

Infographics as a Learning Tool: Perceptions and Preferences of Undergraduate Medical Students

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Abstract

This quantitative study assessed infographics' perceptions, preferences, and effectiveness as a learning tool among Pakistani undergraduate medical students. The research focused on understanding the impact of infographics on knowledge acquisition, comprehension of complex medical concepts, and bridging the gap between theoretical learning and clinical practice. The study utilised a self-evaluated questionnaire developed through a meticulous literature review, self-evaluation, and expert input. The questionnaire covered demographics, perceptions, preferences, effectiveness in knowledge acquisition, impact on understanding complex medical concepts, and linking theoretical learning to clinical practice. The research was conducted at Shahida Islam Medical College, Lodhran, Punjab, Pakistan, and involved undergraduate medical students across various academic years. Data collection occurred between November 10 and November 30, 2023, with 229 participants. Quantitative analysis was conducted using SPSS, involving one-sample t-test, paired samples t-test, independent samples t-test, Pearson correlation, and multiple regression analysis to address specific hypotheses. Findings indicate a strong positive perception and preference for infographics among undergraduate medical students. Infographics were perceived as effective in enhancing knowledge acquisition, positively impacting the understanding of complex medical concepts, and bridging the gap between theoretical learning and clinical practice. Statistical analyses supported these perceptions, demonstrating significant relationships and explaining variance in students' perceptions and knowledge acquisition. This study highlights the substantial role of infographics as valuable tools in medical education, emphasising their positive impact on undergraduate medical students' learning experiences. The findings support the integration of infographics into medical curricula to enhance knowledge acquisition, comprehension, and application in real-life clinical settings.

Keywords: Infographics, medical education, undergraduate medical students, learning tool, visual literacy

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Introduction

Medical students are constantly bombarded with information. They must learn about the human body, diseases, medications, and treatments. This can be a lot to take in, and it can be challenging to remember everything (Helmich et al., 2012; Lyon, 2003). Infographics can be a helpful tool for medical students. Infographics are visual representations of information that can make complex topics easier to understand. They can summarise critical points, illustrate concepts, and provide a quick topic overview (Arcia et al., 2016; Bahanshal, 2023; Li et al., 2023; Sween-Cadieux et al., 2021).

In the dynamic landscape of medical education, the quest for effective learning tools continually evolves to enhance comprehension and retention among budding physicians. The journey through medical school demands a multifaceted approach, where the assimilation of complex information is necessary and pivotal for future medical practice. In this pursuit, the role of innovative pedagogical aids has garnered increasing attention, with one such tool emerging prominently: infographics (Tei-Narh & Nantwi, 2022).

The realm of medicine, with its labyrinthine pathways of knowledge and information, often presents a formidable challenge for learners. While rich in content, the conventional methods of textbooks, lectures, and academic journals may overwhelm students, hinder their understanding, or impede the efficient synthesis of crucial concepts. Recognising these challenges, educators and learners seek novel approaches that align with the cognitive processes of understanding while accommodating the demands of a fast-paced curriculum.

Enter infographics—a visual communication tool that simplifies complex information into a blend of visuals, text, and design elements (Butdisuwan et al., 2024; Shanks et al., 2017). Infographics are appealing not just for their aesthetics but for their ability to condense vast amounts of information into engaging and easily digestible formats (Chun, 2023; Provvidenza et al., 2019). For medical students pursuing a Bachelor of Medicine and Bachelor of Surgery (MBBS), infographics hold particular promise as a learning aid, given the extensive and intricate nature of medical knowledge.

The MBBS curriculum is an intellectual odyssey, traversing anatomy, physiology, pathology, pharmacology, and various specialised medical disciplines (Chun, 2023; Provvidenza et al., 2019). The conventional dissemination of such multifarious information through traditional means often encounters hurdles in engagement, comprehension, and information retention (Leroy et al., 2010). Infographics, on the other hand, offer a refreshing paradigm. By harnessing the power of visual storytelling, these graphic representations transcend the limitations of text-heavy resources, offering a

harmonious blend of concise information, captivating visuals, and structured design (Botsis et al., 2020). The fusion of illustrations, charts, graphs, and succinct textual cues in infographics possesses the potential to unravel the complexities of medical concepts, making them more accessible and comprehensible to aspiring physicians undertaking the rigorous MBBS programme (Hernandez-Sanchez et al., 2021; Huang et al., 2018; Martin et al., 2019; Oliveira et al., 2020).

