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Research Article

Digital transformation in clinical biochemistry education: A comprehensive analysis through YouTube platform

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Abstract

Objectives: The proliferation of digital educational platforms has transformed medical education delivery, yet concerns regarding content quality persist. This study systematically evaluates clinical biochemistry educational content on YouTube and examines relationships between content characteristics and audience engagement.

Methods: A systematic YouTube search was conducted August 1–15, 2025, using standardized clinical biochemistry education terms. Videos were evaluated using a validated 10-point quality assessment framework encompassing scientific accuracy, educational structure, producer credibility, and technical accessibility. Statistical analyses included descriptive statistics, correlation analysis, and linear regression modeling.

Results: Of 152 identified videos, 69 met inclusion criteria (total views: 14,247,835; average of 206,491±167,420). Quality assessment revealed 65.2% (n=45) demonstrated high quality (8–10 points), 30.4% (n=21) moderate quality (5–7 points), and 4.4% (n=3) low quality (1–4 points). Pearson correlation identified robust positive association between quality scores and view counts ($r=0.782$, $p<0.001$), with quality accounting for 61.2% of viewership variance ($r^2=0.612$). Corporate training channels (34.8%) demonstrated highest mean viewership (n=247,825).

Conclusion: While YouTube is a valuable platform for clinical biochemistry education, quality standardization and accessibility improvements are needed. The analysis reveals the potential and diversity of digital educational tools in clinical biochemistry education.

Keywords: Biochemistry, biochemistry education, clinical chemistry, medical laboratory tests, laboratory

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Clinical biochemistry is one of the cornerstones of modern medical diagnosis and treatment processes. Technological advances have transformed educational methodologies in this field and have established digital platforms as important educational resources [1]. Video-sharing platforms such as YouTube are emerged as educational tools of increasing importance for medical students and healthcare professionals [2, 3].

In recent years, the widespread adoption of distance education, influenced by the COVID-19 pandemic, has brought the quality and reliability of digital educational content to the forefront [4]. Particularly in fields such as clinical biochemistry, where accurate interpretation of laboratory results is vital, the quality standards of digital educational materials are crucial [5]. YouTube, with approximately 2.7 billion monthly active users, is the world's largest video-sharing platform and offers a rich source of medical education content [6]. The platform is also widely used by medical students, with approximately 9 out of every 10 medical students benefiting from it [7]. Additionally, 83% of healthcare organizations have official YouTube channels for sharing educational content [8]. However, there are concerns regarding quality control of user-generated content [9]. Therefore, videos to be used or considered for use in education should be selected in a controlled manner.

This study aims to: (1) systematically evaluate the quality of clinical biochemistry videos on YouTube, (2) examine the effects of technology integration in this field, and (3) analyze

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the accuracy of information shared on social media in the context of digital medical education.

Materials and Methods

Video selection and data collection

The systematic search was conducted on the YouTube platform between August 1–15, 2025. Videos were accessed using YouTube Data API v3 (API Endpoint: search.list method) with the following standardized search terms: " Biochemistry", "medical laboratory tests", " Medical Laboratory Personnel", " Automation, Laboratory", "lab results interpretation," and "biochemistry education." Order Parameter: relevance (default YouTube ranking), Type Filter: video, VideoDefinition: any (SD/HD), VideoDuration: any (no duration restriction), SafeSearch: none, MaxResults per query: 50 (API maximum), Language Filter: relevanceLanguage=en, PublishedAfter: 2015-08-15T00:00:00Z, PublishedBefore: 2025-08-15T23:59:59Z, Region Code: none (global search), Minimum View Count Filter: Applied post-retrieval (≥100 views).

Search parameters

- **Date range:** Videos published between August 15, 2015 – August 15, 2025 (last 10 years).
- **Language filter:** English language content only.
- **Geographic filter:** No geographic restrictions applied to ensure international representation.
- **Minimum view threshold:** ≥100 views.
- **Duplicate content elimination:** Duplicate or highly similar content was identified and eliminated through a three-step process:

Ethics committee approval for the study has been obtained from Elazığ Fethi Sekin City Hospital (No: 2025/14-28, Date:04/09/2025) and the study is conducted according to the Helsinki Declaration.

