Review Article • บทฟื้นฟูวิชาการ

Optimizing Learning Outcomes: an Exploration of Educational Evaluation in Anesthesiology

Parichad Apidechakul, Ladda Permpolprasert, Matchima Kerdsrithong, Phongthara Vichitvejpaisal
Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700 Thailand

Abstract

This comprehensive review article explores the critical role of educational evaluation in optimizing learning outcomes within the department of anesthesiology in a university hospital. Focusing on fellowship programs, residency initiatives, nurse anesthetist training, and the 5th-year medical student rotation, the article examines diverse assessment methods and their impact on program effectiveness. The assessment of academic activities, such as morning reports, interesting cases, and symposiums, is scrutinized, revealing insights into their contribution to knowledge enhancement and professional development. The article delves into the encouragement and support provided for anesthesiologists and nurse anesthetists to engage in research studies and article submissions. Furthermore, the assessment of international conference attendance among anesthesiology professionals is explored, emphasizing its role in knowledge transfer, networking, and professional development. Despite the successes observed, challenges in educational evaluation are acknowledged, paving the way for discussions on emerging trends and future directions in anesthesiology education.

Keywords: academic activity, anesthesiology education, continuous improvement, educational evaluation, training program

Introduction

The department of anesthesiology is a crucial pillar in modern healthcare, dedicated to ensuring patient comfort, safety, and well-being during medical procedures. Its primary focus is administering anesthesia to induce temporary loss of sensation or consciousness, facilitating pain-free surgical and medical interventions.[1] Advancements in medical technology, research, and education drive the dynamic evolution of this field, aiming to enhance patient outcomes and safety.[2] This article examines the global landscape of educational evaluation in anesthesiology, considering regional differences in training programs, accreditation standards, and cultural influences.[3] Emphasizing the role of educational evaluation in standardizing training and ensuring quality[4], it explores the identification of

Correspondence to: Phongthara Vichitvejpaisal, E-mail: phongthara@gmail.com
Received January 5, 2024, Revised August 9, 2024, Accepted August 9, 2024

individual learning styles to tailor programs for optimal effectiveness.

Educational evaluation fosters reflective practice among anesthesia practitioners, incorporating a feedback loop involving self-assessment, mentor feedback, and continuous improvement. Addressing challenges in implementation, the article provides practical recommendations and anticipates future innovations in anesthesiology education evaluation. Regular assessments contribute to the continual development of competent anesthesia practitioners, ensuring adaptability to evolving medical knowledge and technology, ultimately benefiting both healthcare providers and patients.

Roles of anesthesia practitioners

Anesthesia practitioners, including anesthesiologists and nurse anesthetists, manage various anesthesia types-general, regional, and local-to ensure patient comfort during surgical procedures. Anesthesiologists conduct thorough preoperative assessments, collaborating with healthcare professionals to create personalized anesthesia plans.[5] Continuous vital signs monitoring and real-time adjustments to anesthesia dosage are paramount for patient safety. Nurse anesthetists often work under anesthesiologist supervision, contributing to comprehensive patient care.[6] Post-procedure, anesthesia practitioners oversee recovery in the post-anesthesia care unit, managing pain and addressing complications. They employ various techniques, such as epidural analgesia and nerve blocks, for effective pain management. Recognizing the collaborative efforts of the anesthesia team, they optimize perioperative outcomes, emphasizing the importance of the entire team in delivering high-quality care.[7]

Importance of educational evaluation

The significance of educational evaluation in anesthesiology cannot be overstated, as it plays a pivotal role in ensuring healthcare professionals in this field receive top-tier training and consistently enhance their skills. This importance manifests across several critical areas.

Patient safety: Educational evaluation identifies and addresses knowledge and skills gaps among trainees, reducing the risk of errors during critical decision-making and medication administration, thereby enhancing patient safety.[8]

Skill development and competency: Regular assessments, including simulation exercises and practical evaluations, contribute to the development of essential skills, measuring competency in tasks such as airway management, drug administration, and emergency response.

Adaptation to advancements in technology: Educational evaluation ensures anesthesia practitioners stay current with evolving technologies, equipment, and procedures, facilitating adaptation to the latest standards of care.

Continuous professional development:

Serving as a tool for ongoing professional development, educational evaluation encourages participation in continuing medical education, conferences, and workshops, keeping professionals updated on new research findings and best practices.[9]

Standardization of training programs: Contributing to program standardization, educational evaluation ensures consistency in content, curriculum, and assessment methodologies, maintaining uniformly high-quality anesthesiology education across institutions.