The inherent advantage of infographics lies in their ability to facilitate not only comprehension but also long-term retention of information (Abbazio & Yang, 2022). Studies in cognitive science affirm that visual aids when strategically employed, can significantly enhance memory retention by leveraging the dual coding theory—engaging both visual and verbal channels of information processing (Keogh et al., 2021; Liu & Wu, 2023).

In the context of MBBS education, where the sheer volume of information can be overwhelming, infographics stand as a beacon of hope. This bridge connects the expanse of medical knowledge with students' diverse learning styles and cognitive processes. However, as with any educational tool, the efficacy of infographics in the medical realm warrants a comprehensive examination.

Advancements in medical education constantly strive to innovate and optimise learning methodologies for students pursuing Bachelor of Medicine and Bachelor of Surgery (MBBS) degrees. Among these innovative approaches, infographics, recognised for their capacity to amalgamate data, information, and visual elements into coherent and accessible representations, have surfaced as a promising adjunct to traditional teaching methods. Within the sphere of medical education in Pakistan, the incorporation and effectiveness of infographics still need to be explored. This research aims to bridge this gap by undertaking a comprehensive assessment of the perceptions and preferences held by Pakistani undergraduate medical students regarding the integration of infographics as a potent learning tool. In recognizing the dynamic and evolving educational landscape, this study seeks to discern the multifaceted impact of infographics in augmenting medical education, specifically focusing on their potential to enhance knowledge acquisition, simplify intricate medical concepts, and potentially bridge the gap between theoretical knowledge as encapsulated in medical textbooks, and its practical application in clinical scenarios.

Research Questions

1. What do Pakistani undergraduate medical students perceive infographics as a learning tool?

2. Do Pakistani undergraduate medical students prefer to learn from infographics rather than traditional methods?
3. How effectively are infographics enhancing knowledge acquisition among Pakistani undergraduate medical students?
4. Do infographics positively impact Pakistani undergraduate medical students' understanding of complex medical concepts?
5. Can infographics bridge the gap between medical textbooks and clinical practice for Pakistani undergraduate medical students?

Hypotheses

- H1: Undergraduate medical students positively perceive infographics as a learning tool.
- H2: Undergraduate medical students prefer to learn from infographics rather than traditional methods.
- H3: Infographics effectively enhance medical knowledge acquisition among Pakistani undergraduate medical students.
- H4: Infographics positively impact Pakistani undergraduate medical students' understanding of complex medical concepts.
- H5: Infographics can bridge the gap between medical textbooks and clinical practice for Pakistani undergraduate medical students.

Literature Review

Several studies underscore the pivotal role of infographics across various domains, particularly in healthcare and education. Falk (2016) highlights their significance in enabling prompt decision-making in healthcare, presenting evidence-based knowledge effectively without consuming excessive time. Infographics offer an efficient alternative to lengthy textual reports, empowering doctors to treat patients confidently.

Majooni et al. (2018) emphasise the layout's impact on infographics' usability, noting that vertical column presentations enhance comprehension and efficiency, reducing workload. The representation of data, especially in infographic form, holds substantial importance. Shcherbakova and Practice (2023) conducted a qualitative study revealing that a vast majority of college students, approximately 85%, are familiar with and utilise infographics as valuable tools for information acquisition and dissemination, saving considerable time in their studies.

Zadro et al. (2022) surveyed healthcare professionals, researchers, academicians, and patients. They found that a significant percentage (41%) preferred infographics over lengthy texts, seeking concise yet comprehensive information. Approximately 64% of respondents considered infographics time-saving tools, although researchers often complemented infographics with full-text reading for a deeper understanding.

Numerous studies echo the sentiment that infographics benefit medical education by providing updated information and saving time (Devine & Wathen, 2021; Jahan et al., 2021; McCrorie et al., 2016; Sherif, 2021). Similarly, research in English language education, such as Khan's study (2021) in Saudi Arabia, demonstrates students' positive perceptions and performance enhancement through infographic-based learning despite some teachers' initial discomfort with their use.

During the COVID-19 pandemic, infographics became instrumental in conveying disease trends to healthcare professionals and the general public, facilitating quick comprehension and informed decision-making (Chan et al., 2020). Suleiman (2023) noted that during this crisis, static infographics disseminated by health organisations in Egypt effectively conveyed credible information, emphasising disease severity and precautionary measures. In medical education, especially oncology radiations, Kok et al. (2022) stressed the importance of customised digital solutions, including infographics, to alleviate cognitive burdens and enhance learning outcomes.

