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Original Research

Single Institution Analysis of Anesthesiology Residents' Online Question Bank Utilization and In-Training Exam Performance

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Introduction

The American Board of Anesthesiology (ABA) In-Training Examination (ITE) is an annual 200 multiple-choice question examination administered to anesthesiology residents in Accreditation Council of Graduate Medical Education (ACGME) accredited programs to assess their clinical and medical knowledge essential for anesthesiology practice. Individual resident performance is benchmarked against all ACGME anesthesiology trainees nationally within the same training year and serves as a formative assessment to identify gaps in knowledge.[1] Performance on the ITE has been shown to be positively correlated with performance on the ABA certification exams.[2-4] Therefore, understanding evidence-based predictors of higher ITE scores can inform the development of graduate medical education curricula with strategies aimed at ensuring high pass rates on the ABA exams, which are required for board certification as an anesthesiologist.

Test-enhanced learning refers to the cognitive principle that active retrieval of information through repeated low-stakes testing facilitates the consolidation of knowledge and improves long-term retention of information.[5] This learning theory is the foundation for online question bank utilization as a commonly employed tool to aid in exam preparation in graduate medical education. Online question banks are a form of a test-enhanced learning platform comprising exam-style practice questions based on the ABA content outline with written explanations and references provided. These platforms allow the learner to create individual quizzes from the question bank and use comparative analytics to assess testing performance and guide learning. These platforms can offer 3 distinct testing modes: timed, untimed, and tutor mode, the latter providing immediate explanations after each question.[6] The use of online question banks in other specialties, such as general surgery and obstetrics and gynecology, has been positively correlated with improved performance on their respective ITEs.[7-9]

To date, no study has examined the impact of online question banks on ITE performance in anesthesiology training. To address this, we explored whether the utilization of online question banks improved examination performance among anesthesiology trainees. Specifically, we examined the relationship between the total number of questions completed, the percentage of questions completed in tutor mode, and the overall percentage of questions answered correctly compared with ITE scores. We hypothesized that completing more questions, using tutor mode more frequently, and achieving a higher percentage of questions answered correctly would have a positive relationship with ITE performance.

Materials and Methods

Following institutional review board exemption, we performed a retrospective review from July 2015 to July 2023 of ABA ITE scaled scores and national percentiles among all MaineHealth Maine Medical Center anesthesiology resident physicians during clinical anesthesia years 1–3 (postgraduate years [PGY] 2–4). TrueLearn (TrueLearn LLC, Charlotte, NC) was the online question bank platform used by residents at our institution and was purchased for them at full retail price.[6] We excluded data from residents in their first year of training because they had not started formal anesthesiology training.

Data collection was performed using resident identifiers, and the program director matched the data to each individual resident, assigning a unique study identification number to preserve confidentiality. Data collected included PGY, calendar year the ITE was completed, total number of questions answered correctly, percentage of questions completed in tutor mode, and percentage of questions completed and answered correctly. Data metrics analyzed included total questions completed, percentage of questions completed in tutor mode, and percentage of questions completed correctly stratified by training and calendar year. All residents regardless of training year complete the same ITE; we stratified their scaled score and national percentile ranking by training year. The scaled score represented the number of questions answered correctly on the exam based

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on a 50-point scale, whereas the national percentile ranking normalizes the scaled score to allow comparison of resident performance within the same training year.

Statistical analysis was performed using SPSS Statistical Software version 28. Data were summarized as mean (standard deviation), median (interquartile range [IQR]), or frequency (n, %), as appropriate. Spearman correlation was used to explore the relationship between 3 online question bank metrics and ITE score, stratified by PGY. We compared ITE scores between those using or not using the online question bank in each PGY using *t* tests and compared nonnormal continuous data among PGY groups by Kruskal-Wallis test. We compared categorical data between PGY groups by chi square test. *P*-values less than .05 were accepted as statistically significant.