Quality assurance and accreditation: Integral to quality assurance, educational evaluation allows accrediting bodies to assess whether programs meet predefined standards, ensuring graduates are well-prepared and align with expectations of the medical community and regulatory agencies.

Identifying learning styles and needs: Evaluations help identify diverse learning styles and needs, enabling educators to tailor teaching methods for effective education that accommodates all learners.

Promoting reflective practice: Through self-assessment and feedback, educational evaluation encourages trainees and practicing anesthesia practitioners to engage in reflective practice, fostering a culture of continuous self-reflection and improvement.[10]

Research and innovation: Educational evaluation provides insights into areas requiring research and innovation, stimulating initiatives to address knowledge gaps and emerging challenges, ultimately improving education and patient care.

Anesthesiology training programs evaluation

Anesthesiology fellowship programs

Anesthesiology fellowship programs aim to elevate clinical competence, covering advanced anesthesia techniques, perioperative management, and critical decision-making. These programs often focus on subspecialties like pain management, critical care, obstetric anesthesia, or cardiac anesthesia to cultivate experts in specific fields. Objectives extend beyond clinical skills, emphasizing research, scholarly activity, leadership development, and teaching abilities. Clinical competence is evaluated through direct observation, feedback, and exams[11], while research contributions, publications, and conference presentations gauge scholarly impact.

Teaching skills are assessed via feedback from residents, medical students, and faculty. Simulation exercises and Objective Structured Clinical Examinations (OSCEs) provide controlled assessments of technical and non-technical skills.[12] The overarching goal is to produce highly skilled anesthesiologists capable of specialized care, measured by applying knowledge in real-world settings and often leading to subspecialty board certification. The impact is evaluated through fellows' contributions to research, leadership roles, and teaching, with alumni career paths reflecting the program's long-term success and reputation. Graduates enhancing the program's legacy underscore the enduring impact and effectiveness of anesthesiology fellowship programs.

Anesthesiology residency programs

Residency programs undergo thorough evaluation, emphasizing the depth and relevance of their core curriculum. Exposure to diverse anesthesiology subspecialties, including pediatric anesthesia, obstetric anesthesia, critical care, and pain medicine, ensures a comprehensive training experience. Evaluation also considers interdisciplinary training opportunities, fostering collaboration with surgeons, nurses, and healthcare professionals to assess program effectiveness. A pivotal aspect of residency program evaluation in some countries is alignment with the Accreditation Council for Graduate Medical Education (ACGME) core competencies.[13] The ACGME, a recognized organization accrediting graduate medical education programs in the United States, provides a framework for assessing residents in dimensions such as patient care, medical knowledge, practice-based learning, interpersonal skills, professionalism, and systems-based practice.

Milestones and observable behaviors gauge residents' progression,[14] emphasizing increasing independence and proficiency in line with ACGME standards. The integration of ACGME core competencies ensures a well-rounded education, contributing to the quality and effectiveness of accredited programs. OSCEs assess clinical skills, emphasizing key procedures and effective communication. In-training examinations identify knowledge gaps, contributing to program evaluation. The inclusion of real-life patient cases, problem-based learning, and multidisciplinary case conferences promotes collaborative learning and a holistic patient care approach. The program's effectiveness in providing continuous feedback based on case-based learning supports professional growth and skill development, ensuring a comprehensive and effective educational experience for residents.

Nurse anesthetist students training programs

Nurse anesthetist students, entering training programs with diverse nursing backgrounds, require tailored evaluation strategies to accommodate variations in clinical experience. As these students navigate their unique scope of practice, blending nursing and anesthesia expertise, training programs address challenges associated with this dual role. The goal is to foster comprehensive clinical skills and a profound understanding of patient care. Evaluation considerations encompass integrating advanced nursing skills like patient assessment, communication, and collaboration within the anesthesia context, reflecting the multifaceted nurse anesthetist role. Emphasizing patient safety and advocacy, evaluation strategies assess students' abilities to prioritize patient welfare, communicate effectively, and navigate ethical complexities.

Clinical competence evaluation occurs through regular assessments during practicum experiences, involving direct observation by preceptors and faculty. Simulation scenarios, covering routine and emergent situations, comprehensively evaluate students' readiness for real-world practice. OSCEs effectively assess clinical competence, evaluating standardized skills like airway management and response to

complications. Encouraging self-assessment and reflection supports students in critically evaluating their performance and committing to lifelong learning.

