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The Impact of Technology-Based Dental Education on Patient Perception and Satisfaction in Dental Setting: A Qualitative Study

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Abstract:

- ***Background***

Digital technology in dental education has changed how dentists communicate with and educate patients. Although quantitative studies show benefits of technology-based tools, limited qualitative evidence exists on patient perceptions.

- ***Aim***

This study aimed to explore patients' experiences, perceptions, and satisfaction with technology-based dental education.

- ***Method***

A qualitative exploratory design was used. Semi-structured interviews were conducted with 150 adult patients who received technology-based dental education during treatment at a tertiary dental care center using purposive sampling. Interviews were conducted in English or Tamil, audio-recorded, transcribed verbatim, and translated where required. Data were analyzed using inductive thematic analysis following Braun and Clarke's framework.

- ***Results***

Eight themes emerged. Patients reported improved understanding of their dental condition using visual aids such as videos, intraoral images, and digital radiographs. Technology-based education reduced fear and anxiety, improved trust,

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and increased satisfaction with care. Digital explanations were preferred over verbal explanations when combined with clear communication. Challenges included information overload, limited digital literacy, and concerns about time and cost. Patients emphasized that technology should support, not replace, human interaction.

- ***Conclusion***

Technology-based dental education improves patient understanding and satisfaction when used in a patient-centered manner. Combining digital tools with empathetic communication supports patient engagement in dental practice.

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I. INTRODUCTION

The incorporation of technology into dental education has drastically transformed the teaching process; and allows for contemporary teaching practices as well as better communication to patients. Previously, dominant forms of patient education with verbal and written explanations are being increasingly replaced by or supplemented with- digital media including videos, animations, 3D models and interactive chairside systems (1). These have proved not only to improve dental education but also provide enhanced clinician-patient communication. In dentistry, provision of quality care is related to effectiveness of communication and the emphasis placed on patient education (2).

Well-informed patients, about their diagnosis, treatment options, and prognosis tend to be more compliant with recommended therapy and become less anxious/worried about receiving dental care, they were also typically more satisfied with their dental visits (3). The employment of technology in patient education provides an enhanced visual understanding and personalized explanation, ensuring active participation by patients in their treatment planning and decision-making (4). The efficacy of these technology-mediated educational approaches might be different among patients with differing socioeconomic backgrounds, such as educational level, occupation and income (5). Patients with higher educational qualifications often possess better health literacy and are more comfortable using digital media, allowing them to grasp complex dental concepts more easily (6).

Employees in technology-driven positions are more adaptable to digital learning platforms and interactive systems within a dental practice (7). This familiarity can potentially boost the confidence, utilization and satisfaction of dental education through these contemporary modalities.

Conversely, patients from lower socio-economic backgrounds may struggle to have access to or comprehend digital educational material because of limited exposure to technologies, low literacy levels, and financial limitations that prevent them from having devices and internet connection (8). These disparities can influence how effectively patients engage with educational interventions, ultimately affecting their perception of care quality and satisfaction levels.

Recognizing the gap between different socioeconomic groups matters if we want technology-driven dental education to work for everyone - not just those who already have easy access. Dentists need to think about how people's backgrounds shape their comfort with digital tools. Some patients catch on quickly, but others struggle because they haven't had much exposure to technology or simply can't access it. But when dental professionals adjust their approach - choosing the right digital communication methods for each individual - they can open up access to information and also make dentist–patient conversations more meaningful, and boost how satisfied people feel about their dental care (9).

Patients react to technology in dental education depends on a mix of factors: education, job, income, and their past experience with technology (10). Some feel right at home; others don't. That's why it's so important to look closely at how technology-based dental education shapes patient understanding, perception, and satisfaction in real clinical settings.

This study digs into those questions in detail, aiming to help dentists design communication strategies that include everyone so no patient gets left out just because of their background. Most studies focus on numbers, showing that digital tools help with dental training (11). But the personal, qualitative side - what patients actually think and feel about those technologies, haven't got enough attention. This research zeroes in on patients' real-world encounters with digital learning aids during dental visits. It asks: How well do these tools work from the patient's point of view? Are they satisfied with tech-supported communication? What works, and what doesn't? The aim was to provide dentists practical advice on how to make educational practices better, strengthen patient communication, and ultimately make dental care more centered around the patient - all by weaving technology into the process in a thoughtful way. Therefore technology-based dental education might improve how patients understand their treatment, how they feel about the quality of care, and how engaged they are during their visits.

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II. MATERIALS AND METHODOLOGY

➢ *Study Design:*

A qualitative exploratory approach was utilized to get a close-up look at patients' views on technology-based education. Semi-structured interviews was conducted to understand how patients felt about and how satisfied they were with, using these digital dental education tools in real clinical settings.

