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Designing a Surgical Anatomy Education Program for Surgical Technology Students

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A B S T R A C T

Introduction: Surgical technology students need anatomy teaching that is directly linked to operative practice, as traditional lecture-based methods often fail to prepare them for the demands of the operating room. A structured, learner-centered program may improve understanding, confidence, and clinical readiness. This study aimed to design a surgical anatomy education program for surgical technology students.

Material and methods: This educational study designed and validated a surgical anatomy program for surgical technology students through needs assessment, expert review, and structured content development. The program was then implemented using a planned instructional approach that linked anatomy to operating room practice. Outcomes were evaluated with appropriate instruments, and the study followed standard ethical principles, including informed consent, confidentiality, and ethics approval.

Results: The surgical anatomy education program showed strong expert endorsement and clear structural coherence, with high validity across most domains (overall CVI=0.97; mean content relevance=4.70±0.41; mean clarity=4.69±0.44; mean necessity=4.75±0.41). The highest ratings were observed for program structure, core topics, procedural guidance, and layout (CVR=1.00; CVI=1.00), while self-assessment questions required the most revision (CVR=0.60; CVI=0.90). The development process was systematic and iterative, progressing from needs assessment to expert review, revision, implementation, and evaluation.

Conclusion: This study indicates that a carefully designed, expert-validated surgical anatomy program can provide a credible foundation for surgical technology education. Its strong content validity and clinically aligned structure suggest that it is suitable for implementation and may improve the relevance and quality of anatomy teaching in the operating room context.

Introduction

In contemporary health professions education, anatomy remains one of the most fundamental yet challenging domains, especially when it must be translated from abstract knowledge into safe and effective clinical performance. For students in surgical technology, anatomy is not merely a theoretical subject; it is the language through which operative procedures, patient positioning, tissue handling, and intraoperative decision-making are understood.

Because these learners are expected to function in highly dynamic surgical environments, their mastery of anatomy must extend beyond memorization toward applied, procedure-oriented understanding [1].

Surgical technology students occupy a distinctive educational position at the interface of basic science and clinical practice.

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They are responsible for supporting surgical teams, preparing instruments, anticipating operative steps, and maintaining procedural safety. In this role, inadequate anatomical understanding can compromise both learning and performance. Consequently, educational programs for these students should be designed not only to deliver anatomical content but also to contextualize it within surgical tasks, operative stages, and common clinical scenarios [2].

Traditional anatomy teaching has often relied on lecture-based delivery, textbook reading, and passive recall. Although these methods can convey large volumes of information, they may not adequately prepare students for the rapid, spatial, and applied reasoning required in operating room settings. Learners frequently report difficulty connecting structures learned in the classroom with those encountered during procedures, and this gap becomes more pronounced when anatomical teaching is detached from actual clinical relevance [3].

This problem is particularly important in surgical education, where learning is time-sensitive and performance-driven. Students must quickly identify structures, understand relationships among tissues, and recognize procedural landmarks that influence surgical access and safety. Without structured educational support, they may experience uncertainty, reduced confidence, and inefficiency during clinical training. A well-designed surgical anatomy program can help reduce this disconnect by organizing content around practical tasks rather than isolated facts [4].

Educational design in health professions has increasingly shifted toward learner-centered and competency-based approaches. In such models, the goal is not simply to transfer information but to foster meaningful understanding, self-directed learning, and durable skill acquisition. For surgical technology students, an anatomy education program should therefore be structured to encourage active engagement, repeated review, and integration of theoretical and practical elements [5].

One of the main advantages of a purpose-built educational program is that it can tailor content to the actual needs of the target group. Surgical technology students do not require the same depth or emphasis as medical students preparing for diagnosis or surgical residents mastering operative anatomy. Instead, they need a focused anatomical framework that supports common operative procedures, instrument placement, patient positioning, tissue exposure, and intraoperative support. A targeted program can prioritize this applied knowledge more efficiently than a general anatomy course [6].

Another important consideration is cognitive load. Anatomy is inherently complex because it requires learners to process spatial relationships, terminology, and functional organization simultaneously. When too much information is presented without structure, learners may become overwhelmed and retain only fragmented knowledge. A carefully designed program can reduce unnecessary cognitive burden by sequencing content logically, using visual supports, and linking each learning unit to a specific surgical context [7].