Interprofessional education opportunities in nurse anesthetist training programs foster collaboration with other healthcare professionals.[15] Evaluation includes scenarios simulating shared decision-making, assessing communication and teamwork skills. Team-based simulation exercises evaluate students' ability to work effectively within a healthcare team, covering communication, leadership, and mutual support during simulated procedures.[16] Feedback from the interprofessional team provides a holistic view of students' team performance, ensuring readiness for real-world interprofessional interactions.

5th-year medical students rotating program

The program features a structured rotation schedule that exposes medical students to various aspects of anesthesiology, encompassing time in the operating room, preoperative assessment clinics, pain management services, and critical care settings. Through hands-on clinical experiences, students actively participate in perioperative patient care, observing and assisting in anesthesia administration, airway management, and postoperative recovery. Rotations aim for a comprehensive understanding of anesthesiology's role in patient care, involving collaboration with healthcare professionals like surgeons, nurses, and ancillary staff. Didactic sessions are integrated to enhance students' theoretical knowledge in key anesthesiology areas, covering topics such as pharmacology, physiology, and perioperative management.

Anesthesiologists and preceptors assess medical student performance during rotations, evaluating clinical skills, professionalism, communication, and teamwork. OSCEs assess specific anesthesiology skills like airway management, perioperative assessment, and emergency response, providing a standardized evaluation of clinical competence. Case study preparation and presentation assess students' application of theoretical knowledge to real-world scenarios. Simulation exercises allow students to demonstrate responses to critical situations, evaluating clinical reasoning, communication, and teamwork skills.

Mentorship opportunities connect medical students with anesthesiologists to guide them through the transition from medical school to residency.[17] Participation in the rotating program exposes students to the expectations and responsibilities of anesthesiology residents, including daily routines, on-call duties, and collaborative dynamics within an anesthesia team. Networking opportunities with anesthesiology residents and departmental events provide insights and foster connections. Career counseling sessions help students explore paths within anesthesiology, understand residency application requirements, and prepare for licensure exams.

Academic activities assessment

Morning reports

Morning reports are vital forums for sharing medical insights among faculty, residents,

and students, fostering continuous learning and clinical knowledge enhancement. These sessions feature presentations on interesting or challenging cases, promoting exploration of diverse scenarios, diagnostic dilemmas, and various management strategies. Literature reviews within morning reports keep participants abreast of recent advancements, contributing to evidence-based practice and critical appraisal of scientific literature. Elements of board review align with the goal of establishing a strong foundation in anesthesiology principles, aiding residents in preparing for certification exams.

Case discussions in morning reports assess critical thinking skills, evaluating participants' abilities to analyze complex cases and propose management strategies. Emphasis is placed on effective communication and presentation skills, encouraging articulate expression of thought processes and data presentation. Morning reports facilitate peer feedback, collaboration, and interdisciplinary discussions, ensuring consideration of anesthesiologic aspects and broader medical and surgical considerations.

Using case-based learning techniques, morning reports enable the application of theoretical knowledge to real-world clinical scenarios, enhancing retention and application.[18] Interactive tools, audience response systems, quizzes, and polls engage participants actively, while small group discussions encourage collaborative problem-solving. Integration of simulation or virtual reality elements provides an immersive, risk-free learning experience, reinforcing key concepts and allowing participants to practice decision-making. Morning reports thus create dynamic learning environments that contribute to the continuous improvement of clinical practice and education.

Interesting cases

Interesting cases serve as a valuable platform for exposing healthcare professionals to rare or unusual pathologies, encouraging critical thinking and a thorough exploration of clinical scenarios beyond the commonplace. These cases, featuring complex diagnostic dilemmas, challenge participants to weigh evidence, consider alternative explanations, and arrive at well-reasoned conclusions. The collaborative nature of cases involving other medical disciplines emphasizes the importance of a multidisciplinary approach in patient care, promoting input from surgeons, radiologists, and specialists. Healthcare professionals actively engage in problem-solving during interactive case discussions, showcasing their analytical and critical thinking skills.

Unique treatment plans are often formulated, considering the patient's overall health, risks and benefits, and individualized care needs. Exposure to interesting cases contributes to continuous learning, keeping healthcare professionals informed about evolving medical knowledge and best practices.[19] Analyzing these cases develops enhanced clinical reasoning skills, helping professionals synthesize information and apply knowledge in complex scenarios. Reflective practice is encouraged as participants evaluate decision-making, consider alternative approaches, and identify areas for improvement, fostering a commitment to continuous self-assessment and improvement.

