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Impact of Integrated Vs. Traditional Curriculum Models on Long-Term Clinical Skills Retention

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ABSTRACT

Integrating basic and clinical sciences has been promoted to enhance clinical reasoning and long-term retention in medical education. **Objectives:** To compare six-month retention of knowledge and interpretation-based clinical reasoning skills among undergraduate medical students taught through integrated versus traditional curriculum models. **Methods:** A quasi-experimental study was conducted among final-year medical students (Integrated curriculum: n=53; Traditional curriculum: n=48). Baseline and six-month follow-up assessments included multiple-choice questions (MCQs) for knowledge and interpretation tasks for clinical reasoning. Objective Structured Clinical Examination (OSCE) scores were also recorded. Independent samples t-tests were applied for normally distributed data and Mann–Whitney U tests for non-normal data, based on Shapiro–Wilk normality results. Effect sizes and 95% confidence intervals (CIs) were calculated. A p-value <0.05 was considered statistically significant. **Results:** Baseline MCQ and interpretation scores were comparable between groups. At six months, knowledge retention (MCQ scores) declined in both groups without a significant between-group difference (p=0.074). Interpretation scores were higher in the integrated group (mean difference 0.48, 95% CI 0.11–0.85, p=0.012), representing a small but statistically significant advantage. OSCE performance was slightly better in the integrated group but did not reach statistical significance (p=0.083). **Conclusions:** The integrated curriculum was associated with a small but statistically significant advantage in preserving interpretation-based clinical reasoning over six months, despite similar knowledge and procedural skill retention. While the effect size is modest, these findings support the relevance of curriculum integration for fostering higher-order reasoning, particularly when coupled with reinforcement strategies.

INTRODUCTION

In recent years, medical education has undergone a global shift from discipline-based, teacher-centered models to more integrated, learner-centered approaches [1]. Integrated curricula aim to link basic sciences with clinical application, thereby fostering deeper understanding and longer retention of clinical skills. Studies conducted in the United States and Europe have demonstrated the effectiveness of integrated models in enhancing clinical reasoning, critical thinking, and long-term competence [2, 3]. International evidence further supports this trend. Paul *et al.* reported improved cognitive retention in integrated settings [4], while Weimer *et al.* emphasized the role of spaced reinforcement within such curricula [5]. A systematic review by Alharbi *et al.* also concluded that integration enhances diagnostic accuracy and application of knowledge in real-life scenarios [6]. In contrast, traditional medical curricula, which separate basic sciences from clinical exposure, continue to be widely used in developing countries due to institutional inertia and resource limitations. In Pakistan, several public and private

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medical colleges still follow traditional models, raising questions about their adequacy in preparing students for modern clinical demands. While local studies, such as those by Alharbi *et al.* and Fatima *et al.* have explored knowledge acquisition under traditional formats, few have examined long-term retention of clinical skills or directly compared integrated and traditional models over time [6, 7].

Despite the global shift toward integrated medical curricula, evidence comparing their long-term effectiveness with traditional models in low- and middle-income countries remains limited. Most local studies have focused primarily on immediate knowledge acquisition rather than sustained retention of clinical reasoning and procedural skills over time. Furthermore, there is a scarcity of longitudinal data evaluating objective measures such as OSCE performance and interpretation-based assessments after clinical rotations. This gap highlights the need for comparative research examining how curriculum structure influences long-term clinical competence in the Pakistani medical education context. This lack of evidence poses a challenge for educators and policymakers striving to reform curriculum design in Pakistan. With limited studies evaluating retention of core competencies such as OSCE performance and interpretation ability, especially after clinical rotations, there remains a critical gap in understanding how curriculum structure influences long-term outcomes. This study aimed to compare the impact of integrated versus traditional curriculum models on the retention of clinical knowledge and skills over a six-month interval.