Studies in higher education settings (Alqudah et al., 2019) and language learning (Putra et al., 2022) showcased varying impacts on student interaction and learning outcomes. The former indicated differences between scientific and humanistic college students in their interaction with infographics, while the latter demonstrated improved English language writing among students exposed to infographics.

Methodology

Study Overview

This quantitative study aimed to assess undergraduate medical students' perceptions, preferences, and the effectiveness of infographics as a learning tool in medical education. The research focused on understanding the impact of infographics on knowledge acquisition, comprehension of complex medical concepts, and bridging the gap between theoretical learning and clinical practice.

Initial Drafting

The questionnaire was initially drafted based on a comprehensive literature review focusing on the impact of infographics on medical education. This phase aimed to cover a broad spectrum of perceptions, preferences, and effectiveness in learning among undergraduate medical students.

Self-Evaluation

The initial draft underwent a self-evaluation phase where a pilot survey was conducted among a smaller group of medical students. Feedback on question clarity, relevance, and completeness was gathered to refine and modify the questionnaire structure.

Expert Input

Subsequently, the refined questionnaire was subjected to expert review by faculty members specialising in medical education and research methodology. Their feedback and recommendations were incorporated to enhance the questionnaire's validity, ensuring alignment with the research objectives and minimising bias.

Finalisation

After integrating suggestions from both the self-evaluation phase and expert input, the final version of the questionnaire was prepared. It comprised several sections focusing on demographics, perceptions, preferences, effectiveness in knowledge acquisition, impact on understanding complex medical concepts, and linking theoretical learning to clinical practice.

Research Instrument

The study utilised a comprehensive self-evaluated questionnaire titled —Undergraduate Medical Students’ Perceptions and Preferences for Infographics as a learning tool." The questionnaire comprised multiple sections targeting demographics, perceptions, preferences, effectiveness in knowledge acquisition, impact on understanding complex medical concepts, linking theoretical learning to clinical practice, and preferences for infographic integration in the medical curriculum.

Participants and Setting

The research was conducted at Shahida Islam Medical College, Lodhran, Punjab, Pakistan. Participants included medical students enrolled at the institution across various academic years.

Data Collection

Data collection occurred between November 10 and November 30, 2023. The in-person distribution of printed questionnaires facilitated data gathering among the medical students. Total number of study respondents is 229.

Data Analysis

Quantitative analysis was conducted using the Statistical Package for the Social Sciences (SPSS). Missing data were handled through multiple imputation techniques to ensure a robust dataset for analysis.

Statistical Analysis

Hypotheses and Corresponding Tests

One-sample t-test (H1 - Perception of Infographics)

Reason: This test was conducted to compare the mean perception score of medical students regarding infographics as a learning tool against a neutral value (e.g., 3 on a 5-point scale). It assesses whether their perceptions significantly differ from a neutral stance.

Paired samples t-test (H2 - Preference for Infographics)

Reason: This test compared preferences for infographics versus traditional methods within the same participants. It aimed to determine if medical students have a statistically significant preference for infographics over traditional methods.

Independent samples t-test (H3 - Effectiveness in Knowledge Acquisition)

Reason: Conducted to compare the knowledge acquisition scores between two groups (one exposed to infographics, one not exposed). It aimed to identify if there is a significant difference in knowledge acquisition between those exposed and those not exposed to infographics.

Pearson correlation (H4 - Impact on Understanding)

Reason: This analysis aimed to explore the relationship between exposure to infographics and understanding complex medical concepts. It assessed if there is a significant linear relationship between these variables.

Multiple regression analysis (H5 - Bridging the Gap):

Reason: Conducted to examine the predictive relationship between exposure to infographics and bridging the gap between textbook learning and clinical practice while controlling for potential confounders. This analysis allows studying the combined influence of multiple variables on the outcome.

These statistical tests were chosen to address each hypothesis by examining relationships, differences, or predictive capacities between variables measured in the questionnaire across different aspects of infographics' impact on medical students' perceptions, preferences, and learning outcomes in medical education.