Symposiums

Symposiums in anesthesiology cover a broad spectrum of topics, including emerging trends, technological advances, and research findings to ensure participants stay informed about the latest developments.[20] They often address current clinical challenges faced by anesthesiologists, discussing perioperative management, pain control strategies, and advancements in anesthesia equipment, offering practical solutions. Topics are chosen to provide a multidisciplinary perspective on patient care, with presentations from surgeons, nurses, and other healthcare professionals fostering a holistic understanding of anesthesia within the broader healthcare context. Some symposiums incorporate interactive workshops for hands-on activities related to specific topics, enhancing practical applicability. Participant feedback is actively sought through post-symposium surveys, gathering insights on topic relevance, presentation effectiveness, and suggestions for improvement. Real-time feedback is obtained through panel discussions and Q&A sessions, allowing participants to pose questions and contribute to the interactive nature of the symposium.

Symposia often involve peer-reviewed presentations, where colleagues evaluate content, clarity, and impact, contributing to the refinement of presentation skills and overall quality. Knowledge retention is assessed through post-symposium assessments or quizzes to gauge the effectiveness of conveying key concepts. Symposiums leverage interactive technology, such as audience response systems, live polls, and virtual reality, to engage participants actively and create a dynamic learning environment. Case-based learning approaches within symposiums allow participants to apply theoretical knowledge to practical scenarios, enhancing critical thinking and problem-solving skills. Live or virtual simulation demonstrations illustrate key concepts, providing a visual and experiential component to the learning experience. Workshops and small group activities promote interactive learning, collaboration, and in-depth exploration of specific topics within the symposium format.

Research studies and article submission

Encouraging anesthesiologists

Mentorship programs, workshops on research methodologies, and data analysis contribute to a supportive environment for anesthesiologists engaging in research. Encouraging collaboration within multidisciplinary teams allows anesthesiologists to contribute expertise to broader research questions. Recognition programs for outstanding research achievements and the use of citation metrics quantify research impact, fostering motivation and pride. Publishing in high-impact journals and collaborating with key opinion leaders enhance visibility and influence in the academic community.

Emphasizing research's direct impact on patient outcomes motivates anesthesiologists, highlighting the contributions to patient care. Research forums, grand rounds, and incorporating research into residency training programs cultivate a research-centric culture, providing platforms for presentation and early engagement.

Supporting research funding and establishing committees within anesthesiology departments demonstrate organizational commitment to advancing research. These initiatives collectively create a conducive environment for anesthesiologists to actively participate in and contribute to research throughout their professional development.

Supporting nurse anesthetists

Empowering nurse anesthetists in research involves providing training sessions on methodologies, fostering confidence and competence. Mentorship programs with experienced researchers offer personalized guidance, addressing barriers and encouraging active participation. Flexible research models, like part-time roles, accommodate clinical demands. Protected research time within schedules addresses time constraints. Recognition programs, awards, and linking research achievements to career advancement motivate nurse anesthetists. Financial incentives, such as research grants or bonuses, provide tangible rewards, easing challenges. Collaboration within interdisciplinary teams seamlessly integrates research into clinical practice, offering valuable insights.[21] Practice-based research networks connect research with daily challenges. Continuous professional development programs and encouragement to incorporate evidence-based practices ensure sustained engagement in research, linking it directly to improved patient care outcomes.

International conferences and professional development

Assessing the value of conference attendance

The value of conference attendance is assessed based on the educational content provided. Evaluating the relevance, depth, and diversity of topics helps participants gauge the educational impact.[22] The presence of renowned keynote speakers and subject matter experts enhances the conference's value, with an assessment of the caliber of speakers contributing to the overall evaluation. Workshops, hands-on sessions, and interactive learning opportunities add value to attendance, with participants assessing the practical applicability of these sessions in enhancing their skills and knowledge. Evaluating the potential impact on professional growth includes considering how the knowledge aligns with current career goals.

Evaluating knowledge transfer and application

Participants assess the conference's success in facilitating the implementation of new practices, evaluating whether the knowledge gained is readily applicable in their professional settings. Evaluating the retention of knowledge acquired during the conference is essential, involving post-conference assessments or follow-up activities to measure retention and application. The success is measured by the extent to which participants incorporate newly acquired knowledge into their clinical practice, assessing changes in

practices, protocols, or approaches based on conference insights. Participants also evaluate whether the conference provides continued education opportunities, such as access to recorded sessions or supplementary materials, contributing to sustained knowledge transfer beyond the conference period.