METHODS

This was a prospective quasi-experimental study designed to compare the long-term retention of clinical skills among medical students taught through integrated versus traditional curriculum models. The quasi-experimental design was chosen because students were already enrolled in pre-assigned curricula at their institutions; random allocation was not feasible due to administrative constraints and ethical considerations. This non-random assignment introduces a potential risk of selection bias; however, baseline equivalence for demographics, prior clinical exposure, and self-reported confidence was assessed to minimize the impact of possible confounders on internal validity. The study was conducted from March 2024 to August 2024 at Health Net Hospital, Peshawar, in collaboration with affiliated medical colleges implementing both curriculum models. Formal approval was obtained from the Ethics Review Committee of Health Net Hospital, Peshawar (Reference No. 3088/HNH/HR). Written informed consent was obtained from all participants. Sample size was calculated using G*Power version 3.1 for an independent samples t-test, with an expected moderate effect size ($d = 0.5$), $\alpha = 0.05$, and power $(1 - \beta) = 0.80$. The effect size assumption was based on findings from comparable published studies examining curriculum-based differences in clinical skill retention, which reported effect sizes in the moderate range. The minimum sample required per group was 48; to account for potential attrition, 101 final-year MBBS students were enrolled, 53 from the integrated curriculum and 48 from the traditional curriculum. A purposive sampling method was used, focusing on students who had completed their clinical rotations exclusively under one curriculum type. This approach improved feasibility but carries the risk of sampling bias, which may limit the generalizability of findings to other settings. The study included final-year MBBS students who had documented exposure to either the integrated or traditional curriculum, had completed both baseline and six-month follow-up assessments, and had provided written informed consent. Students were excluded if they had incomplete academic records, failed to attend the follow-up assessment, were enrolled in hybrid curriculum models, or had participated in supplemental clinical workshops within three months before the baseline assessment. Knowledge retention was assessed using a validated 20-item multiple-choice question (MCQ) test mapped to core clinical competencies. Clinical skills performance was measured through an Objective Structured Clinical Examination (OSCE) using standardized checklists, with two faculty assessors independently rating each station. Although complete blinding to group allocation was not feasible due to scheduling constraints, assessors were not informed of the study hypothesis to minimize potential assessment bias. Interpretation ability was evaluated through structured scenario-based questions scored by trained faculty, while self-rated confidence was measured at baseline using a 10-point Likert scale to assess perceived clinical competence. Baseline assessments (MCQ, OSCE, and interpretation) were conducted at the end of the students' final clinical training block. Identical assessments were repeated six months later without any interim reinforcement, allowing measurement of natural skill decay or retention. Data were anonymized using unique participant codes. Content validity of assessment tools was established via expert panel review. Internal consistency was confirmed with Cronbach's $\alpha = 0.82$ for the MCQ test and $\alpha = 0.85$ for the OSCE checklists. Inter-rater reliability for OSCE scoring was high (intra-class correlation coefficient = 0.89), indicating consistent scoring between assessors. Data were analyzed using IBM SPSS Statistics, version 26.0. Continuous variables were summarized as mean ± standard deviation (SD) when normally distributed and as median

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with interquartile range (IQR) when non-normally distributed. Categorical variables were presented as frequencies and percentages. The Shapiro–Wilk test was used to assess normality for each continuous variable, and the choice between parametric and non-parametric tests was explicitly based on these results and the distributional characteristics of the data. Between-group comparisons were performed using independent samples t-tests for normally distributed variables and Mann–Whitney U tests for non-normal variables (e.g., six-month MCQ scores). For Mann–Whitney U tests, Hodges–Lehmann median differences with 95% confidence intervals (CIs) were reported to provide an estimate of effect size. Within-group comparisons were conducted using paired samples t-tests for normally distributed outcomes and Wilcoxon signed-rank tests for non-normal data. Chi-square tests were used to assess associations between categorical variables. Effect sizes were calculated for statistically significant results, and exact p-values were reported, with $p < 0.050$ considered statistically significant.

RESULTS

Baseline demographic characteristics were similar between the integrated and traditional curriculum groups. The proportion of female students was 47.2% in the integrated group and 43.8% in the traditional group (p=0.730). Distribution by academic year did not differ significantly (p=0.231), and prior clinical exposure was slightly more common in the traditional group (72.9%) compared to the integrated group (62.3%), but without statistical significance (p=0.254). Mean age was almost identical between groups (23.07 ± 2.10 vs. 23.17 ± 1.24 years; p=0.772), and self-reported confidence scores were comparable (6.97 ± 1.09 vs. 7.28 ± 1.45; p = 0.222). These findings confirm that the groups were demographically balanced at the study outset, table 1.