Results

A total of 46 residents were included in our analysis. The use of the online question bank increased as the residents progressed through their training with 70% (26/37) of PGY-2 residents, 80% (24/30) of PGY-3 residents, and 100% (25/25) of PGY-4 residents using the platform (p = .003) (Table 1). The median number of questions answered also increased with each increasing PGY level (642 [IQR 356–1530] PGY-2; 736 [IQR 416–1104] PGY-3; 787 [IQR 464–1126] PGY-4); however, this trend was not statistically significant (p = .13). Tutor mode was used most frequently by PGY-3 residents. The percentage of questions answered correctly was highest among PGY-3 and PGY-4 residents (Table 1). There was a significant difference in scaled score for those using the online question bank in the PGY-2 year but no other differences in the scaled score or national percentile ranking between online question bank groups in a given PGY.

Table 2 shows the bivariate relationships between the total number of questions completed and ITE metrics within each PGY. Although we observed positive trends between total number of online questions completed and both scaled score and national percentile ranking, none of these relationships was significant. Furthermore, there was no relationship between the percentage of tutored questions and ITE scores. In contrast, there were significant relationships between the percentage of online questions answered correctly and both scaled score and national percentile ranking within each PGY. These latter relationships are further illustrated in Figure 1. The correlation between percentage of questions answered correctly and ITE scaled score was (ρ = .49, p = .01) PGY-2, (ρ = .71, p =< .001) PGY-3, and (ρ = .48, p = .02) PGY-4. A similar trend was noted in the national percentile ranking with (ρ = .55, p = .003) PGY-2, (ρ = .71, p =< .001) PGY-3, and (ρ = .46, p = .02) PGY-4.

Discussion

As the first study examining the utility of online question bank utilization for anesthesiology ITE preparation, our results indicate that, whereas there is no significant relationship between the volume and type of usage—including the use of tutor mode—and ITE scores, there is a positive relationship between the percentage of online questions completed correctly and ITE scores within each clinical anesthesia training year.

These findings suggest that the percentage of questions answered correctly using an online question bank is associated with subsequent ITE performance and may serve as a potential indicator for exam readiness. This has significant training implications because it indicates that the use of online question bank data may serve as a guide for identifying at-risk residents who may benefit from a focused individual learning plan to improve performance on the ITE and subsequent ABA certifying exams. Recent national data shows that between 2019 and 2023, ABA Advanced Exam pass rates have decreased from previous years, ranging from 85% to 91%.[10] It is important to better understand evidence-based predictors of higher ITE scores to assist the development of anesthesiology residency curricula and ensure high pass rates on the ABA exams.

Our data for anesthesiology residents is similar to recent studies examining the utility of online question bank usage among general surgery residents in preparing for the American Board of Surgery In-Training Examination (ABSITE) with the percentage of questions completed correctly associated significantly with ABSITE scores.[7,9,11,12] Hancock et al demonstrated that the percentage correct of online question bank questions completed showed significant association (p = .026) with overall ABSITE percentile score, for which each additional 1% correct in an online question bank was associated with a 1.7 ABSITE percentile score increase.[11] Similarly, Rahimpour et al showed that each additional 1% correct in an online question bank was significantly associated (p < .0001) with a 0.77-point increase in percentage correct ABSITE score.[12] When looking at the utility of online question banks for ITE preparation beyond general surgery, a multicenter study of obstetrics and gynecology residents also showed that the percentage correct in an online question bank was positively associated with the Council on Resident Education in Obstetrics and Gynecology exam score.[8]

The relationship between the total number of practice questions completed and general surgery resident ABSITE performance has shown mixed results in recent studies. Two studies looking at the effect of first time online question bank usage compared the percentage correct ABSITE score and percentile scores from the year prior to online question bank implementation to the year following implementation.[7,9] Flentje et al showed a positive relationship between the total number of questions completed and the percentage correct ABSITE score, noting that, with every additional 100 questions completed in an online question bank, the ABSITE score increased by 3% ± 1% (p = .007).[7] Imran et al also demonstrated that the total number of online question bank questions answered was significantly associated (p < .05) with the percentage correct ABSITE score and percentile score. General surgery residents that completed the entire online question bank consisting of 1000 questions showed a 3% increase in percentage correct ABSITE score and a 20% increase in overall ABSITE percentile score.[9] Whereas completing more questions has shown a statistically significant increase in ABSITE scores in these 2 studies, this has not been generally reproducible in other cohorts of general surgery residents.[11] Similarly, our data for

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anesthesiology residents showed a positive correlation between the total number of online questions completed and ITE score but was not statistically significant.