Data Analysis

Section 1: Demographics

Table 1

Socio-Demographic Details

Demographics	Variables	Respondents	Percentage
Academic year in the MBBS program	First Year	81	35.4
	Second Year	7	3.1
	Third Year	15	6.6
	Fourth Year	77	33.6
	Fifth Year	18	7.8
	Intern/Resident (Sixth Year)	31	13.5
Age	18-20	81	35.4
	21-23	102	44.5
	24-26	35	15.3
	27-29	11	4.8
	30+	0	0
Gender	Male	92	40.2
	Female	137	59.8

Table 1 shows the socio-demographic analysis of respondents at Shahida Islam Medical College reveals several key insights. A total of 229 respondents participated in the study, with a balanced distribution across different academic years. The largest group was first-year students, comprising 35.4% of the respondents. This was closely followed by fourth-year students at 33.6%. Interns and residents (sixth year) made up 13.5% of the respondents, indicating active participation from those at advanced stages of their medical education.

Age-wise, the majority of respondents were between 21-23 years old (44.5%), followed by those aged 18-20 years (35.4%). A smaller proportion of respondents were in the 24-26 age bracket (15.3%), and even fewer were aged 27-29 (4.8%). Notably, there were no respondents aged 30 or above.

In terms of gender distribution, females constituted a larger proportion of the respondents (59.8%) compared to males (40.2%). This gender imbalance could reflect the broader demographic trends within the medical college or the healthcare profession.

Section 2: To assess Pakistani undergraduate medical students' perceptions and preferences for infographics as a learning tool.

Table 2

Medical Students' Perceptions of Infographics in Medical Education

Perceptions	Mean	Median	Mode	SD
Infographics are helpful in simplifying complex medical information.	3.55	4	4	1.179
Infographics effectively enhance my understanding of medical concepts.	3.63	4	4	0.953
I find infographics more engaging than traditional text-based learning materials.	3.51	4	4	1.041
Infographics facilitate quicker retention of medical information compared to text-only resources.	3.69	4	4	1.02
Infographics help in visualising medical data or processes better than other learning tools.	3.84	4	4	0.942
I prefer using infographics as a supplementary learning aid alongside textbooks.	3.78	4	4	0.915
Infographics help me remember medical concepts for a longer duration.	3.47	4	4	1.07
Infographics are a useful tool for summarising medical information.	3.61	4	4	0.974
I believe infographics are effective in enhancing my overall learning experience in medical studies.	3.7	4	4	0.945
I find infographics more enjoyable to use in studying medical topics.	3.72	4	4	0.927

Table 2 shows that Pakistani undergraduate medical students' perceptions of infographics as learning tools reveal a consistent positive inclination. Infographics garnered consistently high ratings across multiple aspects—simplifying complex medical information, enhancing understanding, engagement, retention, visualisation,

summarisation, and overall learning experience. Mean scores, varying from 3.47 to 3.84, centre predominantly around 4, indicating strong agreement with the statements. Medians and modes also consistently align closely with 4, signifying prevalent consensus within the surveyed group. The standard deviations, relatively low (ranging from 0.915 to 1.179), suggest minimal variability in responses, emphasising a collective inclination among these students to endorse infographics as valuable, engaging, and effective supplementary aids in comprehending and retaining complex medical information. These findings underscore a substantial inclination among medical students in Pakistan toward utilising infographics as beneficial tools augmenting their learning experiences in medical studies.

Table 3
Medical Students' Preferences for Medical Infographics

Preferences	Mean	Median	Mode	SD
I would choose infographics over plain text for studying medical concepts.	3.42	4	4	1.076
I actively seek out infographics when available for studying medical content.	3.66	4	4	0.931
I believe infographics should be integrated more into the medical curriculum.	3.83	4	4	0.833
I prefer infographics that incorporate both visuals and concise text for studying.	3.73	4	4	0.984
Infographics are my preferred choice for reviewing medical material before exams.	3.69	4	4	0.93
I would recommend the use of infographics to my peers for studying medical topics.	3.68	4	4	0.903
I believe infographics help in better understanding medical procedures or diagrams.	3.78	4	4	0.876
I feel more confident in my knowledge retention when using infographics.	3.62	4	4	0.986
Infographics are an essential part of a modern medical student's study resources.	3.7	4	4	0.913
I would like to have more access to infographics specifically designed for medical learning.	3.8	4	4	0.943

Table 3 reveals the preferences of medical students regarding medical infographics, demonstrating a strong inclination toward utilising visuals in studying medical concepts. The mean scores, ranging from 3.42 to 3.83, primarily cluster around 4, indicating a favourable attitude toward infographics. Medians and modes align closely with 4,

emphasising widespread agreement within the surveyed group. The responses exhibit minimal variability, with standard deviations ranging from 0.833 to 1.076, indicating a collective preference consensus.

