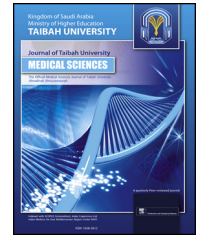




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Educational Article

The mapping of preferred resources for surgical education:
Perceptions of surgical trainees at the Advanced International
Minimally Invasive Surgery Academy (AIMS), Milan, Italy



Salman Y. Guraya, FRCS^{a,*}, Antonello Forgione, PhD^b, Gianluca Sampogna, MD^c
and Raffaele Pugliese, MD^d

^a Department of Surgery, College of Medicine, Taibah University, Almadinah Almunawwarah, KSA

^b AIMS Academy and Department of Surgical Oncology and Minimally Invasive Surgery, Niguarda Hospital, Milan, Italy

^c AIMS Academy, Milan, Italy

^d Department of Surgical Oncology and Minimally Invasive Surgery, Niguarda Hospital, Milan, Italy

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المخلص

الأهداف: توفر الدورات التدريبية الجراحية للمتدربين المعلومات التشريحية والمهارات اليدوية. لكن فهم أنماط التعلم و ما يفضله المشاركين من طرق معينة تساعد مديري البرامج التدريبية على تصميم محتوى دورات تعزز البيئة التعليمية.

طرق البحث: خلال الفترة ٢٠١٠ حتى عام ٢٠١٣، تم توزيع استبانة ذاتية لجميع المشاركين في نهاية كل دورة لأكاديمية الجراحة التداخلية البسيطة المتقدمة الدولية بميلان في إيطاليا. وقد كشفت لنا أجهزة التدريب ردود الفعل من المشاركين بشأن تجربتهم الجراحية والاحتياجات والموارد التعليمية الجراحية المطلوبة في الجراحة التداخلية البسيطة المتقدمة.

نتائج البحث: من أصل ٦٣٦ متدرباً قاموا بالإجابة على الاستبانة، كان ٦٠٦ متدرباً (٩٥٪) يؤدون بعض الإجراءات الجراحية بالمنظار في أماكن عملهم. وقد أبدى ٤٦٧ متدرباً (٧٣٪) ممن قاموا بالإجابة على الاستبانة تفضيلهم "تجربة الجراحة مباشرة في غرفة العمليات"، بينما فضل ٤٢٤ متدرباً (٦٦٪) تعلم المهارات الجراحية على يد زملاء مهرة، وفضل ٢٧٥ متدرباً (٤٣٪) أن يكون "التدريب العملي الجراحي على الحيوانات في بلدانهم". وقد أظهرت النتائج تفضيل الإناث المتدربات المشاركات المؤتمرات الوطنية كمصدر للتعلم أكثر من الذكور بمعدل رتبة ٢٠٧.٢٢ مقابل ١٧٦.٥١ على التوالي. كما كان رأي المتدربين العاملين بالمستشفيات الخدمية بتفضيل المؤتمرات الدولية (معدل رتبة

١٨٩.٢١)، أكثر من العاملين بالجامعات (معدل رتبة ١٨١.٢٢) والعيادات الخاصة (معدل رتبة ١٢٧.٤٥).

الاستنتاجات: تبين هذه الدراسة أن المتدربين الجراحين يفضلون التدريب العملي المباشر في غرف العمليات، وتعلم المهارات الجراحية على يد مدربين مهرة وبرامج الزمالات القصيرة لتعزيز مهاراتهم الجراحية. وبذلك يمكن لمدرسي الجراحة التداخلية البسيطة المتقدمة التركيز على الموارد التعليمية الجراحية المفضلة من قبل المتدربين لتعزيز اكتساب المهارات الجراحية.

الكلمات المفتاحية: التعليم الجراحي؛ المتدربين الجراحين؛ الجراحة التداخلية البسيطة المتقدمة؛ أكاديمية الجراحة التداخلية البسيطة المتقدمة الدولية؛ التدريب العملي المهاري؛ اليدوي

Abstract

Objectives: Surgical training courses provide the trainees with anatomical knowledge and manual dexterity. This study aimed to capture the learning styles and training preferences of participants attending a masterclass training centre. This data can facilitate the program directors in tailoring the course contents to enhance the learning environment.