In investigating evidence-based predictors of higher ITE scores, it is important to understand both what study adjuncts lead to successful outcomes and what motivates residents. Fowler et al showed that, after incentivizing senior anesthesiology residents, the percentage of residents reaching a target ITE score improved from 15.1% to 30.9% (p = .0056), and the first time pass rate on the ABA Advanced Exam increased from 90% to 97.6% (p = .14).[13] Spurzem et al demonstrated that, when general surgery residents were incentivized as a team to use an online question bank for the 6 months prior to the ABSITE, mean ABSITE scores significantly increased by 4.6% (p < .001).[14] Further research is needed to understand the use of incentivization of residents in conjunction with online question bank utilization in anesthesiology residents.

Question banks can be used in different modes: timed mode, untimed modes that simulate a realistic exam environment, or tutor mode in which the residents receive immediate feedback on the correct answer and explanations for each question. Tutor mode is designed to help the user engage with the material in real time to help correct misconceptions and close knowledge gaps in tandem with answering each question. To date, there are no studies that specifically examine whether testing modes or a combination of testing modes is associated with improved examination performance. Whereas prior studies have reported that engaging with practice questions beyond just completing questions results in improved exam performance,[15] our study did not find a correlation between the frequency of tutor mode use and ITE scores. The reasons for this may be due to several factors. There is likely significant heterogeneity in how individuals use the platform and engage in each mode. For instance, using tutor mode does not guarantee the individual will meaningfully engage with the material and question explanations. Similarly, those using the timed or untimed modes may independently return to the questions answered to review the material covered. Additionally, residents have access to other educational resources, such as standard anesthesia textbooks, learning modules produced by the American Society of Anesthesiologists that contain additional practice questions, and weekly lectures based on ABA content. Variations in engagement with these materials, along with prior knowledge or overall academic ability, may contribute to why no relationship was observed between tutor mode and ITE scores. Additionally, it is important to note that, whereas our findings suggest that question bank performance may offer a useful signal to educators, it does not imply that question banks are more valuable than other forms of study. Prior research has shown that the amount of time dedicated to independent study is associated with ITE success, suggesting that overall study time, regardless of the tool used, is an important factor to consider.[16]

This study has a few limitations. First, the use of online question banks was not mandatory among residents in this study, and this led to variability in the temporality of use and cumulative use among residents. Second, we did not survey individual learners to understand what other study materials were used in conjunction with online question banks. It is important to distinguish that, because the total number of questions completed in an online question bank was not correlated with ITE scores, it is possible that trainees are not learning from the use of question banks. Instead, the percentage correct being significantly correlated with ITE score may represent a surrogate marker of learning by additional modalities outside the question bank, confounding our results. To determine the direct association with online question bank utilization and learning, future studies would need to standardize learning materials combined with question bank utilization. Additionally, we did not have access to detailed information on how residents engaged with the question bank use, for instance, timing and frequency of use was not collected, and this can also influence test-taking performance. However, it is important to note that, as a pragmatic study, question bank utilization was highly variable and not standardized among the residents. Other limitations of this study include the small sample size and being a single-center retrospective study, which may limit the generalizability of our conclusions to other anesthesiology residency programs nationwide. Also, the fact that residents have varying levels of baseline knowledge, study patterns, and cognitive aptitude can also influence exam performance contributing to confounding. Ultimately, despite these limitations, this study indicates that there is value in the usage of online question banks as a study tool for preparation toward the anesthesiology ITE and ABA certification exams.

We report for the first time that the percentage of questions answered correctly in an online question bank by PGY 2–4 anesthesiology residents was positively associated with higher ITE scores. As such, the percentage correct in an online question bank may serve as a potential indicator of future ITE performance and, by extension, performance on ABA certification exams. It is important to recognize that, whereas passing the multiple-choice written examination is required for board certification, it represents only one aspect of what it takes to be a competent anesthesiologist as the clinical, technical, and interpersonal skills taught during residency are also essential to practice.

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Abstract

Background: The American Board of Anesthesiology (ABA) In-Training Examination (ITE) is an annual assessment used to guide educational progress throughout residency in preparation for ABA certification examinations. Online question banks are commonly used as a study resource for these examinations; however, the relationship between question bank usage and ITE performance has not been well established.

