially introduced in 1971 and was later accepted by the International Council for Correspondence Education in 1972. A review of the two recent mainline e-Learning projects in the European Union, namely the e-Learning Action Plan, and the e-Learning Program have been fully supported by the European Commission, which provided the necessary infrastructure and equipment, teacher training, encouragement, cooperation, delivery of useful services, and promotion of digital literacy. There are different tools of learning management systems including Moodle, Segue, Interact, Course Work, Atutor, KEWL, etc. Collaborative learning is one of the important objectives of all LMS systems.^{8,9} There has been a great deal of research on collaborative technologies in medical education. The initial results of the literature about the use of LMS in medical education are encouraging but still, there are questions about tackling learning issues the novice in digital learning

versus the expert in medical education. There is a disparity in the existing literature about the acceptance, perception, and effectiveness of the LMS system in medical education for both stakeholders of students and supervisors respectfully.

Although there is a curriculum of Urology by the College of Physicians and Surgeons Pakistan. However, The original training program in urology is very diverse according to available resources among different accredited institutes. This variation in training is observed in all learning domains of knowledge, skills, and affective domain respectively. This need assessment was felt eagerly by supervisors and medical teachers to standardize the teaching Programme across the country.^{10,11} The Department of Urology Institute of Kidney Disease took a lead in structuring the curriculum in nine urological modules. It then developed a multi-modal learning management system and encouraged the residents across the country and abroad to be part of LMS. The rationale of the study is based on the research question about the effectiveness of LMS in urology as a distant learning system in presence of existing traditional learning systems.

OBJECTIVES

1. To identify the benefits of using LMS in delivering urological modules to postgraduate residents
2. To determine the effectiveness of LMS in the assessment of postgraduate residents' learning
3. To examine the perceptions of postgraduate residents on the use of LMS in urological modules

OPERATIONAL DEFINITIONS

LEARNING MANAGEMENT SYSTEM (LMS): It is defined as software that automatically do administer, tracking, reporting of the events, assessment and delivers learning contents rapidly

ROLE of LMS: The term "role" refers to the function or contribution that the Learning Management System (LMS) can have in the teaching, learning, and assessment of urological modules for postgraduate residents. It refers to how the LMS can facilitate and enhance these processes and potentially improve the overall educational outcomes for the residents.

EFFECTIVENESS

This means that all the LMS system has succeeded in standardization in teaching, learning and assessment of postgraduate residents.

MATERIALS AND METHODS:

Study Setting: All accredited departments of urology in Pakistan and interested residents from abroad and IHPR

KMU Peshawar

Study Duration: Minimum of 06 months

Sample size: By using openEpi software sample size is calculated by taking the anticipated frequency of effectiveness of LMS as 69%, confidence level 95%, and margin of error 7%(6). The total sample size calculated is 168. Residents from each province will be taken proportionately according to the proportion they contribute.

S.No	Name of province	Final-year Residents count	Percentage	Sample size(from each province)
1	Khyberpukhtunkhwa	25	22.9	38
2	Punjab	20	18.3	30
3	Sindh	36	33.0	55
4	Baluchistan	4	0.03	1
5	Capital city	24	22.0	37
	Total	109	100	161

- **Sample size:** Though the calculated sample size was 109, but due to encouraging response of residents Total number of 188 residents of urology from Pakistan and abroad participated in the study
- **Study design:** Descriptive
- **Sampling technique:** multistage proportionate sampling technique
- **SAMPLE SELECTION**

Inclusion criteria

1. All the residents who have done their two years of mandatory intermediate module examination.
2. Those who are enrolled in the three urology modules

Exclusion Criteria

1. Final-year residents who have not given consent for participating in the study
2. Those who do not have excess to the LMS system used in the study

The above-mentioned conditions acted as confounders and would have resulted as bias in the study

ETHICS AND CONSENT STATEMENT:

After Ethical approval by institutional research and ethical board of IHPER Khyber medical university phase 5, haytabad, Peshawar pakistan, informed consent was taken from all the subjects including the patients or simulated patients and /or their guardian(s) in the consent for publication of information /images / videos in an online open access publication. Study was approved by the Ethical Committee of Institute of Kidney Diseases Peshawar and Institute of Health Professional Education and Research (IHPER). Ethical approval letter attached as **(Annex 3)**

DATA COLLECTION PROCEDURE:

After Ethical approval by Institutional research and ethical board of Institute of Health Professions Education & Research Khyber Medical University, Phase-5, Hayatabad, Peshawar Pakistan, this study was conducted in all the urology department of Pakistan and abroad. Residents fulfilling the study criteria were recruited for the study. The consented residents were enrolled on specially designed multimodal lmsurology.com. The three urology modules were Urolithiasis, Prostate and Urooncology respectively and one module of conflict resolution as student selected component, The pretest in form of 50 MCQs was taken in the start of every module. The asynchronous teaching methodology was adopted with study guides of modules, power point presentations with voice over, H5P Interactive of real time surgical procedures, Interactive teaching videos on simulator and skill labs, Lessons and resource materials. A pre assignment test was taken about basic knowledge of course as short essay and academic writing. The student were then assigned different assignments in respective modules including solving real case scenarios, H5P Interactive assignments, academic and reflective writings. The assignments were graded according to structured key **(Annex 1)**. The summative assessment in form of post test MCQ was taken on LMS. The perception of residents regarding their overall experience about lms was displayed on dashboard attached as **(Annex 2)**.

Residents were required to respond to all the questions mentioned in the questionnaire. The selection of residents from 18 renowned institutes from every province and federal capital are as follows:

- Khyber Pukhtunkhwa

- ✓ Institute of Kidney Diseases HMC KGMC Peshawar
- ✓ Lady reading Hospital Peshawar
- ✓ Ayub teaching Hospital Islamabad
- ✓ Nawaz Shareef kidney center Swat
- Rawalpindi and Federal Capital
 - ✓ Shifa International Hospital Islamabad
 - ✓ Benazir Bhutto Hospital Rawalpindi
 - ✓ Armed forces institute of Urology AFIU Rawalpindi
 - ✓ Pakistan Institute of Medical Sciences
- Lahore
 - ✓ Sheikh Zayed Hospital Lahore
 - ✓ Services Hospital Lahore
 - ✓ Mayo Hospital Lahore
 - ✓ PKLI Lahore
- Sindh
 - ✓ Aga Khan University Karachi
 - ✓ SIUT Karachi
 - ✓ JPMC Karachi
 - ✓ LUHMS Jamshoro
- Baluchistan
 - ✓ Bolan medical complex

DATA ANALYSIS PROCEDURE

All the data of perception of residents on dash board, grading of assignments, summative score and feedback on Likert scale was analyzed on SPSS version 22. For categorical variables frequencies and percentages were calculated while for scale variables mean and standard deviation (SD) was calculated. For confounding effect adjustment multinomial logistic regression was be applied and results are presented in the form the adjusted and unadjusted results.

RESULTS

Total of four courses were taught on lms. That included three urological modules on Prostate, Uro-oncology and Urolithiasis respectively and one student selected component on conflict resolution

In this study 188 residents were recruited after informed consent, among them 161 (86%) were male and 27(14%) were female. We recruited all the students from 3rd year of their Urological residency who have passed their intermediate module exam. The year of training of the residents is shown in Figure 1.

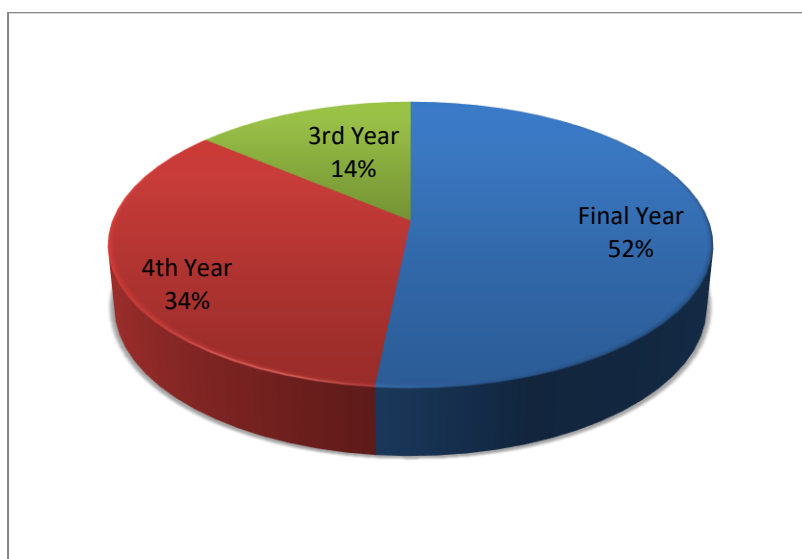


Figure 1: The pie graph showing year of post graduate residency in Urology

Among the residents, 181(93%) were from Pakistan and 13(7%) were from abroad. The details of distribution of residents are shown in Table 1

Table 1: Relative distribution of training centersUrological residents

	Frequency (%)
KPK	73(38.83%)
Punjab	51(27.13%)
Sind	35(18.62%)
Baluchistan	16(8.51%)
India	8(4.26%)
England	5(2.66%)