➢ *Ethical Considerations:*

The Institutional Ethics Committee of Tagore Dental College and Hospital approved the research (IEC/TDCH/48/2025). Participation was entirely voluntary and all responses were recorded anonymously. Informed consent was obtained from all participants involved in the study, before the start of the study.

➢ *Participants:*

Heterogenous purposive sampling technique was followed to obtain 150 study participants, who had previously undergone dental treatment. (12).

- *Inclusion Criteria:*

Patients between the age of 18 and 45 years, who had received dental treatment and willing to give informed consent, to join a recorded interview session.

- *Exclusion Criteria:*

Patients who had cognitive or communication issues that would interfere with participating, along with anyone who didn't want to take part or withdrawing during the study.

➢ *Data Collection:*

Data was obtained through individual, semi-structured interviews aimed at exploring patients' thoughts and feelings about technology-based education during their dental visits (11). Interviews were held over a set time frame at the outpatient department.

➢ *Interview Process:*

Each interview happened face-to-face in a quiet space, giving patients privacy and comfort. Sessions lasted 10 to 20 minutes, depending on depth of information. A semi-structured guide with open-ended questions focused on:

• how clearly the technology explained things
• comfort and confidence during treatment
• how useful digital demonstrations were
• satisfaction with the treatment as a whole
• ideas for improving education for future patients

A bilingual communication approach during interview helped participants could speak freely and say exactly what they meant (13). Since the study population included individuals from varied linguistic backgrounds, the researcher allowed participants to choose the language in which they preferred to communicate.

For participants who were more comfortable speaking in the regional language, interviews were carried out in Tamil. This helped:

- promote ease of expression,
- reduce communication barriers,
- ensure cultural sensitivity, and
- obtain more detailed responses.

The semi-structured interview guide was translated into simple, conversational Tamil to maintain clarity without losing the intended meaning of the questions. When a question needed more explanation, interview was being followed up in Tamil to help the participant dig deeper discussion. For those who felt at ease in English, the interview held in English, using the same guide and order of questions. This kept things consistent but still let everyone use the language they preferred. The interviewer also used English for technical dental terms when it made things clearer. Some participants moved between Tamil and English, depending on what felt right for certain words or ideas. Natural switching between languages had been encouraged because language should not rule to get in the way of what the participant wants to convey. Every interview, no matter the language, was recorded and later transcribed. Tamil responses were translated into English so it could be analyzed everything together.

Each session lasted about 10 to 20 minutes, always in the language the participant chose. Every conversation was recorded using a digital recorder. After the interviews, the recorded audios were transcribed from word to word to keep the details accurate for our analysis. After obtaining participant consent, the audio files were uploaded to TurboScribe.ai, an automated transcription platform known for its high-quality speech-to-text conversion (14).

The software generated verbatim transcripts, capturing the spoken content as accurately as possible. Following automated transcription, each transcript was carefully reviewed by the researcher to ensure correctness, especially for sections involving mixed Tamil and English conversation. Any errors, unclear phrases, or misinterpretations noted in the automated output were manually corrected to maintain the authenticity and meaning of participant responses.

To protect privacy, all personal information during transcription were stripped out and assigned each transcript a unique code. The finalized transcripts were then used for coding and thematic analysis.

➢ *Data Analysis:*

Data were analyzed using inductive thematic analysis following Braun and Clarke's framework (15).

Phase 1: familiarising yourself with your data.
Phase 2: generating initial codes
Phase 3: searching for themes
Phase 4: reviewing themes
Phase 5: defining and naming themes
Phase 6: producing the report

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Transcripts were read repeatedly to identify key ideas and codes. Codes were grouped into broader categories and refined into themes representing shared meanings across the data set. The analysis began with a close examination of the raw data to identify meaningful segments relevant to the research objectives. These segments were progressively interpreted and organized into preliminary code groups through detailed and iterative analysis. Data units addressing similar ideas or experiences were clustered together, which enabled the identification of broader thematic categories. To enhance the rigor and traceability of the analytical process, qualitative data management software had been utilized for coding, data organization, and thematic development. Patterns and relationships among codes had been examined to construct a thematic structure aligned with the study's research objectives.

➢ *Coding:*

Relevant sections of the data were systematically labeled with codes that reflected key concepts related to the research question. These codes served as the foundation for organizing and comparing participant responses.

- *Theme Development:*

Codes were examined collectively to identify consistent patterns and relationships. Related codes were combined to form broader themes that captured shared meanings across the dataset.

- *Theme Review and Refinement:*

The developed themes were reviewed against the coded data to ensure accuracy, coherence, and relevance. Themes were refined further to clearly define their scope and to represent distinct aspects of participants' experiences.