Visual learning is especially relevant in anatomy education. Diagrams, operative images, schematics, and procedure-based illustrations can strengthen comprehension by helping students form mental models of body structures and their relationships. For surgical technology students, these representations are particularly valuable when they are aligned with common operative fields such as abdominal, orthopedic, neurological, and gynecological surgery. A program that integrates visual and procedural learning is more likely to promote meaningful retention [8].

Self-directed learning also plays an essential role in contemporary anatomy education. Students who can review material independently before and after clinical exposure are better prepared to participate actively in training. Educational programs that provide clear objectives, structured summaries, and guided review opportunities can enhance this autonomy. In surgical technology education, such support may improve preparedness for clinical placement and encourage learners to revisit difficult topics more effectively [9].

The role of active learning in anatomy has been emphasized in many educational contexts. Techniques such as case-based learning, small-group discussion, scenario simulation, and reflective review can encourage deeper processing than passive listening alone. For surgical technology students, these strategies are especially useful when they are anchored in operative examples, because they allow learners to connect structure with function and procedure with anatomy in a realistic way [10].

Clinical relevance is a defining feature of successful anatomy education for surgical learners. Students often engage more readily when they can see how anatomical concepts influence surgical access, incision planning, retraction, and avoidance of complications. When the educational content is explicitly linked to perioperative practice, students are more likely to perceive its value and invest effort in mastering it. This connection can improve both motivation and educational outcomes [11].

Another challenge in teaching anatomy to surgical technology students is variability in baseline knowledge. Some students enter clinical training with a solid foundation, whereas others may have limited retention from earlier coursework. A structured educational program can help standardize essential content and ensure that all learners receive the same core preparation. This is particularly useful

in programs where clinical exposure may differ across students or training sites [12].

Assessment is also essential in anatomy education. If a program is designed effectively, it should not only deliver content but also allow educators to evaluate learning outcomes in a measurable way. Multiple-choice tests, practical observation, image identification, and scenario-based questions can help determine whether students have achieved the intended competencies. Incorporating assessment into the design process strengthens both accountability and educational quality [13].

In addition, students' satisfaction with their learning experience should not be overlooked. Satisfaction reflects more than enjoyment; it often indicates perceived usefulness, clarity, relevance, and confidence. In clinical education, student satisfaction is associated with engagement, persistence, and willingness to continue learning. A surgical anatomy education program that is well organized, relevant, and supportive may improve satisfaction while also enhancing academic and practical performance [14].

The need for structured anatomy education is even greater in settings where clinical demands are high and student supervision may be variable. In such environments, learners may not always have adequate opportunities to review anatomical concepts in real time. An educational program can function as a stable learning resource that complements clinical exposure, ensuring continuity between classroom instruction and operative training. This is especially valuable in disciplines where accuracy and timing are critical [15].

Modern educational planning also recognizes the importance of adaptability. A surgical anatomy program should be flexible enough to accommodate different learning styles, curricular constraints, and institutional resources. It may include printed guides, visual modules, instructor-led sessions, or blended formats depending on the context. What matters most is that the educational design remains coherent, practical, and aligned with the students' clinical responsibilities [16].

Despite the importance of anatomy in surgical training, there is still limited evidence regarding specialized educational programs tailored specifically for surgical technology students. Much of the existing literature focuses on medical students, nursing students, or surgical residents, leaving a gap in knowledge about how best to support this particular learner population. This gap highlights the need for educational innovation and targeted program development [17].

Accordingly, designing an educational program that reflects the actual learning needs of surgical technology students is both timely and necessary. Such a program can bridge theoretical and clinical learning, improve comprehension of operative anatomy, and support more confident participation in the surgical environment. The present study aimed to design a surgical anatomy education program for surgical technology students.

Material and methods

Study Design

This study was conducted as an educational development and evaluation project aimed at designing a surgical anatomy education program for surgical technology students. The design followed a structured stepwise process that included needs assessment, program development, expert validation, and implementation.

Setting and Participants

The study was carried out among undergraduate surgical technology students in a medical sciences university. Participants included students who were currently enrolled in clinical or theoretical courses related to surgical practice and anatomy education.

Needs Assessment

A needs assessment was performed to identify the knowledge gaps and educational requirements of surgical technology students in surgical anatomy. This stage helped determine which anatomical topics were most relevant to operating room practice and which areas needed greater instructional support.