Table 1: Comparison of Participant Demographics and Background Variables Between Curriculum Groups (n=101)

Variables	Category	Integrated (n=53)	Traditional (n=48)	Test Statistic	df	p-value	95% CI (Difference)
Gender	Female	25 (47.2%)	21 (43.8%)	$x^2 = 0.119$	1	0.730	–
	Male	28 (52.8%)	27 (56.2%)				
Year of Study	3rd Year	28 (52.8%)	31 (64.6%)	$x^2 = 1.432$	1	0.231	–
	4th Year	25 (47.2%)	17 (35.4%)				
Prior Clinical Exposure	Yes	33 (62.3%)	35 (72.9%)	$x^2 = 1.299$	1	0.254	–
	No	20 (37.7%)	13 (27.1%)				
Age (Years)	Mean ± SD	23.07 ± 2.10	23.17 ± 1.24	t = –0.290 (Welch's test)	85.82	0.772	–0.77 to 0.58
Self-Reported Confidence	Mean ± SD	6.97 ± 1.09	7.28 ± 1.45	t = –1.230 (Welch's test)	86.58	0.222	–0.83 to 0.18

At baseline, MCQ knowledge scores were slightly higher in the integrated group than in the traditional group (6.44 ± 1.22 vs. 6.15 ± 1.14; p=0.222). At six months, median scores were 5.91 (IQR = 5.04–6.31) in the integrated group and 5.26 (IQR = 4.64–6.14) in the traditional group. This difference was not statistically significant (Mann–Whitney U = 1008.5, Z = –1.792, p=0.074; Hodges–Lehmann median difference = 0.42, 95% CI: –0.03 to 0.88). Both groups experienced similar declines in knowledge over time, with no significant difference in change scores (p=0.976), table 2.

Table 2: Knowledge Retention Outcomes by Curriculum Group

Variables	Integrated (n=53)	Traditional (n=48)	Test Statistic / U	df/U	p-value	95% CI (Diff.)	Median (IQR) Integrated	Median (IQR) Traditional	HL Δ (95% CI)
Baseline MCQ Score	6.44 ± 1.22	6.15 ± 1.14	t = 1.228	98.87	0.222	-0.18 to 0.75	–	–	–
MCQ Score at 6 Months	5.75 ± 0.85	5.45 ± 1.19	Mann-Whitney U=1008.5	–	0.074	–	5.91 (5.04-6.31)	5.26 (4.64-6.14)	0.42 (-0.03, 0.88)
Change Score (6mo-base)	-0.69 ± 1.62	-0.70 ± 1.78	t = 0.030	95.37	0.976	-0.66 to 0.68	–	–	–

Baseline OSCE scores were slightly higher in the integrated group but not significantly different (7.70 ± 1.26 vs. 7.46 ± 1.34; p=0.363). At six months, OSCE scores again favored the integrated group (7.47 ± 1.02 vs. 7.09 ± 1.19; p=0.084), though the difference was not statistically significant. Interpretation skills were nearly identical at baseline, but at six months, the integrated group scored significantly higher (6.75 ± 1.21 vs. 6.28 ± 0.99; p = 0.036, indicating better preservation of clinical reasoning, table 3.

Table 3: Comparison of OSCE and Interpretation Scores Between Integrated and Traditional Curriculum Groups

Outcome Measures	Group	Mean ± SD	95% CI (Lower–Upper)	p-value
OSCE Baseline Score	Integrated	7.70 ± 1.26	7.35 – 8.04	0.363
	Traditional	7.46 ± 1.34	7.07 – 7.85	
OSCE at 6 Months	Integrated	7.47 ± 1.02	7.19 – 7.76	0.084
	Traditional	7.09 ± 1.19	6.74 – 7.43	

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Interpretation Baseline	Integrated	7.20 ± 0.96	6.94 – 7.47	0.991
	Traditional	7.21 ± 1.04	6.90 – 7.51	
Interpretation at 6 Mo	Integrated	6.75 ± 1.21	6.42 – 7.09	0.036
	Traditional	6.28 ± 0.99	5.99 – 6.57	

In the integrated group, OSCE scores decreased slightly over six months, but the change was not statistically significant (mean difference = 0.22 ± 1.58; p=0.305). Interpretation scores showed a greater decline (mean difference = 0.45 ± 1.66), with a p-value of 0.052, suggesting a possible reduction in performance without reinforcement, table 4.