In addition, basic descriptive statistics had been used to summarize the socio-demographic characteristics of the study participants. The frequency of theme occurrences across transcripts also been documented to illustrate the prevalence of specific perceptions or experiences, while maintaining the interpretive and contextual integrity inherent to qualitative research.

III. RESULTS

➢ *Theme 1: Improved Understanding and Clarity Through Technology*

- *Thematic Subgroup: Visualization and Comprehension*

Participants consistently stated that digital tools helped them "see the problem directly," reducing confusion about their diagnosis. Visual aids such as RVG images and intraoral photographs clarified what the dentist explained verbally.

✓ "When I saw my tooth on the screen, I finally understood why the filling was needed."
✓ "The video made it so simple. I could imagine exactly what they were going to do."
✓ "When I watched the short video before extraction, I finally understood what the doctor was going to do. It cleared my doubts."
✓ "Seeing my own x-rays and pictures made me realize why treatment was needed."

Participants expressed that technology allowed them to understand the severity of the condition and the rationale for the recommended treatment.

➢ *Theme 2: Reduction in fear and anxiety*

- "Earlier I was nervous about the drilling sound, but after seeing the video, I knew it was normal."
- "I felt more relaxed when I saw the steps explained clearly."

➢ *Theme 3: Enhanced Trust and Communication*

- *Thematic Subgroup: Transparency and Confidence*

Many patients described a heightened sense of trust when digital tools were used:

✓ "I felt the doctor was being more honest because I could see everything myself."
✓ "It builds confidence when they show you before and after images."
✓ "When the dentist showed me everything on screen, it felt like he respected me and wanted me to understand."
✓ "It builds trust because I can see the problem myself."

Technology was perceived as improving communication, making the dentist's explanation clearer and more credible.

➢ *Theme 4: Positive Emotional Impact and Reduced Anxiety*

- *Thematic Subgroup: Emotional Reassurance*

Patients commonly reported feeling less anxious during consultations involving technology:

✓ "Earlier I used to panic when they explained things verbally. Seeing the picture made me calmer."
✓ "The animation helped me understand that the procedure is not as scary as I imagined."

Some participants, however, mentioned that graphic images occasionally triggered discomfort:

✓ "Seeing the cavity close-up was a bit scary, but it was still helpful."

➢ *Theme 5: Increased Satisfaction with Dental Care*

- *Thematic Subgroup: Perceived Value and Quality of Care*

Most participants stated that technology enhanced their satisfaction with overall dental care quality:

✓ "The clinic felt modern, and I felt I was getting high-quality treatment."
✓ "I was more satisfied because I could follow what the dentist was explaining."

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For many, technology transformed the dental visit from passive receiving of information to active involvement in decisions.

➢ *Theme 6: Barriers and Challenges in Using Technology*

- *Thematic Subgroup: Digital Literacy and Overload*

While overall responses were positive, a few participants expressed difficulty in understanding digital content:

✓ "Sometimes the doctor shows too many images, and I get confused."
✓ "I am not used to digital screens, so I needed more time."
✓ "I don't use gadgets much, so I got confused at first."
✓ "Short clips are better; too much information makes it boring."
✓ Some also noted that poor-quality images or technical issues reduced clarity:
✓ "The RVG picture was not clear, so I couldn't understand much."

Concerns about cost and time added to the discussion:

✓ "I'm not sure if these digital tools add to the treatment charges."

➢ *Theme 7: Comparison With Traditional Explanations*

- *Thematic Subgroup: Perceived Superiority of Digital Methods*

A majority felt that technology-based education was superior to traditional verbal explanations:

✓ "Earlier they just told us what the problem was. Now they show it. It's a huge difference."
✓ However, a small number preferred simpler explanations:
✓ "Too much technology makes things complicated. Sometimes just telling is enough."

- *Thematic subgroup: Importance of Human Interaction*

✓ "Videos are fine, but I still want the doctor to talk to me personally."
✓ "Technology should support, not substitute, the human touch."

➢ *Theme 8: Suggestions for Enhancing Patient Education*

- *Thematic Subgroup: Need for Simplicity and Guidance*

Participants recommended the following improvements:

✓ Using simpler visuals
✓ Slowing down explanations
✓ Combining verbal and digital descriptions
✓ Providing short educational videos before treatment

✓ "If they explain the picture slowly and in simple words, it will be better."
✓ "Short videos about procedures in the waiting area would help."

IV. DISCUSSION

The highlights of this qualitative study sheds light on how technology is changing dental education and, in turn, shaping how patients see and feel about their dentalcare. People in the study said digital tools - like chairside videos, animations, digital X-rays, intraoral photos, and even mobile apps - made dental problems and treatments much easier to understand. This fits with what others have found: technology draws patients in and gives them the information they need to make smart choices about their dentalcare (16). One aspect that stood out was that explanations became far clearer when dentists relied on visual aids or interactive tools rather than verbal explanations alone.