Methods: We performed a retrospective review from July 2015 to July 2023 to examine the relationship between ABA ITE performance and question bank utilization among anesthesiology residents at MaineHealth Maine Medical Center during postgraduate years (PGY) 2–4. Question bank usage was measured by evaluating the total questions answered, percentage of questions answered in tutor mode, and percentage of questions answered correctly stratified by training and calendar year. Spearman correlation was used to explore the relationship between question bank metrics and ITE score, stratified by PGY.

Results: We observed significant relationships between the percentage of questions answered correctly and both ITE scaled score and national percentile ranking within each PGY. The correlation between percentage of questions answered correctly and ITE scaled score was (ρ = .49, p = .01) PGY-2, (ρ = .71, p =< .001) PGY-3, and (ρ = .48, p = .02) PGY-4. A similar trend was noted for the national percentile ranking; (ρ = .55, p = .003) PGY-2, (ρ = .71, p =< .001) PGY-3, and (ρ = .46, p = .02) PGY-4.

Conclusion: The percentage of online question bank questions answered correctly by anesthesiology residents was positively associated with higher ITE scores across PGY 2–4. The percentage correct of online question banks may be used as a predictive marker for ITE performance.

Keywords: Education, medical, graduate; certification; anesthesiology; retrospective studies

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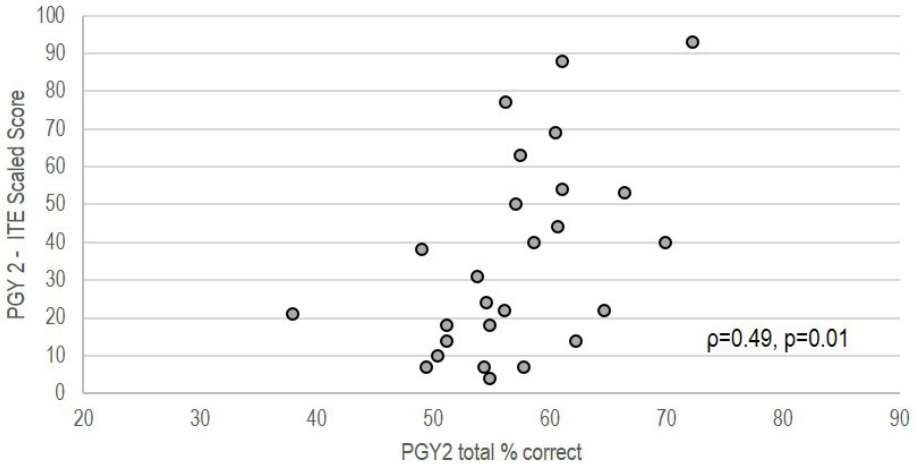
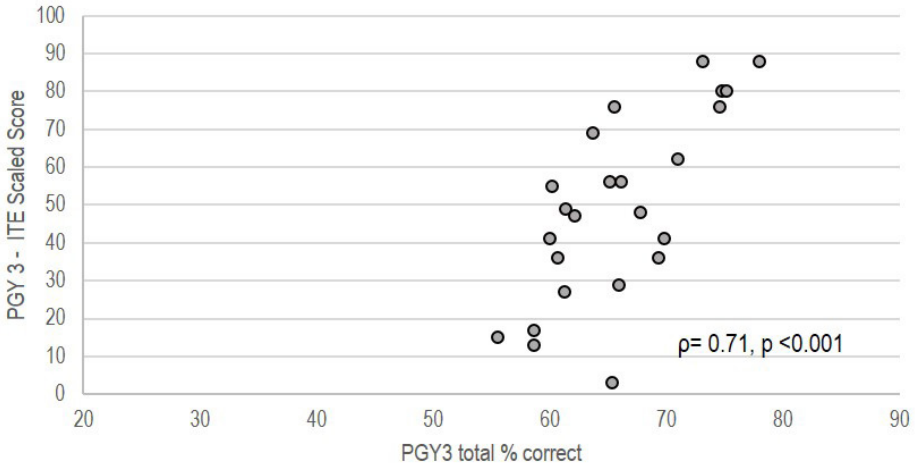
Figure

Figure 1. *The relationships between percentage of TrueLearn correct and in-training exam scaled scores by postgraduate year among those using TrueLearn. (a) PGY-2 (n = 26). (b) PGY-3 (n = 24). (c) PGY-4 (n = 24).*