Table 4: Within-Group Change in OSCE and Interpretation Scores in Integrated Curriculum (n=53)

Outcome Comparison	Mean ± SD	95% CI (Lower–Upper)	p-value
OSCE Baseline vs. 6 Months	0.22 ± 1.58	-0.21 – 0.66	0.305
Interpretation Baseline vs. 6 Months	0.45 ± 1.66	-0.003 – 0.91	0.052

This 3D clustered column chart illustrates the mean interpretation scores achieved by students at 6 months, comparing the integrated curriculum group (6.75 ± 1.21) to the traditional group (6.28 ± 0.99). Error bars (represented as stacked SDs) indicate variability within each group. The graph demonstrates that participants in the integrated curriculum achieved slightly higher mean interpretation scores at the 6-month follow-up compared to those in the traditional curriculum. The difference in mean scores was statistically significant (p=0.036). Although both groups exhibited variability in performance, the integrated group not only outperformed the traditional group in terms of average score but also had slightly greater score dispersion, as indicated by a higher standard deviation (1.21 vs. 0.99). This suggests that while the integrated approach was more effective on average, individual performance varied more widely, figure 1.

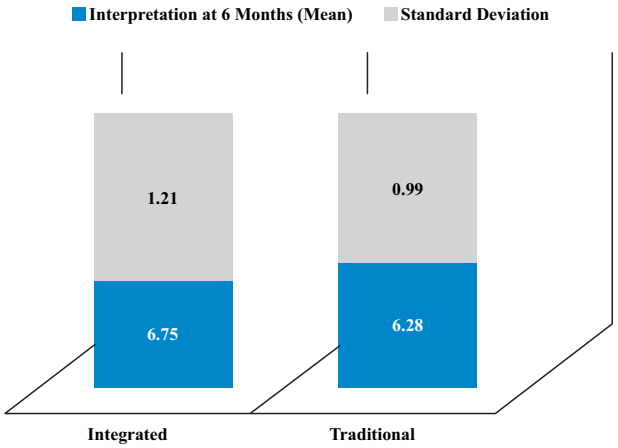

Figure 1: Comparison of Mean Interpretation Scores at 6 Months with Standard Deviation Between Integrated and Traditional Curriculum Groups

DISCUSSION

This study aimed to evaluate the long-term retention of clinical skills among undergraduate medical students taught through integrated versus traditional curriculum models. While knowledge retention (MCQ scores) declined modestly in both groups over six months, the integrated group demonstrated a small but statistically significant advantage in interpretation scores, which reflect higher-order clinical reasoning. Given the modest magnitude of this difference, the result should be interpreted cautiously, acknowledging statistical significance but also its practical limitations. The baseline comparability of both groups in terms of demographics and confidence levels adds strength to the internal validity of this quasi-experimental design. However, the quasi-experimental nature and purposive sampling limit causal inferences and generalizability, a limitation common to curriculum comparison studies. The lack of significant group differences in knowledge retention at six months aligns with studies by Veer *et al.* and Ji *et al.* both of which emphasized that factual knowledge deteriorates over time unless actively reinforced [8, 9]. In contrast, interpretation skills were better preserved in the integrated curriculum group. This finding, although modest in effect size, supports previous work by Jujo *et al.* who advocated that integrated teaching encourages deeper cognitive processing and long-term clinical reasoning development [10]. Similarly, McMains *et al.* and Al-Badri *et al.* argued that integrated approaches improve the meaningful application of knowledge rather than just factual recall [11, 12]. The OSCE scores, although slightly better in the integrated group, did not reach statistical significance, which was consistent with Rafiq-uz-Zaman *et al.* and Shahrezaei *et al.* who found that improvements in procedural skills often require repeated, hands-on reinforcement over time, regardless of curriculum format [13, 14]. The modest within-group decline in interpretation scores over time (p=0.052) without refresher training mirrors the trend reported by Shahrezaei *et al.* where skills decayed even in high-performing students unless periodic reinforcement was applied [14]. This supports Yin *et al.* that deliberate practice and spaced learning are critical for long-term retention [15]. Our results also align with Offiah *et al.* who found that integrated curricula facilitate the transfer of knowledge into clinical reasoning by blending basic sciences with clinical contexts [16]. Likewise, a systematic review by Albert *et al.* concluded that students under integrated curricula were better at diagnostic interpretation and clinical application [17]. Moreover, a multicenter longitudinal analysis by Chaou *et al.* showed that students from integrated programs sustained higher performance in licensing exams and clinical competencies