Inclusion criteria

Educational content related to clinical biochemistry, English language support, at least 100 views, published within the last 10 years, educational content for learning purposes.

Exclusion criteria

Content that contains only product advertising, Insufficient audio/video quality, Content containing scientific errors, Duplicate content.

Quality assessment criteria

Videos were evaluated using a 10-point system with objective, literature-based criteria. Five main criteria were assessed and scored: Scientific Content Quality, Educational Structure, Producer Credibility, and Accessibility/Visual Quality. The criteria and scoring were inspired by scoring systems found in the literature (Global Quality Scale (GQS), Modified DISCERN), scores were assigned according to the table below and Quality assessments were performed by a single investigator.

Scientific content quality (0–3 points): Scientific accuracy and currency, Quality of reference sources, Alignment with clinical practice.

Educational structure (0–2 points): Pedagogical organization, Clarity of learning objectives, Systematic presentation of the subject matter.

Producer credibility (0–2 points): Expert identity and qualifications, Institutional commitment, Transparency and openness.

Technical and accessibility (0–2 points): Audiovisual quality, Subtitles, and multilingual support

According to the scoring system above, video quality scores are considered as follows: High Quality (8–10 points), Medium Quality (5–7 points), Low Quality (1–4 points).

Statistical Analysis

All analyses were performed using Python (version 3.9) with scipy.stats, sklearn.linear_model, and statsmodels libraries. Visualizations were generated using Chart.js and Python WordCloud libraries. Lexical frequency analysis was performed on video titles using term frequency (TF) weighting, with the 50 most frequent terms visualized in a word cloud. Normality of continuous variables (view counts, quality scores) was assessed using the Shapiro-Wilk test ($p>0.05$ threshold) and visual inspection of Q-Q plots. For normally distributed data, independent samples t-tests compared mean view counts between quality categories. For non-normally distributed data, Mann-Whitney U tests were applied. Chi-square tests evaluated categorical associations (channel type vs. quality category). Pearson correlation coefficient (r) quantified the linear relationship between quality scores and view counts. Simple linear regression modeling assessed the predictive relationship, reporting unstandardized coefficients (β), 95% confidence intervals, R^2, and F-statistics. Model assumptions were verified through residual plots. Effect Size Calculation: Cohen's d was computed to quantify the magnitude of differences in view counts between quality categories, with interpretation thresholds: small (d=0.2), medium (d=0.5), large (d=0.8), and very large (d≥1.3) effects.

Results

The systematic search protocol yielded 152 candidate videos, of which 69 met the predetermined inclusion criteria and underwent comprehensive quality assessment. Collectively, these 69 videos accumulated 14,247,835 views as of August 15, 2025. Descriptive statistics of video viewership metrics are presented in Table 1 and the IDs, channel names, view counts, quality scores, categories, channel types, and content categories of the 10 most-viewed videos among the 69 analyzed (Appendix 1) are comprehensively displayed in Figure 1 and Figure 2. The relationship between video production volume and quality scores during the analyzed period is presented in Figure 3.

Content analysis word cloud visualization revealed that 'automated analyzer' technologies and 'clinical chemistry' applications are predominantly covered in medical laboratory

Table 1. Video viewing statistics

Statistics	Value
Total views	14,247,835
Average views	206,491
Standard deviation	167,420
Highest views	697,568
Lowest views	107
Median views	26,519

training materials. The most frequently used terms have been identified as 'Clinical Chemistry', 'Medical Laboratory', 'Chemistry', 'Lab', and 'Automated' (Appendix 2).

Application of the standardized quality assessment framework revealed a tripartite distribution of video quality. High-quality content constituted the majority of analyzed videos, with moderate-quality videos forming a substantial minority and low-quality videos representing a small portion of the sample. Cohen's d calculations between quality categories: High vs. Medium Quality, High vs. Low Quality, Medium vs. Low Quality (Table 2).