Methods: Between 2010 and 2013, a questionnaire was administered to all participants at the end of each course at the Advanced International Minimally Invasive Surgery Academy (AIMS) in Milan, Italy. The instrument explored the feedback of participants regarding their surgical experiences, learning needs and desired surgical educational resources in minimally invasive surgery.

* Corresponding address: Department of Surgery, College of Medicine, Taibah University, Almadinah Almunawwarah, KSA.

E-mail: salmanguraya@gmail.com (S.Y. Guraya)

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Results: Of 636 respondents, 606 (95%) performed some laparoscopic procedures at their workplaces. Of the respondents, 467 (73%) preferred 'direct experience in the operating room', 424 (66%) preferred 'tutoring with skilled colleague', and 275 (43%) wanted 'hands-on training on animals in their own countries'. Female respondents favoured national congresses as educational resources more than males, with mean ranks of 207.22 vs. 176.51, respectively (p 0.022). The respondents serving hospitals preferred international congresses (mean rank 189.21) more than the respondents serving universities (mean rank 181.72) and private clinics (mean rank 127.45).

Conclusion: This study shows that surgical trainees prefer hands-on training in operating rooms, tutoring by skilled colleagues and short fellowships to learn and enhance their surgical skills. Surgical educators can focus on these preferred surgical educational resources to enhance students' acquisition of surgical skills.

Keywords: AIMS; Hands-on training; Minimally invasive surgery; Surgical education; Surgical trainees

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Introduction

Modern surgical education has been transformed from a traditional model of apprenticeship into the current system of surgical training based on accredited educational models and research.¹ Surgical trainers need not only consider what their trainees are doing but also how they are doing it. The popular notion for surgical training, 'See one, do one, teach one' is no more valid than the evolving dynamics of current surgical training programs influenced by the diverse gender, educational, ethnic, and cultural backgrounds of the trainees.² In addition to being trained in surgical skills, a surgical trainee is also groomed as a health advocate, skilled professional, collaborator, researcher, and communicator.³

To maximize the benefits of training, it is important to understand how a trainee learns various surgical skills.⁴ The literature describes two types of surgical skills; technical and non-technical.^{5,6} Technical skills include manual dexterity, and conceptual and technical knowledge, and non-technical skills include cognitive and interpersonal capabilities.⁷ Evidence-based research suggests that medical students⁸ and surgical trainees and faculty members have specific learning styles.^{9,10} This holds true for both technical and non-technical surgical skills. Identification of these unique learning preferences, so unique to each individual, helps trainers improve the delivery of surgical education and the potential for life-long learning.¹ Little data

exists on tailor-made comprehensive surgical training platforms that can accommodate a construct of the training needs of all trainees.

This study probed the perceptions of the participants attending various surgical training courses at AIMS, Milan, Italy. AIMS provides state-of-the-art surgical training under the supervision of world-renowned surgeons across surgical specialties. The data gathered in this study provide a roadmap for addressing the learning needs and preferences of surgical trainees at AIMS as well as other surgical training centres.

Materials and Methods

AIMS was founded in 2010 and is a multidisciplinary research and training centre dedicated to improving surgical services using innovative technologies for minimally invasive surgery.¹¹ AIMS conducts 10 training courses per year and provides practical training skills for surgeons with different levels of expertise. Courses include a wide spectrum of surgical disciplines, including colorectal, upper GI, bariatric, endocrine (thyroid, parathyroid, adrenals, pancreas), and solid organ (liver, pancreas, spleen, kidney) surgery. Training on flexible operative endoscopy for treatment of early ENT mucosal lesions is also provided.

A typical course includes live surgery demonstrations and theoretical sessions, followed by hands-on training in dry and wet labs. Modern video conferencing facilities with high-definition projectors are directly connected through fibre-optic cable to Niguarda Hospital's operating rooms. Twenty-eight surgeons can simultaneously utilize 14 endo-laparoscopic high definition towers with ultrasonic dissectors, high frequency bipolar coagulators, flexible devices, staplers, and a tilting operating table.