A key theme that emerged was the improved clarity and comprehension that patients experienced when information was delivered through visual and interactive formats. Traditional verbal explanations were perceived as insufficient by many participants, while digital visuals helped bridge the gap between professional terminology and patient understanding (17). Visuals didn't just clear up confusion - they also made people feel like the whole process was more open and honest. This approach helped to build trust and made patients feel more confident in the decisions they were making.

Another key insight was that, patient satisfaction shot up when technology was used every step of the way. For example, intraoral cameras gave patient proof of what was happening in their mouths, so they trusted the dentist's advice more (18). Many people said seeing these images calmed their nerves, especially when facing scary procedures. This emotional comfort lines up with other research showing that patient-centered tech not only informs but also helps people feel safer and more at ease during treatment.

However, the study also revealed diverse preferences and challenges. Some patients - especially older adults or those new to digital tools - felt overloaded by too much information or fast-paced demonstrations (19). Technology makes understanding easier, but you have to use it thoughtfully, tailoring it to each patient's needs. Gaps in digital literacy show why there is need of careful balance with blend classic chairside conversations with the right amount of tech.

Dodi et al. pointed out that most patients already know about digital dental tools, and a lot of them see clear upsides - things like more accurate treatment, better comfort, and a stronger sense of safety. Still, just being aware of the technology isn't enough (20). Dodi's group stressed that, even with positive attitudes, many patients don't fully grasp the details. That's where good communication from the dentist comes in - it's what actually helps patients see the full benefits. Touati et al. review showed that when dentists use extra aids - like visuals or interactive tools - patients feel more satisfied, the care gets better, and the dentist–patient relationship grows stronger, compared to just talking things through verbally (21). Gracco, De Stefani & Bruno found

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that innovations like digital x-rays and 3D imaging don't just make diagnostics sharper and faster - they also make the whole process more comfortable for patients (22).

The previous study results were in contradictory with the current study results. Not everyone benefited the same way from technology-based education. Some participants - especially older adults or those unused to digital interfaces - found it hard to keep up with the fast pace of visual information. This variation comes down to digital literacy, cognitive processing speed, and degree of adaptability to tech-based communication (23). So, technology's impact isn't automatically positive for everyone; it depends a lot on individual patient traits and what they're comfortable with.

Earlier research often highlights steady improvements in patient satisfaction with digital tools, but this study conveys that technology actually led to information overload (24). The differences probably stem from the kind of technology used, how complex it was, and how long the demonstrations lasted. In this study setting, the best results came from simple, straightforward visuals backed up by clear verbal explanations - not just handing patients a device and expecting them to learn on their own.

Additionally, a few participants raised concerns about the time consumed in explaining procedures using technology, wanted a smoother workflow. Others flagged the cost of advanced devices as a real obstacle in some clinics. These points really drive home the need for proper training so dental professionals can use technology efficiently - and the importance of making sure digital tools support, not replace, real conversations with patients.

Overall, the study reinforces that technology-based dental education has a positive impact on patient perception, involvement, and satisfaction, provided it is implemented thoughtfully. Technology helps patients feel more in control and part of the decision-making process, but for it to really work, it needs to be easy to use, clinicians have to know what they're doing, and the approach has to match each patient's needs. The key is to use digital tools when they fit, keep the patient at the center, and always balance technology with real human interaction. That's where you get the most benefit.

V. CONCLUSION

This qualitative study shows just how much technology-based dental education shapes the way patients see and feel about their dentalcare. Digital tools - visual aids, chairside videos, imaging tech - really help patients understand their oral health and treatment options. They build trust between patients and clinicians, and make it easier for patients to take part in decisions about their care.

Every patient does not respond the same way; age, comfort with technology, and personal preferences all matter. Participants pointed out that digital tools work best when you mix them with genuine, empathetic conversation.

Technology alone doesn't cut it - people need that human touch to make patients feel comfortable and understood. When done right, technology-based education fits in well with traditional methods. If the dentist tailor the information in patient-centered aspect, it can boost satisfaction, reduce anxiety, and make the whole dental experience better.

VI. LIMITATIONS

This study adds important insights, but it has its drawbacks. Since it's qualitative and the sample size is small, restrict generalizability to wider populations. All participants were recruited from one dental setting, so results might not reflect variations in technology use across diverse clinical contexts.

The study relied on self-reported data, which opens the door to recall errors or people saying what they think researchers want to hear. It didn't measure digital literacy or previous experience with technology, so how those factors shaped the responses of the participatory individuals. Finally, the focus stayed on patient perceptions and satisfaction - clinical outcomes or long-term effects weren't part of the picture.

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- *Conflicts of Interest*
  There are no conflicts of interest

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