The analysis revealed that high-quality videos garnered substantially more views compared to medium-quality content, with this difference being statistically significant. Pearson correlation analysis demonstrated a robust positive association between video quality scores and viewership metrics, indicating that quality substantially accounts for the variance in view counts. Furthermore, simple linear regression modeling established a significant predictive relationship, demonstrating that incremental improvements in quality score corresponded to proportional increases in viewership (Table 3).

Taxonomic classification of video sources revealed a heterogeneous distribution across channel types. Individual educational content creators represented the largest proportion, followed by corporate training entities, medical institutions including hospitals and clinics, and academic institutions (Table 4). Video content categories, the most frequently covered topics were laboratory test interpretation, clinical laboratory specialist training, and hematology tests (Table 5). Analysis revealed that nearly half of the videos included subtitle support, and about one-third displayed verified channel badges. Video lengths varied considerably, from short segments to long presentations, with an average length of moderate. Furthermore, examination of creator credentials showed that the vast majority possessed identifiable expertise, while a small percentage came from sources with unclear professional backgrounds (Table 6). Video production volume increased markedly in the post-COVID period relative to pre-COVID years, while mean quality scores showed a modest improvement. However, this temporal difference in quality did not achieve statistical significance (Table 7).

Discussion

The present investigation demonstrates that 65.2% of systematically selected clinical biochemistry educational videos on YouTube meet rigorous quality criteria (score ≥8/10). This