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[18]. These findings collectively suggest that while the integrated curriculum's advantage in interpretation scores is statistically significant, it should be viewed as one component of broader curriculum reform efforts rather than a sole determinant of long-term clinical competence. Despite these advantages, the lack of significant within-group improvement or maintenance in OSCE scores over time signals a potential weakness in experiential consolidation, as emphasized by Natesan *et al.* and Menard *et al.* [19, 20]. Future curriculum reforms should, therefore, pair integration with structured, repeated practical exposure to sustain psychomotor and procedural skills alongside reasoning ability.

This study has several limitations. The quasi-experimental design and purposive sampling may introduce selection bias and limit causal inference. The single-institution setting and relatively short six-month follow-up period may also restrict generalizability and the assessment of sustained long-term outcomes. Additionally, unmeasured institutional or teaching variations could have influenced performance differences. Future multicenter longitudinal studies with randomized allocation, extended follow-up periods, and incorporation of qualitative feedback are recommended to better understand the long-term educational impact of curriculum integration and its practical significance in diverse medical training environments.

CONCLUSIONS

It was concluded that integrated curriculum models were associated with a small but statistically significant advantage in preserving interpretation-based clinical skills over a 6-month interval, despite similar trends in knowledge retention and OSCE performance. While the effect size is modest, the finding remains relevant for curriculum reform, especially in resource-constrained and transitioning medical education systems. The results reinforce global calls for curriculum integration in medical education and emphasize the need for targeted reinforcement strategies to optimize long-term clinical competence.

Authors' Contribution

Conceptualization: SFJ
Methodology: HA, SA[1]
Formal analysis: SFJ, HA, FP, SA[1] FMK, SA[2]
Writing and Drafting: FJ, HA, FP, SA[1], FMK, SA[2]
Review and Editing: SFJ, HA, FP, SA[1], FMK, SA[2]

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Yang Y, Gielissen K, Brown B, Spak JM, Windish DM. Structure and Impact of Longitudinal Graduate Medical Education Curricula Designed to Prepare Future Clinician-Educators: A Systematic Scoping Review: BEME Guide No. 74. Medical Teacher.2022 Sep;44(9):947-61.doi:10.1080/0142159X.2022.2039381.

[2] Hense H, Harst L, Küster D, Walther F, Schmitt J. Implementing Longitudinal Integrated Curricula: Systematic Review of Barriers and Facilitators. Medical Education.2021 May; 55(5): 558-73. doi: 10.1111/medu.14401.

[3] Higgins M, Madan C, Patel R. Development and Decay of Procedural Skills in Surgery: A Systematic Review OF THE Effectiveness of Simulation-Based Medical Education Interventions. The Surgeon.2021Aug; 19(4): e67-77. doi: 10.1016/j.surge.2020.07.013.

[4] Paul A, Leung D, Salas RM, Cruz TE, Abras C, Saylor D *et al.* Comparative Effectiveness Study of Flipped Classroom Versus Online-Only Instruction of Clinical Reasoning for Medical Students. Medical Education Online.2023Jan;28(1):2142358.doi:10.1080/10872981.2022.2142358.

[5] Weimer JM, Widmer N, Strelow KU, Hopf P, Buggenhagen H, Dirks K *et al*. Long-Term Effectiveness and Sustainability of Integrating Peer-Assisted Ultrasound Courses into Medical School—A Prospective Study. Tomography. 2023 Jul; 9(4): 1315-28. doi: 10.3390/tomography9040104.Alharbi A,

[6] Nurfianti A, Mullen RF, McClure JD, Miller WH. The Effectiveness of Simulation-Based Learning (SBL) On Students' Knowledge and Skills in Nursing Programs: A Systematic Review. BioMed Central Medical Education.2024 Oct; 24(1): 1099. doi: 10.1186/s12909-024-06080-z.

[7] Fatima M, Khan A, Naz R, Noori MY. Impact of Teaching Methods on Clinical Reasoning in Forensic Medicine: A Quasi-Experimental Study. Medical Education. 2024 Sep; 35(12).