The pie graph, showing national and international participants is shown in Figure 2

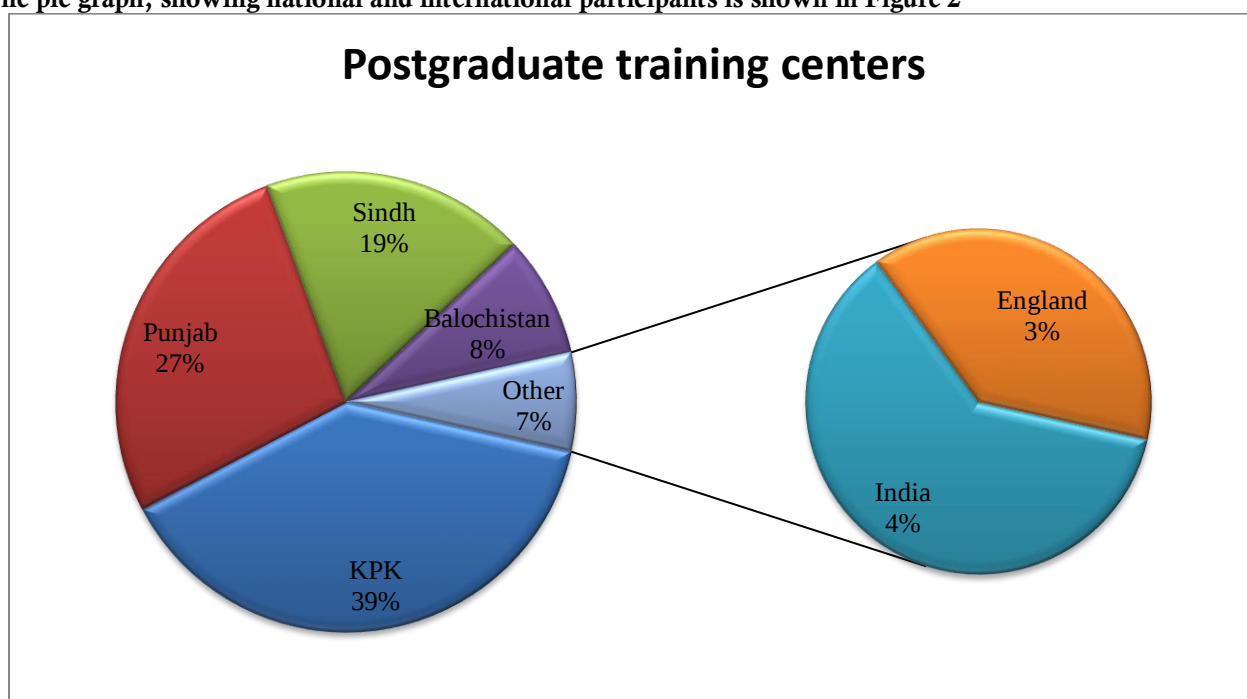


Figure 2: Pie graph showing the distribution of different locations of Urological residents

Course contents and its description are shown in Table 2

Table 2: Resource guidance, Course contents and Description

	Frequency
Total Course Uploaded	4
Study guides PDF	4
Benchmark studies PDF	14
No of Interactive Videos	45
H5P Videos	25
No of Presentations	25
No of Quizzes	08
No of Interactive lessons	14
No of Assignments	15
TOTAL	154

The pretest and post test assessment and assignments are shown in Table 3

Table 3: The Pre and Post test // assignment

	Passed students Before Course	Passed students After Course	p-value
Formative Assignment	23%	100%	<0.001*
Summative Assignment	15%	97%	<0.001*

Chi-square test

Comparative analysis showed that the mean pre and post course quiz results were statistically significantly different (p-value t= 9.12 <0.001). Similarly Assignment test were statistically significantly different (t test 2.19, <0.001). There was no significant difference in pre and post test regarding gender, center of training and year of training (p>0,05). The post test grades and assignments in three urological and one student selected component module is shown in Table 4

Table 4: The post test grades of assignments in modules

Module	Pass 95 %	Pass 85%	Pass 80%	Pass 75%	Pass 70 %	Fail Below 60 %
Prostate: BPH						0
Urolithiasis						0
Urooncology						0
Conflict resolution						0

The details of perception of the residents about use of LMS on three urological is shown in Figure 3

