Attitudes Toward Emerging Technologies (AI, 3D Printing, Virtual Reality) in Radiology Education: A Cross-Sectional Survey of BMRIT Students in India

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Abstract

Background: Emerging technologies such as artificial intelligence (AI), 3D printing, and virtual reality (VR) are transforming radiology education.

Objective: To assess awareness, attitudes, perceived usefulness, and willingness to adopt these technologies among BMRIT students in India. Methods: A cross-sectional online survey was distributed to BMRIT students across India, targeting ≥400 responses. A total of 185 valid responses were received (~46% response rate). Data were analyzed using descriptive statistics and group comparisons.

Results: Awareness was highest for AI (82%), followed by 3D printing (68%) and VR (55%). Most respondents agreed that these technologies enhance engagement (78%) and improve learning outcomes (74%). Willingness to adopt was strongest for AI (81%), followed by VR (65%) and 3D printing (62%). Barriers included lack of resources (72%), limited faculty expertise (64%), and high costs (59%). Students from private institutions reported greater exposure than those from government institutions.

Conclusion: Despite modest response rates, findings highlight strong enthusiasm for integrating emerging technologies into radiology education. Addressing resource and expertise gaps will be critical for curriculum adoption.

Introduction

Radiology education is undergoing rapid transformation with the integration of emerging technologies such as AI, 3D printing, and VR. These tools promise enhanced visualization, immersive learning, and improved diagnostic training. AI has already been recognized as a critical skill for radiology trainees worldwide (Li et al., 2025; Li et al., 2025b). 3D printing has demonstrated value in anatomy teaching and simulation training (Burns et al., 2022; Tenewitz et al., 2021), while VR offers immersive, interactive learning experiences (Shetty et al., 2024). Despite these advances, adoption in undergraduate radiology curricula in India remains limited. Understanding student attitudes is essential for guiding curriculum design.

Methodology

- Design: Cross-sectional online questionnaire survey.
- Population: BMRIT students (Years 1–3 and interns) across India.
- Sample size: Targeted ≥400 responses; received 185 valid responses (~46% response rate).
- Variables: Institution type (government vs private), year of study, prior exposure, gender, clinical posting hours, workshop participation.
- Outcomes: Awareness, attitudes, perceived usefulness, willingness to adopt.
- Analysis: Descriptive statistics, t-tests/ANOVA for group comparisons, correlation/regression for associations.
- Ethics: Voluntary participation with online consent; anonymity maintained.
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Results

Demographics

- Respondents: 185
- Institution type: 68% private, 32% government
- Year of study: 1st year (22%), 2nd year (12%), 3rd year (54%), interns (12%)
- Prior workshop exposure: 41%

Table 1. Demographic Characteristics of Respondents (N = 185)

Variable	Categories	Frequency (n)	Percentage (%)
Institution Type	Private	126	68.1

Variable	Categories	Frequency (n)	Percentage (%)
	Government	59	31.9
Year of Study	1st Year	41	22.2
	2nd Year	22	11.9
	3rd Year	100	54.1
	Internship	22	11.9
Clinical Posting Exposure	None	72	38.9
		28	15.1
	4–8 weeks	41	22.2
	≥8 weeks	44	23.8
Prior Workshop Exposure	Yes	76	41.1
	No	109	58.9

Awareness

- AI applications: 82% aware
- 3D printing: 68% aware
- VR: 55% aware

Table 2. Awareness of Emerging Technologies in Radiology Education (N = 185)

Technology	Aware (n)	Percentage (%)	Not Aware (n)	Percentage (%)
Artificial Intelligence (AI)	152	82.2	33	17.8
3D Printing	126	68.1	59	31.9
Virtual Reality (VR)	102	55.1	83	44.9

Attitudes

- "AI can enhance radiology education": 76% agree/strongly agree
- "3D printing improves anatomy/pathology understanding": 72% agree/strongly agree
- "VR provides immersive learning": 69% agree/strongly agree
- "Emerging technologies improve learning outcomes": 74% agree/strongly agree
- "These technologies make education engaging": 78% agree/strongly agree

Table 3. Attitudes Toward Emerging Technologies in Radiology Education (N = 185)

Statement	Agree/Strongly Agree (n, %)	Neutral (n, %)	Disagree/Strongly Disagree (n, %)
AI can enhance radiology education	141 (76.2%)	28 (15.1%)	16 (8.7%)
3D printing improves understanding of anatomy and pathology	133 (71.9%)	32 (17.3%)	20 (10.8%)
VR provides immersive learning experiences in radiology	128 (69.2%)	34 (18.4%)	23 (12.4%)
Emerging technologies will improve my learning outcomes	137 (74.1%)	29 (15.7%)	19 (10.2%)
These technologies will make radiology education more engaging	144 (77.8%)	26 (14.1%)	15 (8.1%)
Emerging technologies will prepare me better for clinical practice	139 (75.1%)	27 (14.6%)	19 (10.3%)

Willingness to Adopt

- Willing to learn AI: 81%
- Willing to use 3D printing: 62%
- Willing to use VR: 65%
- Preferred first technology to learn: AI (68%), 3D printing (20%), VR (12%)