[8] Veer V, Phelps C, Moro C. Incorporating Mixed Reality for Knowledge Retention in Physiology, Anatomy, Pathology, and Pharmacology Interdisciplinary Education: A Randomized Controlled Trial. Medical Science Educator.2022 Dec; 32(6): 1579-86. doi: 10.1007/s40670-022-01635-5.

DOI: https://doi.org/10.54393/pjhs.v6i8.3400

[9] Ji M, Luo Z, Feng D, Xiang Y, Xu J. Short-and Long-Term Influences of Flipped Classroom Teaching in Physiology Course On Medical Students' Learning Effectiveness. Frontiers in Public Health.2022Mar; 10: 835810. doi: 10.3389/fpubh.2022.835810.

[10] Jujo S, Sakka BI, Lee-Jayaram JJ, Kataoka A, Izumo M, Kusunose K *et al.* Medical Student Medium-Term Skill Retention Following Cardiac Point-of-Care Ultrasound Training Based on the American Society of Echocardiography Curriculum Framework. Cardiovascular Ultrasound.2022Oct;20(1):26.doi:10 .1186/s12947-022-00296-z.

[11] McMains JC, Larkins MC, Doherty AM, Horiates J, Alachraf K, Gordon JA *et al.* Knowledge Retention from Emergency Medicine Simulation-Based Learning Curriculum for Pre-Clinical Medical Students.Cureus.2023Jun;15(6).doi:10.7759/cureus .41216.

[12] Al-Badri N, Touzet-Roumazeille S, Nuytten A, Ferri J, Charkaluk ML, Nicot R. Three-Dimensional Printing Models Improve Long-Term Retention in Medical Education of Pathoanatomy: A Randomized Controlled Study. Clinical Anatomy.2022Jul;35(5): 609-15. doi: 10.1002/ca.23878.

[13] Rafiq-uz-Zaman M and Nadeem MA. Comparative Analysis of Skill-Based Education Curriculum in Pakistan and India: A Contemporary Review. International" Journal of Academic Research for Humanities". 2024 Sep; 4(3): 188-97.

[14] Shahrezaei A, Sohani M, Taherkhani S, Zarghami SY. The Impact of Surgical Simulation and Training Technologies on General Surgery Education. BioMed Central Medical Education.2024 Nov; 24(1): 1297. doi: 10.1186/s12909-024-06299-w.

[15] Yin X, Wang L, Li Q, Han J, Zhou F, Wang S. Theoretical Models to Guide Undergraduate Medical Curriculum Development: An Integrative Review. BioMed Central Medical Education.2025 Dec; 25(1): 1-7. doi: 10.1186 /s1 2909-025-07644-3.

[16] Offiah G, Ekpotu LP, Murphy S, Kane D, Gordon A, O'Sullivan M *et al.* Evaluation of Medical Student Retention of Clinical Skills Following Simulation Training. BioMed Central Medical Education.2019 Jul; 19(1): 263. doi: 10.1186/s12909-019-1663-2.

[17] Albert FA, Seidu AA, Mason HM, Anderson E, Alele FO, Heggarty P *et al.* A systematic Review of Medical Practitioners' Retention and Application of Basic Sciences to Clinical Practice. BioMed Central Medical Education. 2024 Sep; 24(1): 997. doi: 10.1186/s12909-024-05952-8.

[18] Chaou CH, Yu SR, Ma SD, Tseng HM, Ou LS, Huang CD *et al.* Effect of National Curriculum Reform on Medical Students' Preparedness for Practice: A Prospective Cohort Study from Undergraduate to Postgraduate Periods. BioMed Central Medical Education.2022 Nov; 22(1): 826. doi: 10.1186/s12909-022-03909-3.

[19] Natesan S, Bailitz J, King A, Krzyzaniak SM, Kennedy SK, Kim AJ *et al.* Clinical Teaching: An Evidence-Based Guide to Best Practices from the Council of Emergency Medicine Residency Directors.Western Journal of Emergency Medicine.2020Jul;21(4):985. doi: 10.5811/westjem.2020.4.46060.

[20] Menard L, Blevins AE, Trujillo DJ, Lazarus KH. Integrating Evidence-Based Medicine Skills into A Medical School Curriculum: A Quantitative Outcomes Assessment. British Medical Journal Evidence-Based Medicine.2 021 Oct; 26(5): 249-50. doi: 10.1136 /bmjebm-2020-111391.