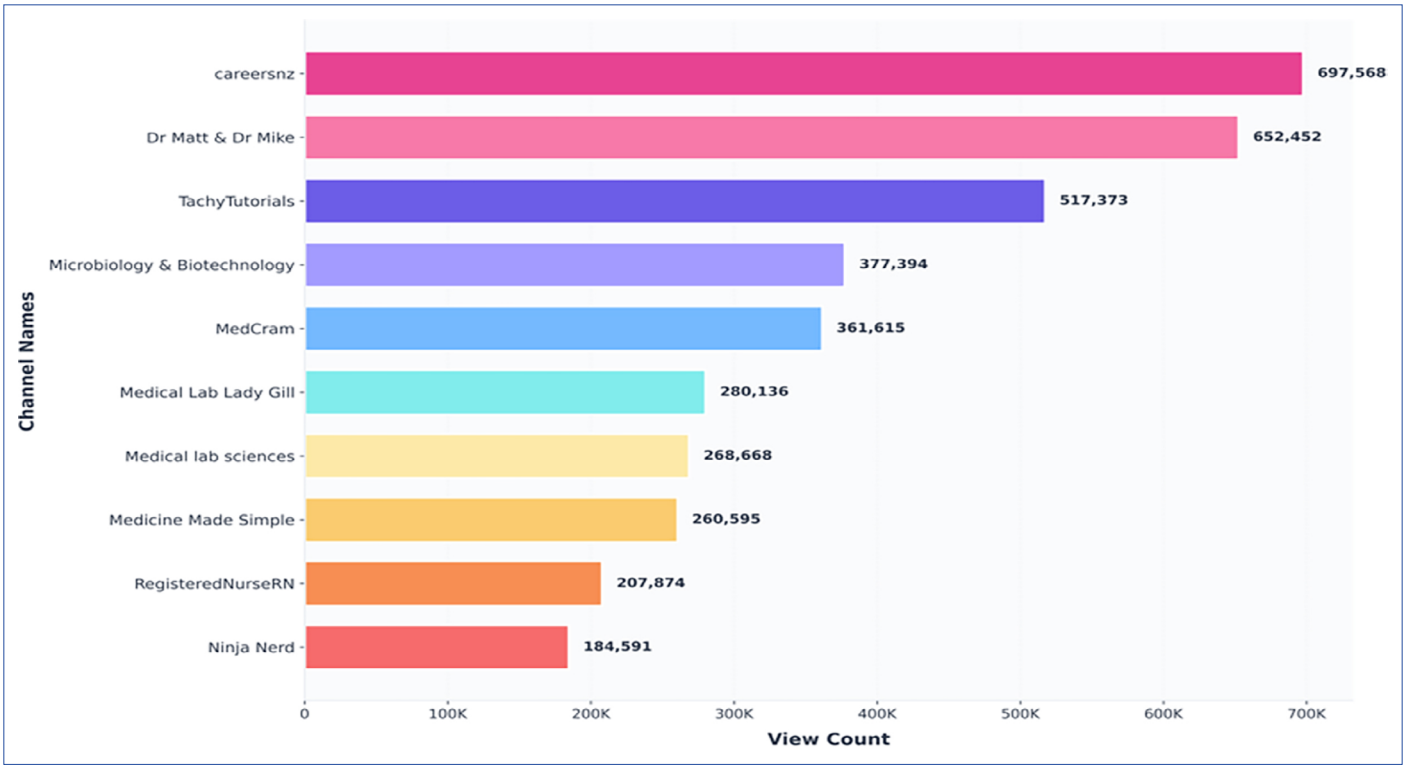

Figure 1. Top 10 most-viewed videos: Channel types and viewership metrics bar chart displaying view counts (in thousands, K=×1,000) for the ten highest-viewed videos (n=10/69).

Rank	Video ID	Title	Channel Name	Views	Quality Score	Category
1	YDWk-C8nN2Y	A day in the life of a Medical Laboratory Technician	careersnz	697,568	8/10	Career Introduction
2	6PTB254Kkbk	Urinalysis Explained	Dr Matt & Dr Mike	652,452	9/10	Test Interpretation
3	jjSinZsLdWY	ALT, AST, ALP & GGT (Liver Function Tests) - How to Interpret	TachyTutorials	517,373	8/10	Test Interpretation
4	E4a8g1o72AM	BIOCHEMICAL TEST | Bacterial Identification Technique	Microbiology & Biotechnology	377,394	7/10	Microbiology
5	57mvZvV3zpY	Liver Function Test Interpretation (LFTs) | Liver Enzymes	MedCram	361,615	9/10	Test Interpretation
6	DfLQizAR1VU	Hematology: How to interpret automated Complete Blood Count	Medical Lab Lady Gill	280,136	9/10	Automation
7	w8eCtpBbTa4	Enzymes and it's characters	Medical lab sciences	268,668	6/10	Basic Biochemistry
8	JVmPu8o2ycc	Full Blood Count (FBC/CBC) interpretation | COMPLETE GUIDE	Medicine Made Simple	260,595	8/10	Test Interpretation
9	2va2aT6lqrU	Metabolic Panel Explained: Basic (BMP) & Comprehensive	RegisteredNurseRN	207,874	8/10	Test Interpretation
10	JiaMJaA34Jg	Liver Function Tests (LFTs) | Clinical Medicine	Ninja Nerd	184,591	9/10	Test Interpretation

Figure 2. Detailed video analysis list displaying video ID, title, channel names, view counts, quality score, and content category for the top 10 most-viewed videos (n=10 of 69 total videos analyzed).