Students prefer infographics over plain text when studying medical concepts and actively seek them out when available. They strongly believe that infographics should be integrated more into the medical curriculum and prefer infographics that combine visuals with concise text. Additionally, they express confidence in the effectiveness of infographics for better understanding medical procedures and diagrams, enhancing knowledge retention, and considering them an essential resource for modern medical students.

These findings underscore the medical students' inclination toward utilising and recommending infographics as crucial tools in comprehending and retaining complex medical information, highlighting a desire for increased access to tailored medical infographics.

Section 3: To determine the effectiveness of infographics in enhancing medical knowledge acquisition among undergraduate medical students

Table 4

Assessing the Impact of Infographics on Medical Knowledge Acquisition among Undergraduate Medical Students.

Assessing Infographics' Impact on Medical Knowledge Acquisition	Mean	Median	Mode	SD
Infographics have improved my understanding of complex medical concepts.	3.49	4	4	1.138
Infographics help me grasp medical information more quickly compared to traditional text-based resources.	3.74	4	4	0.959
Infographics facilitate better retention of medical knowledge.	3.85	4	4	0.907
Using infographics has increased my interest in exploring medical topics.	3.79	4	4	0.878
Infographics effectively break down complex medical information into easily understandable parts.	3.75	4	4	0.952
Infographics have positively impacted my ability to apply medical knowledge.	3.72	4	4	0.87
Infographics make it easier for me to remember medical facts and procedures.	3.69	4	4	0.87

I feel more confident in my medical knowledge after using infographics.	3.65	4	4	0.889
Infographics are an effective tool for reinforcing what I learn in my medical studies.	3.51	4	4	1.054
Infographics are an essential supplement to my regular medical study materials.	3.6	4	4	1.062

Table 4, an assessment of infographics' impact on medical knowledge acquisition among medical students in Pakistan, indicates a positive influence across various aspects. Mean scores, ranging from 3.49 to 3.85, predominantly cluster around 4, denoting a substantial positive impact. Medians and modes align closely with 4, highlighting widespread agreement within the surveyed group. Standard deviations, ranging from 0.87 to 1.138, indicate relatively low variability in responses, suggesting a collective consensus in assessing the impact of infographics.

Students perceive that infographics have significantly improved their understanding of complex medical concepts, facilitated quicker grasp and better retention of medical knowledge, and increased interest in exploring medical topics. They believe infographics effectively break down complex information, positively impacting their ability to apply medical knowledge, aiding memory recall, and reinforcing their regular study materials.

These findings underline the substantial positive impact of infographics on medical students' medical knowledge acquisition, highlighting their effectiveness in comprehension, retention, application, and overall support within the medical education framework.

Section 4: To evaluate the impact of infographics on understanding complex medical concepts among undergraduate medical students

Table 5
Evaluating Infographics' Impact on Comprehending Complex Medical Concepts

Impact of Infographics on Understanding Complex Medical Concepts	Mean	Median	Mode	SD
Infographics have clarified complex medical concepts that were initially challenging to understand.	3.43	4	4	1.048
Infographics have aided in comprehending intricate medical theories and principles.	3.66	4	4	0.798
Infographics have assisted in visualizing and grasping complex medical processes effectively.	3.5	4	4	1.05

Using infographics has improved my ability to understand medical concepts compared to traditional study materials.	3.64	4	4	0.953
Infographics have simplified convoluted medical information for better comprehension.	3.81	4	4	0.862
Infographics have enhanced my understanding of intricate medical diagrams or charts.	3.72	4	4	0.842
I find it easier to grasp the details of complex medical procedures through infographics.	3.69	4	4	0.993
Infographics have significantly contributed to my understanding of complex medical terminologies.	3.83	4	4	0.839
Infographics have played a vital role in breaking down complex medical topics into simpler, more understandable components.	3.86	4	4	0.884

Table 5, an evaluation of infographics' impact on understanding complex medical concepts among medical students in Pakistan, showcases a significant positive influence. Mean scores, ranging from 3.43 to 3.86, predominantly cluster around 4, indicating a strong positive impact. Medians and modes align closely with 4, highlighting widespread agreement within the surveyed group. Standard deviations, ranging from 0.798 to 1.05, suggest relatively low variability in responses, reflecting a collective consensus in evaluating the impact of infographics.

Students affirm that infographics have clarified initially challenging medical concepts, aided in comprehending intricate theories and principles, and effectively assisted in visualising complex medical processes. They believe infographics simplify convoluted information, enhance understanding of diagrams, facilitate grasping complex procedures' details, and significantly contribute to understanding complex terminologies and topics.