Program Design Process

The educational program was designed based on the results of the needs assessment, review of the literature, and consultation with experts in surgical technology, anatomy, and medical education. The content was organized around clinically important anatomical concepts that are directly related to operating room practice. Educational objectives were defined for each section, and the material was structured in a logical sequence from basic to applied anatomy. Teaching methods, learning activities, and instructional materials were selected to support active learning, self-study, and clinical integration. The final program was developed in a way that was both educationally sound and practically suitable for surgical technology students.

Validation of the Program

After the initial design, the program was reviewed by a panel of experts to ensure its scientific accuracy, educational relevance, and practical applicability. Expert feedback was used to revise the content, clarify learning objectives, improve the structure, and enhance the usability of the program. The validation process helped confirm that the final version of the educational program was appropriate for the target learners and aligned with the needs of surgical technology education.

Intervention or Implementation

The finalized surgical anatomy education program was implemented among the target students over a planned instructional period. During implementation, students received the designed educational content through the selected teaching format, and they were encouraged to actively engage with the material through study, discussion, and clinical connection. The intervention was delivered in a way that integrated theoretical anatomy with surgical practice, allowing students to better relate the learned concepts to operating room procedures. Any pre- and post-intervention evaluations were conducted according to the study plan to assess the effect of the program.

Outcome Measures

The main outcomes of the study were educational outcomes such as knowledge, understanding, clinical readiness, and satisfaction. Depending on the study objectives, these outcomes were measured using validated tools such as questionnaires, tests, or performance checklists. Data collection instruments included standardized tools designed to assess the impact of the educational program. These instruments were evaluated for validity and reliability before use, and scoring methods were clearly defined.

Statistical Analysis

The collected data were analyzed using appropriate statistical methods based on the type of variables and study design. Descriptive and inferential statistics were applied, and the significance level was set in advance.

Ethical Considerations

The study was conducted in accordance with ethical principles, and informed consent was obtained from all participants. Confidentiality was maintained, participation was voluntary, and the study was approved by the relevant ethics committee.

Results

The expert review indicated a consistently high level of agreement regarding the relevance and acceptability of the surgical anatomy education program. Across the main components, most items received essentiality ratings from nearly all experts, with CVR values ranging from moderate to perfect agreement and CVI values clustering near the maximum, which suggests that the proposed content was judged to be both necessary and well aligned with the educational needs of surgical technology students. The strongest support was observed for the overall structure, core anatomical topics, procedural guidance, and layout, all of which were rated highly in terms of relevance, clarity, and necessity. This pattern implies that the program was not only conceptually sound but also organized in a way that made it practically applicable for undergraduate learners in the operating room setting. At the same time, the expert panel provided constructive feedback that led to targeted refinement of several sections, particularly the self-assessment questions, visual materials, and clinical correlation content. Although these domains also achieved acceptable validity indices, they were identified as areas where wording, difficulty level, or illustrative detail could be improved to enhance usability and instructional value. Overall, the results suggest that the final version of the program benefited from expert-driven modification and reached a strong level of content validity before implementation. In practical terms, this means the educational package was considered sufficiently rigorous, relevant, and learner-centered to support its use in surgical anatomy training for surgical technology students (table 1).

Table 1. Content Validation and Expert Review of the Surgical Anatomy Education Program

Program Component	No. of Experts Rating as Essential (n=10)	CVR	CVI	Mean Content Relevance	Mean Clarity	Mean Necessity	Expert Comments / Revision Summary	Final Decision
Overall program structure	10	1.00	1.00	4.90 ± 0.32	4.80 ± 0.42	4.90 ± 0.32	Minor reordering of modules recommended	Accepted with minor revision
Learning objectives	9	0.80	0.95	4.70 ± 0.48	4.60 ± 0.52	4.80 ± 0.42	Objectives refined for measurability	Accepted with minor revision
Core surgical anatomy topics	10	1.00	1.00	4.90 ± 0.32	4.70 ± 0.48	4.90 ± 0.32	Content aligned with OR curriculum	Accepted