Between 2010 and 2013, a self-administered English language-validated questionnaire was administered to all students at the end of each course ([Appendix 1](#)). The instrument explored participant feedback regarding the learning needs and desired surgical educational resources in minimally invasive surgery. The responses were collected in Excel, and SPSS version 20 was used for statistical analysis. Descriptive analysis was performed using frequencies and percentages of demographics. Inferential analysis was performed by two non-parametric tests for ordinal data, the Mann–Whitney U test and the Kruskal–Wallis test. Both tests were used to measure variations among different demographic variables. The Mann–Whitney U test was used to investigate significant variations across two groups, and the Kruskal–Wallis test was used to analyse variations among more than two groups. The level of significance in this study was 5%.

Results

In total, 636 Italian respondents completed the survey, 486 (76.42%) male and 150 (23.58%) female ([Table 1](#)). Although data from 350 non-Italian participants were

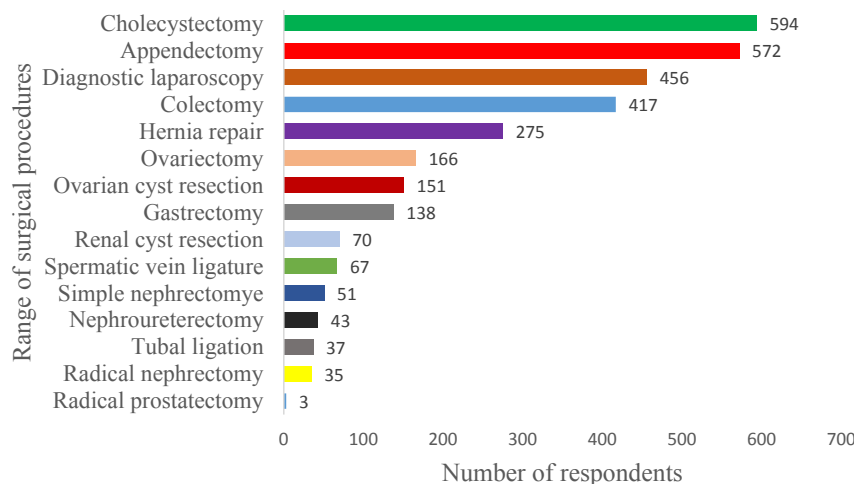
Table 1: Demographic characteristics of all participants in this study (n = 636).

Demographic variables	Categories	Frequency	Percentage
Gender	Male	486	76.42%
	Female	150	23.58%
Geographic position	Northern Italy	454	71.38%
	Central Italy	108	16.98%
	Southern Italy	74	11.64%
Type of job	Hospital	471	74.06%
	University	89	13.99%
	Private clinic	76	11.95%

also available, this study focused on the Italian respondents to maintain the homogeneity of the study cohort. The respondents' age range was 21–65 years, with an average age of 44 years. The average surgical experience of respondents was 16 years, and 417 respondents had experience with colorectal surgery. The majority of respondents (454; 71.38%) hailed from northern Italy, and 471 (74.06%) had been involved in hospital-based clinical practice.

Six hundred and six (95%) participants performed some laparoscopic procedures at their workplaces. Figure 1 presents the range of surgical procedures performed by respondents at their workplaces. Cholecystectomy was the most common surgical procedure, as indicated by 594 respondents, followed by appendectomy (572) and diagnostic laparoscopy (456).

Table 2 presents gender variances in the preferences of educational resources, as analysed by the Mann–Whitney U test. There were five significant variances between male and female respondents, as shown in bold in Table 2. Female respondents considered the national congress to be a better educational resource compared to male respondents with a mean rank of 207.22 females vs. 176.51 males. Female respondents preferred 'tutoring with a skilled colleague', with mean ranks of 206.56 and 185.06,

**Figure 1: Range of surgical procedures performed by respondents at their workplaces (n = 636).**

respectively. By contrast, male respondents preferred Internet-based courses, DVDs and multimedia.

The opinions of respondents regarding the best surgical educational tool are presented in Figure 2. The majority of respondents, 467 (73%) in total, favoured "direct experience in operating room", whereas "Internet-based courses" were the least favoured educational tool (37; 5.8%).