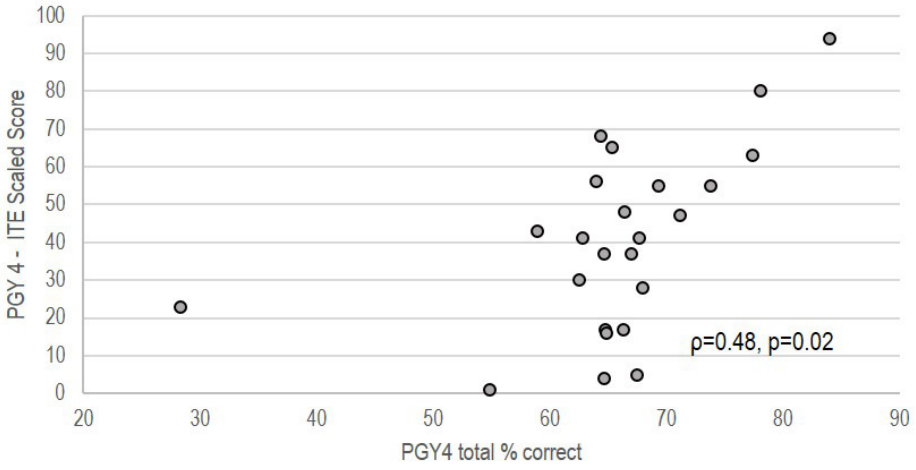
(a)



(b)



(c)



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Tables

Table 1. *Descriptive Data, TrueLearn Usage and ITE Scores, Stratified by Year*

Variable	PGY-2		PGY-3		PGY-4	
	n	Measurement[1]	n	Measurement[1]	n	Measurement[1]
Used TrueLearn	37	26 (70.3)	30	24 (80.0)	25	25 (100.0)[3]
TrueLearn metrics among those using the platform						
Total questions	26	642 [356-1530]	24	736 [416-1104]	25	787 [464-1126]
Percentage tutored	26	56 [2-88]	24	78 [36-90]	25	67 [26-86]
Percentage correct	26	57 [53-61]	24	66 [61-71]	25	65 [64-69]
ITE scaled score						
Overall	37	30.2±5.6	30	37.3±4.4	25	37.4±4.3
TrueLearn	26	31.5±5.1[2]	24	37.9±4.6	25	37.4±4.3
No TrueLearn	11	27.1±5.8	6	35.2±2.7	0	-
ITE national percentile						
Overall	37	24 [13-52]	30	47.5 [29-69]	25	41 [20-56]
TrueLearn	26	27.5 [24.5-30]	24	48.5 [31-74]	25	41 [20-56]
No TrueLearn	11	21 [9-46]	6	37 [24-57]	0	-

Abbreviations: ITE, in-training exam; PGY, postgraduate year.

[1] Data shown as n (%), mean ± standard deviation, or median [interquartile range].

[2] $p < .03$ by t test, TrueLearn vs no TrueLearn; comparisons for PGY-2 national percentile scores, PGY-3 scaled scores, and PGY-3 national percentile scores were not significant.

[3] Significant difference among PGY groups, $p = .003$ by chi square test.

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Tables *continued*

Table 2. *The Relationship Between True Learn Usage and ITE Scores, Stratified by PGY*

Variable	PGY-2			PGY-3			PGY-4		
	n	ρ	*p*-value[1]	n	ρ	*p*-value[1]	n	ρ	*p*-value[1]
ITE scaled score vs									
Total questions	37	0.32	0.054	30	0.39	0.034	25	0.20	0.35
Percentage tutored	26	-0.17	0.40	24	0.01	1.00	25	0.27	0.18
Percentage correct	26	0.49	0.01	24	0.71	<0.001	25	0.48	0.02
ITE PGY-national percentile score vs									
Total questions	37	0.17	0.32	30	0.29	0.12	25	0.23	0.26
Percentage tutored	26	-0.08	0.71	24	0.05	0.82	25	0.32	0.12
Percentage correct	26	0.55	0.003	24	0.71	<0.001	24	0.46	0.02

Abbreviations: ITE, in-training exam; PGY, postgraduate year.

[1] Spearman's correlation.