Illustrations and visual materials	9	0.80	0.95	4.60 ± 0.52	4.50 ± 0.53	4.70 ± 0.48	Some images simplified for clarity	Accepted with revision
Step-by-step procedural guidance	10	1.00	1.00	4.80 ± 0.42	4.70 ± 0.48	4.80 ± 0.42	Language standardized across sections	Accepted
Clinical correlation section	9	0.80	0.95	4.60 ± 0.52	4.60 ± 0.52	4.70 ± 0.48	Expanded to improve practical relevance	Accepted with minor revision
Self-assessment questions	8	0.60	0.90	4.40 ± 0.52	4.50 ± 0.53	4.50 ± 0.53	Item difficulty moderated	Accepted with revision
Glossary of key terms	9	0.80	0.95	4.70 ± 0.48	4.80 ± 0.42	4.70 ± 0.48	Terminology standardized	Accepted
Layout and formatting	10	1.00	1.00	4.80 ± 0.42	4.90 ± 0.32	4.80 ± 0.42	Formatting finalized after editorial review	Accepted
Total score / overall index	—	0.88	0.97	4.70 ± 0.41	4.69 ± 0.44	4.75 ± 0.41	Overall content validity confirmed by expert panel	Final version approved

This flowchart presents a structured, stepwise approach to developing and implementing the surgical anatomy education program for surgical technology students. The process begins with a needs assessment and a review of the literature and curriculum requirements, which informed the initial drafting of the program. The draft was then subjected to expert panel review, allowing the content to be refined through targeted revisions before finalization. After the finalized program was prepared, it was implemented in the intended educational setting, followed by outcome evaluation to determine its effectiveness. Overall, the figure illustrates a systematic and academically rigorous pathway from educational need identification to program delivery and assessment, highlighting the iterative nature of evidence-based curriculum design in medical education (figure 1).

Figure 1. Program Development and Implementation Flowchart for the Surgical Anatomy Education Program

This flowchart outlines the instructional components of the surgical anatomy education program in a clear, sequential manner. The program begins with the definition of learning objectives and the selection of key surgical anatomy topics, followed by the preparation of an illustrated study guide and the integration of clinically relevant correlations. It then incorporates step-by-step operative principles, self-assessment multiple-choice questions, and review items to reinforce learning and promote active recall. After content validation by an expert panel, the program is revised and finalized before being delivered through blended theoretical and practical training. The final step involves evaluating the effects of the program on students' knowledge, skills, and satisfaction. Overall, the figure reflects a comprehensive, evidence-informed educational design that links curriculum planning with clinical application and outcome assessment (figure 2).