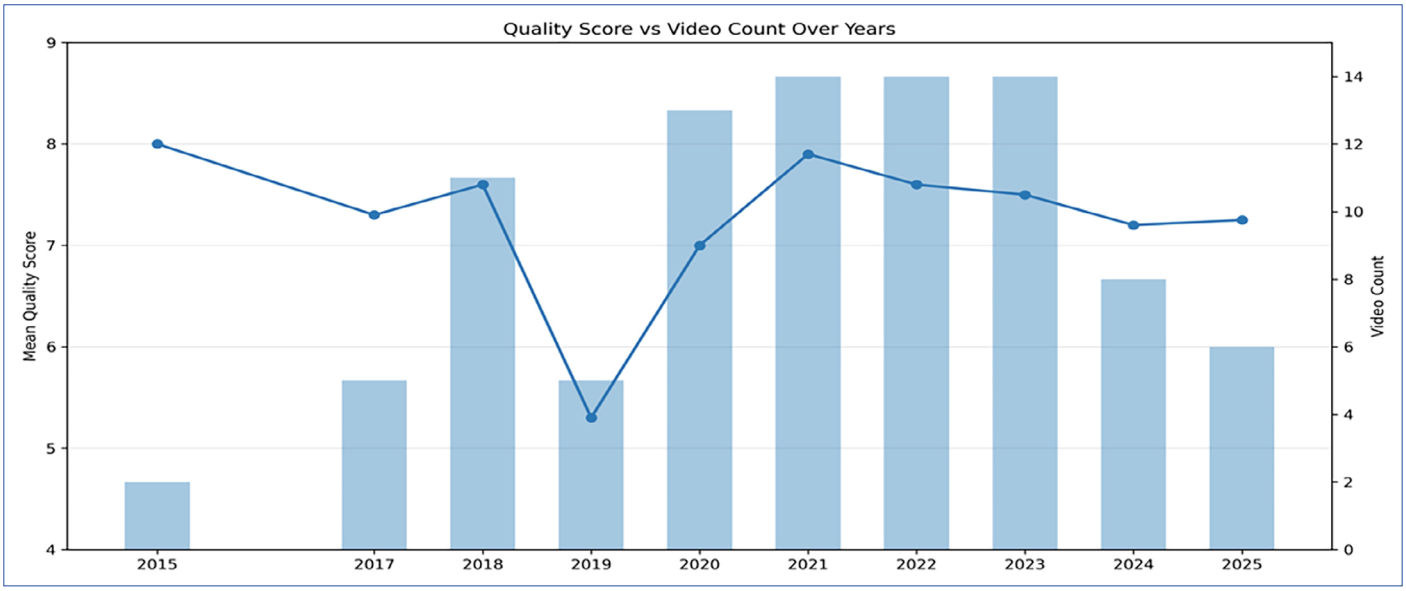

Figure 3. Quality score vs video count over years.

proportion substantially exceeds quality benchmarks documented in previous systematic reviews of medical content on the platform [10, 11]. The fact that high-quality content received statistically significantly more views (284,156 vs. 89,247, $p<0.001$) demonstrates that higher-quality content achieves greater visibility, which may be partially explained by platform algorithms favoring engagement metrics associated with quality ($r=0.782$, $p<0.001$). According to the linear regression model, for each 1-point increase in quality score, the videos receive an average of 40,267 additional views (95% CI: 32,450–48,084 [Table 3]). Effect size analysis, on the other hand, confirms that quality differences lead to significant differences in the number of viewers. These findings substantiate the hypothesis that content quality exerts a substantial influence on audience reach within the digital education ecosystem, with higher-quality educational content consistently attracting larger audiences [12].

In light of the data obtained from the analysis, the high representation of practical applications such as laboratory test interpretation (26.1%), Clinical laboratory specialist training

Table 2. Distribution of video quality categories and statistical comparisons (n=69)

Quality category	Video count (%)		Mean views ±SD	Cohen's d
	n	%		
High (8–10)	45	65.2	284,156±195,420	1.24†
Medium (5–7)	21	30.4	89,247±67,350	1.98‡
Low (1–4)	3	4.4	12,458±8,750	0.89§

†: High vs. Medium; ‡: High vs. Low; §: Medium vs. Low. SD: Standard deviation.