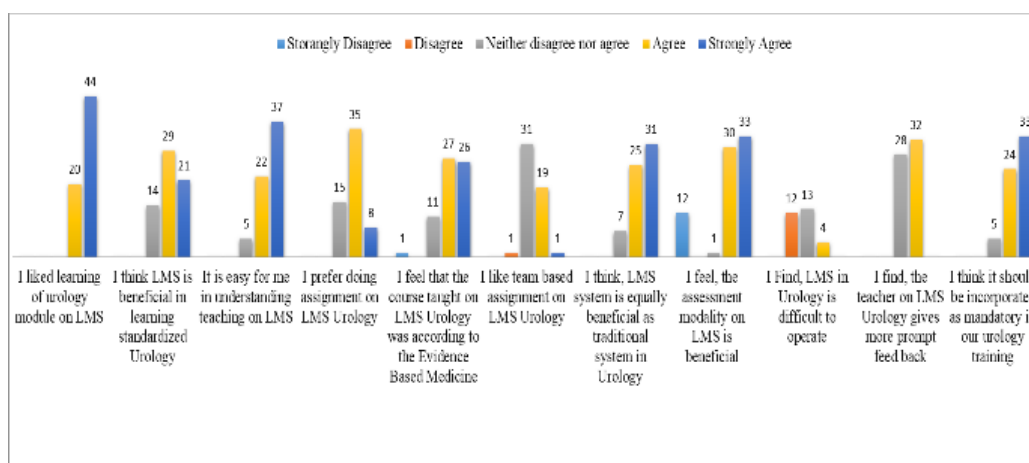


Figure: 3: Bar graph showing the perception of postgraduate residents about lms

The linear regression test showed significant difference in favor of LMS as positive perceptions in form strongly agreed for effectiveness of LMS in teaching, assessment and perception (p=0.001).

The screen shot of history taking in urology module as interactive question on H5P is shown in Figure 4

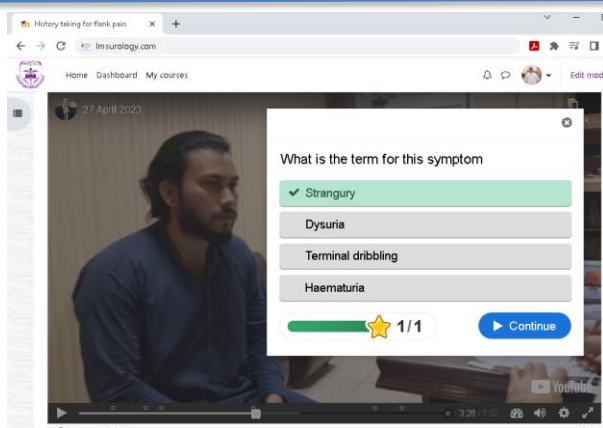


Figure 4: Interactive video lesson on H5P in History taking

The screen shot of principal author on H5P regarding dietary modification in prevention of renal stone in urolithiasis module is shown in Figure 5

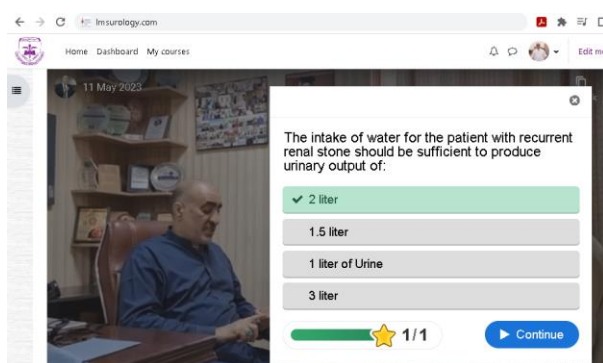


Figure 5: Interactive video session on H5P on dietary modification counseling

DISCUSSION

Medical education is an art that crafts the teaching of science. The growing technological advances like learning management system as tool for distant learning has revolutionised the medical education. The present study also endorsed the fact, that LMS is very effective in all domains of teaching, learning and assessment of postgraduate residents. Though we have completed our study among residents of Urology however it can be adopted in undergraduate and postgraduate residents of any specialty.

The strength of our study is the sample size. We were able to recruit more than desired number of residents, not only from Pakistan but also from India and UK. This reflects the importance of LMS, the standardization of curriculum, the teaching and quality assessment among postgraduate residents beyond the territorial boundaries. Another, strength is that though effectiveness of LMS has been widely studied in undergraduate medical schools but it's the first study in local setup that has addressed the postgraduate residents who are the budding consultants and academia.

Though LMS provided deep insight to the affective domain of residents regarding the course of " Conflict

resolution" in student selected component. Yet the inability of teaching psychomotor domain to the urological residents in form of surgical skills is inherent weakness of LMS. The asynchronous method of teaching surgical skills through interactive videos, simulators etc is mere the enhancement of cognitive domain.