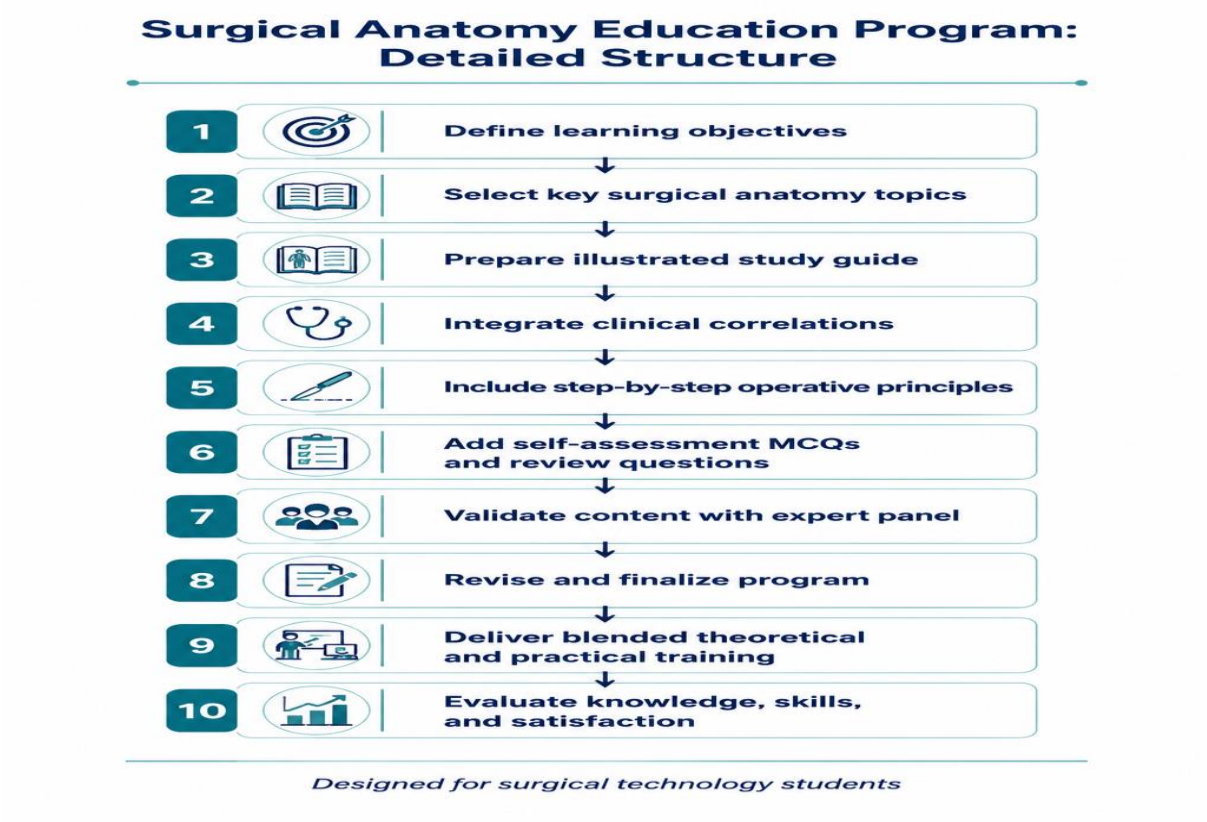

Figure 2. Detailed Structure of the Surgical Anatomy Education Program

Discussion

The present study demonstrated that the surgical anatomy education program achieved strong expert endorsement and was refined through a systematic development process that linked educational need, curricular alignment, and clinical applicability. Overall, the expert panel reported high ratings for content relevance, clarity, and necessity across most domains, with particularly robust support for the program structure, core surgical anatomy topics, procedural guidance, and formatting. Although some components, such as self-assessment questions, illustrations, and clinical correlations, required revision, these modifications strengthened the final version and improved its educational coherence. In parallel, the flowcharts showed that the program was developed through a staged and evidence-informed pathway, beginning with needs assessment and literature review, progressing through drafting and expert validation, and ending with implementation and outcome evaluation. Taken together, these findings suggest that the final educational package was both methodologically sound and pedagogically appropriate for surgical technology students [14].

One likely reason for the strong expert agreement is that the program was built on a clear needs assessment and aligned closely with the actual learning demands of operating room training. Surgical technology students require not only factual anatomical knowledge but also the ability to connect anatomy with intraoperative decision-making, spatial orientation, and procedural safety. A program that explicitly targets these competencies is more likely to be viewed as necessary and relevant by experts who understand the gap between theoretical anatomy instruction and clinical performance. In other words, the high CVR and CVI values probably reflect the fact that the content addressed a real educational deficiency rather than

an abstract curriculum preference. When educational material is directly mapped to professional tasks, expert reviewers are more likely to judge it as essential and worth retaining [15].

The particularly high scores for overall structure and core topics also suggest that the program was organized in a way that respected both educational logic and clinical workflow. A coherent sequence of objectives, anatomy content, procedural principles, and practice-based activities helps learners build understanding from basic to applied knowledge. This is especially important in surgical education, where fragmented or overly theoretical teaching can weaken retention and limit transfer to the operating room. The favorable evaluation of the structure likely indicates that the program avoided this problem by presenting anatomy as a clinically meaningful framework rather than as isolated memorization material. That kind of organization often increases perceived clarity and usefulness, which in turn enhances expert acceptance [16].

The expert panel's positive response to the procedural guidance and clinical correlation sections may reflect the practical orientation of the program. In surgical technology education, students do not learn anatomy for its own sake; they must understand how anatomical relationships influence patient positioning, instrument use, tissue handling, and surgical access. By linking anatomical concepts to operative principles, the program probably reduced the distance between classroom learning and clinical application. This integration is important because learners often struggle to convert static anatomical knowledge into dynamic surgical reasoning. When teaching materials show how anatomy functions in real procedural contexts, they become more memorable, more actionable, and more credible to both students and reviewers [17].

At the same time, the need to revise illustrations, glossary terms, and self-assessment questions highlights an important feature of high-quality educational design: expert validation is not simply a confirmation step, but a mechanism for refinement. Visual materials in anatomy education must be precise, uncluttered, and aligned with the learner's level of training. If images are too complex, too dense, or insufficiently labeled, they can increase cognitive burden rather than support understanding. Similarly, self-assessment questions must be calibrated to test essential concepts without becoming unnecessarily difficult or ambiguous. The fact that these elements were revised suggests that the expert panel helped optimize the balance between challenge and accessibility, which is a hallmark of effective instructional design [18].