Preferences for educational resources with respect to geographic distribution of the respondents analysed using a Kruskal–Wallis test are shown in Table 3. Significant differences are shown in bold in Table 3. Respondents from northern Italy recommended international congresses (mean rank 188.06) compared to mean ranks of 154.69 and 135.06 by respondents from central and southern Italy, respectively. However, respondents from central Italy preferred hands-on training courses with animals in other countries (mean rank 183.22), contrasting with mean ranks of 154.85 and 127.47 in northern and southern Italy, respectively.

The choice of surgical educational resources, analysed using a Kruskal–Wallis test, of the participants working in hospitals, universities, and private clinics are shown in Table 4. Respondents working in hospitals preferred international congresses (mean rank 189.21) more so than respondents working in universities (mean rank 181.72) and private clinics (mean rank 127.45). By contrast, respondents working in private clinics preferred Internet-based courses (mean rank 190.06) compared to hospital and university employees, who had mean ranks of 145.51 and 139.28, respectively.

The future forecast regarding choice of surgical educational resources to be used in the future is shown in Figure 3. A scale from 1 to 5 was used, with 1 being "totally useless" (minimum) to 5 being "absolutely useful" (maximum). The largest group of respondents, 268 total, marked the highest score of 5 for 'direct experience in operating room', followed by 250 respondents who marked a score of 5 for 'tutoring with a skilled colleague'.

Table 2: Range of preferences for surgical educational resources across gender (n = 636).

Resources	Male mean rank	Female mean rank	Mann–Whitney U	Asymp. Sig. (2-tailed)
National congress	176.51	207.22	8647	0.022*
International congress	168.94	182.22	8401	0.306
Direct experience in operating room	196.65	203.09	12,526	0.538
Short period of observership at centres of excellence	163.03	168.00	8160	0.692
Tutoring by a skilled colleague	185.06	206.56	10,370	0.031*
Hands-on courses with animal in your country	160.97	177.75	7095	0.188
Hands-on courses with animal in other country	146.24	163.57	5988	0.160
Master class in laparoscopy	138.08	143.40	5285	0.662
Short (3-month) fellowship	151.07	130.49	5329	0.098
Internet-based courses	143.91	116.14	4466	0.021*
Use of DVD and multimedia	171.54	140.44	6516	0.018*
Use of lap trainer	150.54	184.22	5957	0.007*

Note: Mann–Whitney U test is applied here. * represents the level of significance at 5%.

Discussion

The study results show that the respondents attending AIMS had reasonable experience of basic as well as some advanced laparoscopic procedures, such as cholecystectomy, diagnostic laparoscopy, and colorectal operations. The respondents' laparoscopic experience indicates that their remarks and perceptions were reliable, and a consensus of opinion could be reached based on their recommendations. The participants' average surgical experience of 16 years signals that although sufficiently experienced, they require surgical training to sharpen their skills and to master modern surgical instruments. The majority of respondents suggested that the best educational tool for surgical training is 'direct experience in operating room'. Although the supervising surgeon maintains overall control of the procedure during direct operating room experience, he or she still permits hands-on experience for trainees to achieve surgical proficiency.¹² Surgical training relies on gradual independence where surgical supervision is withdrawn step-wise as the trainee's skills improve.¹³ The educational model of direct supervision of trainees in operating rooms, also known as 'operating from the other side of the table', was endorsed by senior surgeons, who believed that providing direct control to trainees was a reliable strategy for learning how to operate.¹³ A popular notion states: "the best way to learn to operate is to actually operate".¹⁴ However, the situation becomes

more complex due to patient safety, which requires supervising surgeons to raise their level of control of the situation.