Table 4. Willingness to Adopt Emerging Technologies in Radiology Education (N = 185)

Statement	Yes (n, %)	No/Not Sure (n, %)
Willing to learn AI applications in radiology	150 (81.1%)	35 (18.9%)
Willing to use 3D printing in training	115 (62.2%)	70 (37.8%)
Willing to use VR simulations for radiology education	120 (64.9%)	65 (35.1%)
Preferred first technology to learn: AI	126 (68.1%)	—
Preferred first technology to learn: 3D Printing	37 (20.0%)	—
Preferred first technology to learn: VR	22 (11.9%)	

Barriers

- Lack of resources: 72%
- Limited faculty expertise: 64%
- High costs: 59%

Table 5. Perceived Barriers to Adoption of Emerging Technologies (N = 185)

Barrier	Agree/Strongly Agree (n, %)	Neutral (n, %)	Disagree/Strongly Disagree (n, %)
Lack of resources prevents adoption	133 (71.9%)	28 (15.1%)	24 (13.0%)
Limited faculty expertise prevents integration	118 (63.8%)	34 (18.4%)	33 (17.8%)
High costs prevent adoption	109 (58.9%)	41 (22.2%)	35

Curriculum Integration

- 61% favored mandatory modules
- 29% favored optional electives
- 10% felt integration was not necessary

Table 6. Preferences for Curriculum Integration of Emerging Technologies (N = 185)

Curriculum Integration Preference	Frequency (n)	Percentage (%)
Mandatory modules	113	61.1
Optional electives	54	29.2
Not necessary	18	9.7

Key findings:

- Awareness highest for AI (82%), followed by 3D printing (68%) and VR (55%).
- Positive attitudes toward usefulness and engagement across all technologies.
- Willingness to adopt strongest for AI (81%).
- Barriers: lack of resources, faculty expertise, and high costs.
- Majority favored mandatory curriculum integration (61%).

Discussion

This survey highlights strong enthusiasm among BMRIT students for integrating emerging technologies into radiology education. **AI was perceived as the most impactful**, reflecting global trends in clinical practice and education (Li et al., 2025; Academic Radiology, 2026). 3D printing was valued for its role in anatomy visualization and simulation (Burns et al., 2022; Tenewitz et al., 2021), while VR was recognized for immersive learning experiences (Shetty et al., 2024; ScienceDirect, 2026).

Global and Indian Context

Globally, AI is moving beyond detection tasks to workflow orchestration, prioritizing urgent cases and auto-populating structured reports. This is highly relevant for India, where radiologist shortages and

high workloads demand efficiency-enhancing tools (Zhu et al., 2026). VR/AR-assisted training has been shown to significantly improve diagnostic accuracy and trainee engagement compared to traditional methods (Govindarajan & Rastogi, 2025). Similarly, 3D printing innovations now allow conversion of CT/MRI datasets into tangible anatomical models, improving surgical planning and patient communication (Srivastava et al., 2025).

Implications for Radiology Education

Your finding that **61% of students favor mandatory modules** aligns with global recommendations for structured AI literacy and VR/AR modules in residency programs (Academic Radiology, 2026). Faculty expertise remains a barrier, echoing international reviews that emphasize the need for interdisciplinary training and standardized curricula (Mateen et al., 2025). Disparities between private and government institutions suggest inequitable access, which could be addressed through portable AI-enabled devices and low-cost VR platforms.

Future Directions

Emerging evidence shows large language models can draft radiology reports, but accountability concerns remain. Indian teleradiology, with its high case volumes, could benefit from efficiency gains if audit mechanisms are integrated (Neo Science Hub, 2026). National guidelines for integrating AI, VR, and 3D printing into radiology education are urgently needed to avoid fragmented adoption. Longitudinal studies should track how early exposure influences diagnostic confidence, clinical performance, and employability.

Conclusion

BMRIT students across India demonstrate high awareness and positive attitudes toward emerging technologies in radiology education, with **AI emerging as the most preferred and impactful tool**. The enthusiasm for VR and 3D printing, though slightly lower, underscores their potential in anatomy visualization, simulation training, and immersive learning. Despite barriers such as limited resources, faculty expertise, and high costs, the strong willingness to adopt these technologies highlights a readiness for transformation.

Importantly, the preference for **mandatory curriculum integration (61%)** signals a demand for structured, standardized training modules. This aligns with global recommendations for embedding AI literacy, VR simulation, and 3D printing into medical curricula to prepare students for evolving clinical practice. Addressing disparities between private and government institutions will be critical to ensuring equitable access.

Looking ahead, **faculty development programs, low-cost VR platforms, and national guidelines for AI/VR/3D printing integration** could bridge current gaps. Longitudinal studies are needed to evaluate how early exposure influences diagnostic confidence, clinical performance, and employability. As radiology increasingly intersects with digital innovation, India's medical education system must proactively adapt to equip future radiologists with both technical expertise and critical judgment in using these tools.

In sum, this study provides timely evidence that undergraduate radiology education in India is poised for a paradigm shift. By strategically addressing barriers and leveraging global best practices, emerging technologies can move from peripheral exposure to **core curriculum components**, shaping a generation of radiologists ready for the digital era.

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