The moderate-to-high variation across items, especially in the self-assessment domain, may also indicate that some parts of the program required greater pedagogical sensitivity than others. Core content is usually easier to standardize because experts can readily agree on the essential anatomical topics that should be included. By contrast, assessment items and illustrative explanations are more vulnerable to differences in teaching style, interpretation, and expected difficulty. This may explain why the self-assessment questions received slightly lower ratings than the main content areas. Even so, the final scores remained acceptable, suggesting that the program maintained educational rigor while still allowing room for learner support. Such variation is not a weakness; rather, it reflects the natural process of transforming expert knowledge into teachable material [19].

The high ratings for layout and formatting further imply that presentation quality played a meaningful role in expert judgment. In educational interventions, content can be excellent but still ineffective if the presentation is crowded, inconsistent, or visually tiring. For surgical anatomy, where diagrams, labels, and stepwise explanations must be quickly interpretable, clean formatting is especially important. A well-structured layout may reduce extraneous cognitive load and improve navigation through the material, making the learning experience more efficient. The expert panel's strong approval of this domain suggests that the final version of the program was not only scientifically appropriate but also user-friendly, which increases the likelihood of successful uptake by students and instructors [20].

The flowchart depicting program development and implementation also supports the interpretation that the study followed a rigorous curriculum design model. Beginning with a needs assessment ensured that the intervention was grounded in an identified educational gap, while the literature review helped avoid redundancy and incorporated established best practices. Drafting the program, reviewing it with experts, revising it, and then implementing it created a logical sequence that is consistent with evidence-based educational development. This staged process is important because it minimizes the risk of introducing poorly matched or unsupported content into the curriculum. It also demonstrates that the program was not created as a one-time teaching aid, but as a deliberately constructed educational package designed for real academic use [21].

Another important explanation for the strong validity findings is that the program appears to have been designed with learner characteristics in mind. Surgical technology students are usually in the transition phase between classroom learning and active clinical participation, so they benefit from materials that are concise, clinically anchored, and immediately relevant. If the content level matches their stage of training, experts are more likely to judge it as appropriate. Programs that are too advanced may be seen as unrealistic, while overly simple content may be dismissed as insufficient. The balance achieved in this study likely contributed to

the favorable content validity results and the positive overall rating of the program [22].

The iterative nature of the validation process also likely improved the final educational quality. Expert panels do not merely identify what should remain; they also reveal what should be clarified, simplified, or expanded. This is particularly valuable in anatomy education, where terminology, spatial relationships, and procedural descriptions can easily become ambiguous. By revising the materials in response to expert feedback, the program likely achieved better internal consistency and pedagogical precision. This iterative improvement is one reason why content validation is such an important step in educational research: it converts a preliminary draft into a more robust and defensible intervention [23].

From a broader perspective, these findings support the idea that interdisciplinary curriculum design is especially important in operating room education. Surgical anatomy sits at the intersection of basic science and clinical practice, and its teaching should therefore reflect both domains. Programs that are constructed solely from an academic perspective may fail to satisfy clinical experts, whereas programs based only on practical experience may lack conceptual depth. The strong validation observed here suggests that the present program succeeded in combining both dimensions. That balance likely explains why experts viewed it as relevant, necessary, and suitable for surgical technology students, rather than as a generic anatomy module detached from professional reality [24].

Conclusion

Overall, the results indicate that the final educational program was not only validated but also optimized through expert collaboration. The strongest agreement around structure, key topics, and formatting suggests that the program has a solid foundation for implementation, while the revisions to assessment items and visual materials show responsiveness to pedagogical detail. The flowcharts further reinforce that the intervention was carefully designed as a stepwise, evidence-informed process rather than a simple instructional handout. In practical terms, this means the program has the potential to serve as a credible and adaptable educational resource for surgical technology students, particularly if it is integrated with supervised clinical teaching and ongoing evaluation. Such an approach would likely maximize both knowledge acquisition and transfer to practice.

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Conflicts of interest

The authors declare that they have no competing interests.

Disclosure Statement

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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