Networking and collaboration opportunities

The effectiveness of a conference in facilitating networking is evaluated by the quality and quantity of opportunities provided. Assessing the accessibility of speakers, networking sessions, and collaborative forums contributes to this evaluation. Participants assess the level of interaction with peers and subject matter experts, and the ability to engage in meaningful discussions enhances the overall experience. Evaluating the potential for collaborative projects resulting from conference interactions is important, assessing whether participants identify opportunities for research, initiatives, or partnerships. The value of international conferences is often measured by the diversity of perspectives and the opportunity to interact with professionals from different regions, enhancing the overall experience by assessing the inclusivity of the conference and exposure to diverse viewpoints. International conferences and professional development activities offer significant advantages.[23] However, these activities also have disadvantages, such as cost, time commitment, variable quality of content, personal and professional impact, and logistical

Challenges and future directions

Common challenges in educational evaluation

Ensuring consistent and standardized assessment practices across different educational programs remains a challenge due to variability in methods and criteria, hindering accurate learner evaluation. Shifting to competency-based evaluation requires overcoming resistance to change and ensuring alignment with defined competencies, necessitating faculty development and a clear implementation roadmap. Limited resources, including faculty time and financial support, can impede robust educational evaluation strategies, making it challenging to balance comprehensive assessment with resource constraints. Striking the right balance between clinical experiences and didactic components in anesthesiology education is challenging, requiring careful curriculum planning to ensure learners gain practical skills while acquiring a solid theoretical foundation.

Emerging trends in anesthesiology education

The increasing integration of simulation and virtual reality technologies in anesthesiology education enhances hands-on training and decision-making skills.[24] Adaptive learning platforms that personalize content based on learners' needs and progress are gaining traction, optimizing time and resources. Anesthesiology education is moving toward increased interprofessional collaboration, incorporating opportu-

nities for learners to work alongside professionals from other disciplines. The use of data analytics is expanding, allowing institutions to analyze learner performance, identify trends, and tailor interventions, providing insights into areas of improvement. Recognizing challenges in the medical field, anesthesiology education is placing a greater emphasis on well-being and resilience training, integrating strategies to support learners' mental health for a more sustainable and resilient workforce.

Recommendations for future improvement

Establishing standardized competency frameworks across anesthesiology training programs enhances consistency in evaluation, with collaboration among accrediting bodies and institutions contributing to universally recognized competencies. Regularly evaluating and adopting emerging technologies ensures anesthesiology education programs stay abreast of innovations,[25] with institutions creating mechanisms for ongoing assessment and integration of tools that enhance learning outcomes. Facilitating collaboration among institutions and sharing best practices can address resource constraints, and joint initiatives for faculty development, curriculum planning, and assessment strategies contribute to overall improvement. Promoting research on the effectiveness of educational interventions in anesthesiology is crucial. Rigorous evaluation of teaching methods, technology integration, and competency-based approaches provides evidence for continuous improvement and informs future directions. The future of anesthesiology education, embracing innovation and collaboration, hinges on prioritizing learner and educator well-being.[26]

Conclusion

Anesthesiology education, spanning residency, fellowships, nurse anesthetist training, and professional development, faces challenges like standardization, technology integration, competency-based evaluation, resource allocation, and balancing clinical and didactic components. Emerging trends include simulation and virtual reality, adaptive learning, interprofessional education, learning analytics, and a focus on well-being. Faculty development programs, addressing assessment practices and emerging trends, are crucial. Institutions must stay agile in adopting emerging technologies, evaluating tools for efficacy.

References

1. Elzohry AAM, Elhamed MFA, Mohanad AM, El Gawad A, Saad BG. Anaesthesia concept as simple as possible. Biomed J Sci Tech Res. 2018;6:4946-54.
2. Ramezani M, Mohd Ripin Z. 4D printing in biomedical engineering: Advancements, challenges, and future directions. J Funct Biomater. 2023; 14:347.
3. Park J, Cheoun ML, Choi S, Heo J, Kim WH. The landscape of academic global surgery: a rapid review. J Public Health Emerg. 2021;5:9.
4. Ortega P, Diamond L, Alemán MA, et al. Medical Spanish standardization in U.S. medical schools: consensus statement from a multidisciplinary expert panel. Acad Med. 2020;95:22-31.