Urology is known to be male dominated specialty of surgery. This is not only true for nations like Pakistan. Soojin Kim et al from has also reported that due to several factors, there is less number of female residents opting for urological specialty¹², the same was observed in Italy by Sofia Reale et al in their study¹³, Same was observed in present study where the percentage of female resident was 14%.

The LMS urology is a software designed to manage and deliver urology related contents, training programs, assignments, quizzes and other learning activities. Different blackboards have been used in LMS to share the learning materials. Lecture notes or scripts were provided mostly as PowerPoint, PDF, Podcasts, Virtual patient, discussion forums or quiz formats are part of the LMS Blackboard features.⁷

In synchronous way of teaching, there is a direct

communication between teacher and learner, however in asynchronous method the students learn in his own time and space. This creates the dilemma that how to teach and whether, the purpose of learning has been served or not. This dilemma can now be easily sorted by introduction of H5P paid technology as a content creation tool which can be incorporated in LMS. In present study, in addition to traditional sharing tools of research material, we used 25 interactive videos with assignments in H5P system on LMS. The additions of H5P videos have enhanced the learning abilities of students in distant learning courses¹⁵.

The formative and summative assessment in any teaching Programme is utmost important for checking the effectiveness, standardization, validity and reliability of the course. Same is true for learning management system too. Learning management system provides a wide array of choices in assessment of participants. The summative assessment is important as it weighs both teacher and student. In the present study, significant difference in $p < 0.001$ was observed between pre and post test for formative and summative assessment. The same findings have been endorsed in literature by Kabbasi *et al.*¹⁵.

By 2019, Learning management system was not well known in medical educational sectors in Pakistan¹⁶. The Learning management system for distant learning is gaining popularity in Pakistan after 2020 in the era of COVID. The apprehensions of non-communication, lack of interest, failure to comply with asynchronous way of online teaching were of grave concern before starting the study. So we set an objective to check the perception of residents of using LMS at the end of four offered courses. The response was overwhelmingly positive in favor of LMS. The majority strongly agreed that LMS is beneficial, user-friendly, effective in assessment, standardized according to evidence-based medicine and should be incorporated in curriculum. The point in which participants responded disagree was their team participation on LMS.

David A back also reported the student perception of LMS as effective in exam preparation in 63% of respondents, clarity in 82% and easy to use in 92%.⁷ The Memon *et al.* also endorsed our findings in their study conducted in Karachi in 2019. They concluded that the participants of medical schools versed with LMS favour its efficacy in teaching, learning and assessment of medical students. Rahim *et al.* concluded positive perception and experience of using Learning Management System on Moodle in medical curriculum just same as perception of our participants in lmsurology.com.

This study is implicated on medical teachers, medical educationist, postgraduate residents and accrediting

bodies for inference regarding use of this novel technological advancements. New research is desired to bridge the gap of teaching psychomotor skills on LMS by introducing new modalities like gamification.

CONCLUSION:

The Learning management system in Urology is an effective tool in teaching, learning and assessment of postgraduate residents. There is a favorable perception for the use of LMS among residents of Urology.

Declaration

Ethics approval and consent to participate

The ethical certificate has been taken from IHPM Khyber medical university Peshawar has been taken before start of research and the consent form of the participant was also assured before start of research. Both the forms are attached as annexure as supplementary files.

Consent for publication

The consent for publication was taken by KMU and Institute of Kidney Diseases.

Availability of data and materials

The availability of the data is with corresponding author as Excel and SPSS files. It's not yet shared with BMC as it contains the names, RTMC numbers, Personal identity of postgraduate residents, their formative and summative scores. This can be shared if desired by the journal after taking permission of participants.

Experiments of on Humans or Tissue

I hereby declare, that no experiments on human being, animals or human tissue were performed in the study. This research on medical education included only videos on simulators, H5P. Online power point lectures etc.

Competing interests

I hereby declare that there is no conflict of interest in the study.

Funding

No funding was taken from any organization, university, company. All of the participants were registered free of cost with all resource material. The LMS Programme was developed by author by his own pocket. The principal author also declares that no funding has been requested for the publication of the article in BMC medical education. That charges will also be paid by the principal author who is also the corresponding author.

Authors' contributions

Dr Faiza Hayat, Principal and Dr Saifullah Khan, Corresponding Author:
Conception of idea, literature review, developing

modules, LMS system, manuscript writing and analysis

Dr Liaqat Ali , Co Author

Helped in running the module, data analysis and supervision of research project.

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