These findings underscore the substantial positive impact of infographics on medical students' comprehension of complex medical concepts. They serve as valuable aids in simplifying, visualising, and comprehending intricate medical information, contributing significantly to their overall understanding of the medical curriculum.

Section 5: Infographics have been instrumental in my ability to comprehend the interconnectedness of various complex medical concepts.

Table 6
Assessing Infographics' Role in Linking Textbook Learning to Clinical Practice

Infographics' Role in Linking Medical Textbooks to Clinical Practice	Mean	Median	Mode	SD
Infographics help me visualise how theoretical knowledge from textbooks translates to clinical scenarios.	3.5	4	4	1.05
Infographics aid in understanding how medical concepts learned in textbooks apply to real-life patient cases.	3.69	4	4	0.872
Infographics facilitate the connection between theoretical medical knowledge and its practical application in clinical settings.	3.69	4	4	0.877
Using infographics enhances my ability to bridge the gap between textbook information and clinical decision-making.	3.76	4	4	0.821
Infographics provide a clearer understanding of how to apply textbook knowledge during patient diagnosis and treatment.	3.88	4	4	0.823
Infographics help in visualising the practical implications of theoretical medical concepts.	3.45	4	4	1.061
I find infographics useful in bridging the gap between learning theoretical concepts and their clinical relevance.	3.62	4	4	0.902
Infographics assist in understanding the practical implications of medical theories for patient care.	3.83	4	4	0.823
Infographics provide a link between textbook learning and the practical skills required in clinical practice.	3.79	4	4	0.904
Using infographics improves my ability to apply textbook knowledge to actual patient scenarios.	3.86	4	4	0.952

Table 6, an assessment of infographics' role in connecting textbook learning to clinical practice among medical students in Pakistan, illustrates their significant contribution to bridging theoretical knowledge to practical application. Mean scores, ranging from 3.45 to 3.88, predominantly cluster around 4, indicating a substantial positive impact. Medians and modes align closely with 4, highlighting widespread agreement within the surveyed group. Standard deviations, ranging from 0.821 to 1.061, suggest relatively low variability in responses, reflecting a collective consensus in assessing the role of infographics.

Students acknowledge that infographics help visualise how theoretical knowledge translates into clinical scenarios, aid in understanding practical applications of textbook concepts inpatient cases, and facilitate the connection between theoretical knowledge and its practical implementation in clinical settings. They perceive

infographics as valuable tools in bridging the gap between textbook learning and clinical decision-making, providing clarity in applying theoretical concepts during patient diagnosis and treatment.

These findings emphasise the substantial role of infographics in enhancing medical students' comprehension and application of theoretical knowledge to real-life clinical settings. Infographics serve as vital aids in linking textbook learning to the practical skills and decision-making essential in their future clinical practice.

Table 7

One-Sample Test for Perceptions of Infographics among Medical Students

One-Sample Test						
	Test Value = 3					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Perception	13.441	228	0	0.65109	0.5556	0.7465

Table 7 conducts a one-sample t-test to assess medical students' perceptions of infographics. The test compares these perceptions to a presumed mean value of 3. The analysis yields a significant difference, evident from a high t-statistic of 13.441 with 228 degrees of freedom and a p-value of 0. This outcome rejects the null hypothesis, indicating that medical students' perceptions differ significantly from the assumed mean of 3.

The difference between the observed perception mean and the test value is 0.65109. This difference is a 95% confidence interval that spans from 0.5556 to 0.7465, further supporting the rejection of the null hypothesis as this interval does not encompass the test value of 3.

The results highlight a marked positive leaning towards infographics among students. Their perceptions clearly surpass the assumed mean value of 3 when measured using the provided scale. This implies a robustly favourable stance regarding infographics among this student cohort, emphasising their strong positive perception of infographics as learning tools in medical education.

Table 8
ANOVA for Evaluating the Impact of Infographics on Medical Knowledge Acquisition

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86.353	4	21.588	133.735	0
	Residual	36.159	224	0.161		
	Total	122.512	228			

An ANOVA evaluating the effect of infographics on medical knowledge acquisition is shown in Table 8. The analysis dissects variance into two components: explained and unexplained.

In the regression model, infographics account for a substantial portion of the variance, explaining 86.353 units of the total 122.512 variance in medical knowledge acquisition. This signifies infographics' influence on understanding medical concepts among medical students.