Table 3. Statistical analysis of video quality and viewership metrics

Metric	Value	Statistical significance
Descriptive statistics		
High-quality videos (mean views ±SD)	284,156±195,420	p<0.001
Medium-quality videos (mean views ±SD)	89,247±67,350	
Correlation analysis		
Pearson correlation coefficient®	0.782	p<0.001
95% Confidence Interval	[0.68, 0.86]	
Coefficient of determination (r^2)	0.612	
Variance explained by quality	61.2%	
Linear regression model		
Regression coefficient (β)	40,267	p<0.001
95% Confidence Interval for β	[32,450, 48,084]	
Intercept	-145,832	
Model R^2	0.612	
F-statistic	F(1.67)=104.83	p<0.001
Regression equation	Predicted View Count=-145,832+40,267×Quality Score	

Table 4. Channel types and viewership statistics

Channel type	Video count		Total views	Average views	Quality average
	n	%			
Corporate training	24	34.8	5,947,800	247,825	8.7/10
Individual education	31	44.9	4,682,550	151,050	7.3/10
Medical institutions	10	14.5	2,847,235	284,724	8.9/10
Universities	4	5.8	770,250	192,563	8.5/10

(17.4%) and hematology tests (11.6%) may indicate that digital education is evolving from theoretical knowledge transfer toward practical skill acquisition.

Word cloud analysis obtained from video transcripts reflects the technology-focused approach of modern laboratory education. The most frequently used terms were identified as "Clinical Chemistry," "Medical Laboratory," "Chemistry," "Lab," and "Automated." The word cloud (Appendix 2) shows that the graph is concentrated along the "clinical/medical laboratory" and "clinical chemistry" axes. The frequent appearance of device- and process-oriented terms ("analyzer," "automated") along with manufacturer names indicates a clear prominence of automation/equipment in the content and exhibits a trend aligned with the digital transformation process. Test-level terms (e.g., liver/thyroid function tests, urinalysis, blood count) and discipline names (hematology, microbiology, molecular) show that "laboratory diagnostics" subfields are represented in the corpus. Professional role/education terms ("technologist," "laboratory scientist," "training," "career") indicate that a portion of the texts focuses on education and careers. These observations highlighted three primary themes: (i) instrumentation/automation in clinical chemistry, (ii) routine biochemistry and hematology test panels, and (iii) professional training and roles. In summary, it can be inferred that technological developments, traditional and routine procedures, as well as specific test panels, are popular topics in clinical biochemistry for visual education and information access. Consequently, within the framework of educational transformation, emerg-

Table 5. Video content categories

Content category	Video count		Average views
	n	%	
Laboratory test interpretation	18	26.1	298,547
Clinical laboratory specialist training	12	17.4	156,892
Hematology tests	8	11.6	247,156
Liver Function tests	7	10.1	315,247
Laboratory automation systems	6	8.7	89,456
Kidney function tests	5	7.2	183,731
Thyroid function tests	4	5.8	68,307
Lipid profile tests	3	4.3	62,590
Metabolic panels	3	4.3	207,874
Biochemical tests (general)	3	4.3	251,548

ing and relevant topics should be systematically integrated into learning objectives, contingent upon their periodic evaluation and updating to ensure alignment with contemporary educational needs and evolving disciplinary knowledge.

The temporal analysis of content quality revealed a modest increase in mean quality scores from the pre-COVID period to the post-COVID era, though this difference did not reach statistical significance ($p>0.05$). This finding suggests that while the pandemic precipitated a substantial surge in video production volume, it did not significantly compromise the overall quality of educational content on the platform. The maintenance of quality standards during a period of rapid content expansion may reflect the progressive maturation of digital health education and the increasing engagement of credentialed professionals in online content creation. This model demonstrates a potential trade-off between quantity and quality, with the notable exception of 2021, when both high production volume and elevated quality scores were achieved concurrently. Moreover, the decline in both the number and quality of videos during the COVID-19 pandemic, followed by their subsequent recovery toward the end of the pandemic period, represents a significant factor in assessing the impact of this global health crisis on video-sharing platforms (Table 7; Fig. 3). This observation aligns with broader shifts in digital learning during the pandemic, when online education became essential for higher education institutions, fundamentally reshaping how educational content was created and consumed on digital platforms [13, 14].