5. Mahajan A, Esper SA, Cole DJ, Fleisher LA. Anesthesiologists' role in value-based perioperative care and healthcare transformation. Anesthesiology. 2021;134:526-40.
6. Baird M, O'Donnell JM, Martsolf GR. Effects of opting-out from federal nurse anesthetists' supervision requirements on anesthesiologist work patterns. Health Serv Res. 2020;55:54-62.
7. Warner MA, Arnal D, Cole DJ, et al. Anesthesia patient safety: next steps to improve worldwide perioperative safety by 2030. Anesth Analg. 2022;135:6-19.
8. Harbell MW, Methangkool E. Patient safety education in anesthesia: current state and future directions. Curr Opin Anaesthesiol. 2021;34:720-5.
9. Mann S, Webb K. Continuing professional development: key themes in supporting the development of professional practice. In: Schwab G, Oesterle M, Whelan A, (Eds), Promoting professionalism, innovation and transnational collaboration: a new approach to foreign language teacher education. 2022;p15-44.
10. Holmboe ES, Iobst WF. Assessment guidebook. Chicago: Accreditation Council for Graduate and Medical Education. 2020;p31-4.
11. Warner DO, Isaak RS, Peterson-Layne C, et al. Development of an objective structured clinical examination as a component of assessment for initial board certification in anesthesiology. Anesth Analg. 2020;130:258-64.
12. Lee R, Raison N, Lau WY, et al. A systematic review of simulation-based training tools for technical and non-technical skills in ophthalmology. Eye. 2020;34:1737-59.
13. Frank JR, Taber S, van Zanten M, Scheele F, Blouin D, International Health Professions Accreditation Outcomes Consortium. The role of accreditation in 21st century health professions education: report of an international consensus group. BMC Med Educ. 2020;20:1-9.
14. Kohar A, Tran D, Perret D, et al. Physical medicine and rehabilitation milestone evaluation project: development of standardized rotation-specific milestone-incorporated faculty-of-resident evaluation tools. Am J Phys Med Rehabil. 2021; 100:809-14.
15. Paige JT, Sonesh SC, Garbee DD, Bonanno LS, eds. Comprehensive healthcare simulation: Inter-Professional team training and simulation. 1st ed. 2020 Edition. Cham: Springer Nature. 2020;Jan 31.
16. Jeong HW, Ju D, Lee AK, et al. Effect of a hybrid team-based advanced cardiopulmonary life support simulation program for clinical nurses. PLoS One. 2022;17:e0278512.
17. Tsai AH, Bodmer NJ, Gupta K, Caruso TJ. It takes a village: a narrative review of anesthesiology mentorship. Anesthesiol Clin. 2022;40:301-13.
18. Thomae AV, Verweij L, Witt CM, et al. Evaluation of a newly developed flipped-classroom course on interprofessional practice in health care for medical students. Med Educ Online. 2023;28: 2198177.
19. Dang D, Dearholt SL, Bissett K, Ascenzi J, Whalen M. Johns Hopkins evidence-based practice for nurses and healthcare professionals: model and guidelines, 4th ed; Sigma Theta Tau International: Indianapolis, IN, USA, 2022.
20. Kamińska D, Zwoliński G, Laska-Leśniewicz A, et al. Augmented reality: current and new trends in education. Electronics. 2023;12:3531.
21. Rane NL. Multidisciplinary collaboration: key players in successful implementation of ChatGPT and similar generative artificial intelligence in manufacturing, finance, retail, transportation, and construction industry. [OSF Preprints] 2023 Oct [cited 2024 Jan 5] Available from: https://doi.org/10.31219/osf.io/npm3d
22. Keup JR, Petschauer JW, Groccia JE, et al. The first-year seminar: designing, implementing, and assessing courses to support student learning and success. The National Resource Center for The First-Year Experience. 2023 Jul 24.
23. Stundner O, Adams MCB, Fronczek J, et al. Academic anaesthesiology: a global perspective on training, support, and future development of early career researchers. Br J Anaesth. 2023;

131:871-81.
24. Huang VW, Jones CB, Gomez ED. State of the art of virtual reality simulation in anesthesia. Int Anesthesiol Clin. 2020;58:31-5.
25. Ambardekar AP, Eriksen W, Ferschl MB, et al. A consensus-driven approach to redesigning graduate medical education: the pediatric anesthesiology Delphi study. Anesth Analg. 2023;136:437-45.
26. Mathis MR, Schonberger RB, Whitlock EL, et al. Opportunities beyond the anesthesiology department: broader impact through broader thinking. Anesth Analg. 2022;134:242-52.