The residual component, representing unexplained variance or error in the model, totals 36.159 units. This residual variation might encompass factors beyond the scope of the study or unaccounted influences on medical knowledge acquisition.

Crucially, the F-statistic of 133.735 with a significance level (p-value) of .000 reflects a highly significant relationship between infographics and medical knowledge acquisition. This indicates that infographics are crucial in explaining the observed variance in how undergraduate medical students acquire medical knowledge.

In essence, the ANOVA emphasises infographics as a significant explanatory factor in enhancing medical knowledge acquisition among the surveyed medical students. The results underline their pivotal role as effective tools in comprehending and grasping medical concepts within the context of medical education.

Table 9

Coefficients of Perceptions, Impact, Evaluation, and Role in Infographic Perception

Model		Coefficients				
		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Constant	-0.065	0.169		-0.384	0.701
	Perfection	0.621	0.07	0.539	8.848	0
	Impact	0.057	0.08	0.052	0.705	0.482
	Evaluation	0.355	0.083	0.323	4.272	0
	Role	-0.025	0.077	-0.022	-0.328	0.743

Table 9 depicts coefficients revealing factors influencing medical students' perception of infographics. Perfection and Evaluation exhibit significant impacts, positively shaping perceptions. A one-unit increase in Perfection correlates with a 0.621 rise in perception scores, while higher Evaluation scores relate to a 0.355 increase. Impact and Role, however, show non-significant relationships, suggesting a limited influence on infographic perception within this model. These findings underscore the substantial influence of perfectionist tendencies and the perceived value of evaluation in shaping positive attitudes toward infographics among medical students, highlighting these factors as pivotal in fostering favourable perceptions of educational tools in medical contexts.

Table 10

Correlations between Perceptions, Perfection, Impact, Evaluation, and Role

		Correlations				
		Perception	Perfection	Impact	Evaluation	Role
Perception	Pearson Correlation	1	.810**	.717**	.759**	.665**
	Sig. (2-tailed)		0	0	0	0
	N	229	229	229	229	229
Perfection	Pearson Correlation	.810**	1	.769**	.762**	.710**
	Sig. (2-tailed)	0		0	0	0
	N	229	229	229	229	229

Impact	Pearson Correlation	.717**	.769**	1	.830**	.794**
	Sig. (2-tailed)	0	0		0	0
	N	229	229	229	229	229
Evaluation	Pearson Correlation	.759**	.762**	.830**	1	.812**
	Sig. (2-tailed)	0	0	0		0
	N	229	229	229	229	229
Role	Pearson Correlation	.665**	.710**	.794**	.812**	1
	Sig. (2-tailed)	0	0	0	0	
	N	229	229	229	229	229

** . Correlation is significant at the 0.01 level (2-tailed).

Table 10 demonstrates robust correlations among medical students' perceptions of perfection, impact, evaluation, role, and infographic perception. Strong positive correlations exist between perceptions and all other factors: Perfection (0.810**), Impact (0.717**), Evaluation (0.759**), and Role (0.665**). These factors also display strong mutual correlations among themselves: Perfection correlates strongly with Impact (0.769**), Evaluation (0.762**), and Role (0.710**). Impact showcases significant associations with Evaluation (0.830**) and Role (0.794**), while Evaluation strongly correlates with Role (0.812**). These robust correlations emphasise the cohesive relationship among perceptions, perfectionist tendencies, impact, evaluation, and role, collectively influencing medical students' positive perceptions of infographics in the context of medical education.

Discussion

This research reveals several informative insights regarding perceptions and preferences for infographics as a learning tool among medical students. However, after interpreting the consequences, medical students strongly endorsed and suggested that infographics should be part of their curricula because they are essential for modern medical education and help them summarise medical literature.

In this study, multiple aspects were asked to assess the perception of infographics among medical students—simplifying complex medical information, enhancing understanding, engagement, retention, visualisation, summarization, and overall learning experience infographics were rated persistently high. Our hypothesis was supported by

Pakistani medical students positively perceiving infographics as a learning tool. Furthermore, according to the present study's findings (Bicen & Beheshti, 2022; Jaleniauskiene & Kasperiuene, 2023), it was evident that infographics improve learning and communication skills and learning outcomes.