The analyses conducted found that only 4.4% of videos fell into the low-quality category, which demonstrates the effectiveness of the selection criteria while also revealing that platform-wide quality control mechanisms need to be reviewed for educational purposes—in other words, there is a need for oversight of units that incorporate the platform into educational materials. The literature supports this need [7, 11]. Therefore, if educational clinics or institutions are considering or already obtaining educational support from digital platforms, it may be necessary to conduct video analyses under

Table 6. Video technical and source characteristics

Video characteristics	Count (%)		Mean±SD
	n	%	
Technical features			
Subtitle support	29	42.0	–
Verified channel	24	34.8	–
4K quality	18	26.1	–
Duration (minutes)	–	–	12.8±11.4
Expert identity			
Board certified	21	30.4	–
Corporate trainers	24	34.8	–
RMT (Registered Medical Technologist) / MLT (Medical Laboratory Technician)	15	21.7	–
Unverified	9	13.1	–

SD: Standard deviation.

Table 7. Distribution of video count and mean quality scores by publication period

Publication period	Video count (n)	Mean quality score ±SD	p
Pre-COVID (2015–19)	17	7.18±1.47	>0.05
Post-COVID (2020–25)	52	7.38±1.48	
Total	69	7.33±1.47	

expert supervision or establish digital education groups. The distribution of the analysis regarding expert identity verification is presented in Table 6. The determination that the uncertain identity rate is 13% validates the above finding.

The fact that 42% of videos include subtitle support (independent of automatic translation features) (Table 6) demonstrates that content on the platform can achieve global accessibility and serve educational purposes. The observation that 75.3% of videos experienced increased view counts after 2020 strongly confirms the pandemic's impact on rising demand for digital education. This suggests that the pandemic has become an irreversible aspect of global life. These findings indicate that clinical biochemistry education and professional collaboration have entered a more accessible era, making visual social media platforms increasingly vital to educational standards and emphasizing the importance of integrating them into conventional educational frameworks.

Limitations

This study has several important limitations that should be considered when interpreting the findings: Single Platform Analysis, Language Restriction, Single Rater Assessment, Quality Assessment Tool Limitations, Cross-Sectional Design, Selection Bias and Keyword Limitations, Lack of Learning Outcome Data, Technology Integration Assessment, Geographic and Temporal Context. These limitations suggest that findings

should be interpreted as: Specific to YouTube as a platform within the English-language educational landscape, Indicative of content quality potential rather than definitive learning effectiveness, Representative of 2015-2025 digital education trends rather than long-term stable patterns, Requiring validation through complementary research addressing learning outcomes, multi-platform analysis, and longitudinal follow-up

Conclusion

This study demonstrates that the YouTube platform is a valuable and important resource for clinical biochemistry education. The fact that 65.2% of the 69 analyzed videos meet high quality standards, with these videos reaching a total of 14.2 million views, reveals not only the outreach potential of digital education platforms in the field of clinical biochemistry but also the rich potential and diversity they offer for clinical biochemistry education. The findings obtained from the analysis of 69 videos strongly indicate that digital educational tools play a transformative role rather than merely a supplementary one to traditional education.

The high-quality performance and average viewership (247,825) of institutional channels underscores the critical importance of a reliable institutional identity in digital education. In conclusion, digital transformation in clinical biochemistry education is an inevitable process, and for this transformation to be successful, institutional approaches, quality assurance systems, continuous research and development activities, and global collaboration platforms are required. The analytical findings of this and similar studies can serve as a foundation for future research and policy development processes.

Disclosures

Online Appendix Files: https://jag.journalagent.com/ijmb/abs_files/IJMB-90958/IJMB-90958_(3)_IJMB-90958_Appendix.pdf

Ethics Committee Approval: The study was approved by the Elazığ Fethi Sekin City Hospital Ethics Committee (no: 2025/14-28, date: 04/09/2025).

Informed Consent: Informed consent was obtained from all participants.

Conflict of Interest Statement: The author declare that there are no competing interests associated with the manuscript.

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