Secondly, these results indicated the need for more access to tailored medical infographics. They emphasised the ability of undergraduate medical students to use and promote infographics as essential tools for the retention and comprehension of challenging medical information. On the other hand, Karre (2015) and Yildirim (2016) also reported that infographics made learning more accessible, enhanced analytical abilities, clearly showed the relationships between concepts, and elevated the efficacy of instruction. Infographics are more frequently used by students than plaintext, as students perceive them to provide additional information and a more effective way to develop a better understanding (Patel et al., 2020). Infographics effectively enhance medical knowledge acquisition among undergraduate students supporting our hypothesis.

Thirdly, we determined the effectiveness of infographics in enhancing medical knowledge acquisition among medical students in Pakistan. They demonstrate the advantages of using infographics to acquire medical students' medical knowledge. Additionally, it shows how well infographics perform for understanding, remembering, applying, and providing general support within medical education. These results are compatible with Habibi et al. (2023) and Noh et al. (2015), who argue that infographics aid in analysing complicated medical information and help improve medical students' critical thinking.

Fourthly, our null hypothesis was rejected. The results suggested that this student cohort has a firmly reasonable opinion of infographics, highlighting their strong positive perception of infographics as teaching aids in medical education. Additionally, these consequences are consistent with Martin et al. (2019), who also claim infographics could improve their knowledge of new medical literature rather than traditional methods.

Lastly, we identified the role of linking medical textbooks to clinical practice and found significant contributions to integrating the theoretical and practical implications of knowledge. These results are also compatible with Vanichvasin (2013), who states that infographics bridge knowledge and practice. A strong positive correlation existed between perceptions and all other factors: Perfection, Impact, and Role.

It can be inferred from the analysis of the data collected for this study that infographics effectively enhance the acquisition of medical knowledge among undergraduate medical students in Pakistan. Therefore, infographics should be encouraged as a learning tool in medical education. Moreover, training in creating and

using infographics may be arranged to spread awareness about the usefulness of infographics and to increase their further use in academic settings (Boss and Larmer, 2018).

Study Implications

The positive perceptions and preferences for infographics among undergraduate medical students at Shahida Islam Medical College highlight several key implications for medical education. First off, there is widespread agreement among students that using infographics in the curriculum can significantly improve knowledge acquisition and comprehension of difficult medical concepts. This suggests that other medical schools should consider integrating infographics into their teaching materials to improve learning outcomes. Additionally, the use of infographics can bridge the gap between theoretical learning and clinical practice, facilitating a smoother transition for students into practical settings. The findings also underscore the need for educational institutions to invest in training faculty and students on the effective creation and use of infographics, thereby fostering a more engaging and effective learning environment. Lastly, the widespread positive reception of infographics among students indicates their potential as a scalable educational tool that can be adapted across various disciplines and educational levels to enhance overall educational experiences.

Conclusion

This study sheds light on the significant role that infographics play in the learning experiences of Pakistani undergraduate medical students. The findings reveal students' consistent and positive inclination towards infographics as valuable tools for comprehending and retaining complex medical information. The perceptions and preferences articulated by the participants underscore the potential of infographics to enhance the overall medical education experience.

The study indicates that infographics are perceived as helpful in simplifying complex medical information and are preferred over traditional text-based learning materials. The effectiveness of infographics in knowledge acquisition, as evidenced by the positive impact on understanding complex medical concepts, is particularly noteworthy. Students strongly preferred infographics as a supplementary learning aid and demonstrated a belief in their effectiveness in reinforcing and improving knowledge retention.

Furthermore, the positive impact of infographics extends beyond theoretical learning, as students acknowledged their ability to bridge the gap between medical textbooks and clinical practice. Infographics were seen as instrumental in visualising how theoretical knowledge translates into real-life clinical scenarios, fostering a better

understanding of practical applications of medical concepts, and improving the application of textbook knowledge to actual patient scenarios.

The study contributes to the existing literature by providing insights into the perceptions and preferences of undergraduate medical students in a non-Western context, specifically in Pakistan. The positive findings advocate for the integration of infographics into medical education curricula, emphasising the need for tailored and accessible medical infographics to support students' learning experiences further.

Educators and curriculum developers can leverage these findings to enhance teaching methods, making medical education more engaging and effective. The study's limitations, including sample size and institutional focus, should be considered when interpreting the results. Future research could explore the implementation of infographics across various medical institutions and cultures to understand their impact on medical education better globally.

Ultimately, the positive perceptions and preferences of Pakistani undergraduate medical students in this study emphasise the potential of infographics as a valuable and effective pedagogical tool in medical education, with implications for improving learning outcomes and bridging the gap between theoretical knowledge and clinical practice.

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