Research has shown that during a trainee's first 20–30 surgical cases, patients are exposed to a greater risk and the time to complete surgical procedure is longer.¹⁵ Additionally, trainers cannot provide enough cases for trainees to master all surgical techniques during the stipulated surgical training period. Virtual reality simulation training for improving operating room performance has proven effective in overcoming these hurdles.¹⁶ Simulation offers outstanding opportunities for learner-centred training, can be repeated, and procedures can be performed without negative outcomes.¹⁷ From an educational perspective, for adequate acquisition of surgical skills, supervisors can objectively measure the performance and can provide feedback to trainees. Additionally, rare and difficult cases can be taught in a controlled environment without risking patients' lives. Some emerging surgical simulation models can be embedded into surgical training programs with strong learning impacts. However, a study comparing the operating room performance on the continuous curvilinear capsulorhexis (CCC) portion of cataract surgery of the ophthalmology residents trained by traditional wet lab vs. surgical simulation found no significant differences in the overall satisfaction scores of the two groups, and there was no significant difference in

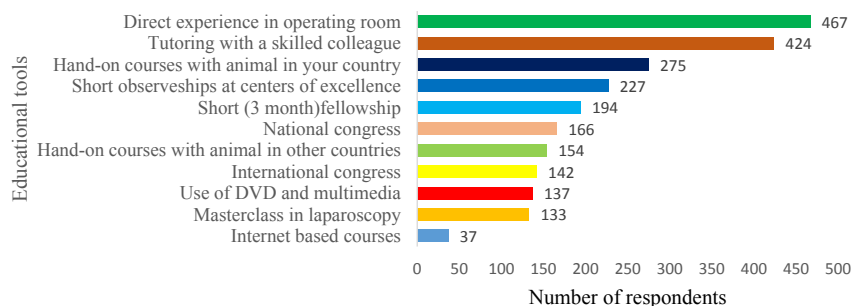


Figure 2: Best educational strategy for surgical training as proposed by participants (n = 636).

Table 3: Preferences for surgical educational resources across regions (n = 636).

Resources	Mean rank			Chi-Square	Asymp. Sig. (2-tailed)
	Northern	Central	Southern		
National congress	197.35	162.97	180.43	5.485	0.064
International congress	188.06	154.69	135.06	11.944	0.003*
Direct experience in operating room	201.76	200.56	250.95	10.352	0.006*
Short period of observership at centres of excellence	168.62	173.41	175.45	.234	0.890
Tutoring with a skilled colleague	202.22	191.95	176.44	3.434	0.180
Hands-on courses with animals in your country	171.08	161.60	161.22	.637	0.727
Hands-on courses with animals in other country	154.85	183.22	127.47	8.483	0.014*
Master class in laparoscopy	140.31	153.64	146.96	1.122	0.571
Short (3-month) fellowship	149.98	158.59	165.30	1.200	0.549
Internet-based courses	144.60	137.30	149.79	.451	0.798
Use of DVD and multimedia	168.27	176.93	189.80	1.585	0.453
Use of lap trainer	164.63	162.12	139.38	2.030	0.362

Note: Chi² value of Kruskal–Wallis test. * represents the level of significance at 5%.

any individual score except time (the wet lab group was faster than the simulator group).

A range of models for surgical residency training programs have been developed worldwide.¹⁸ These include core curriculums with options, spiral curriculums, and adaptive curriculums. Most of these models are driven by specific needs or pre-defined goals. In exploring specific needs in this study, respondents preferred supervised training in operating rooms. As a modern surgical training centre, AIMS is connected to the operating rooms at Niguarda Hospital, providing AIMS trainees with direct, high-definition, and multiple views. These views allow trainees to be virtually present in operating rooms with the option of interacting with operating surgeons. Additionally, animal labs at AIMS and other surgical training centres provide learning environments similar to those of operating rooms. AIMS has also provided learning opportunities by introducing a clinical mini-fellowship tele-mentoring event for the laparoscopic colorectal surgery

program using telementoring strategy. A Russian surgical trainee was provided on-site training and observation of a surgeon-mentee by an experienced surgeon-mentor, followed by mentored experimental hands-on surgical training and finally, mentoring from a distance during initial clinical cases.¹¹

Female respondents in this study considered the national congress to be a better educational resource than did males. By contrast, male respondents preferred Internet-based courses, DVD material and multimedia. The development of high fidelity computer-based simulators and the global availability of the Internet have transferred surgical learning away from the operating room.¹⁹ Furthermore, the Internet provides an opportunity for supervisors to standardize surgery training and assessment both locally and worldwide. The Internet is being used to provide learning platforms for problem-based learning,²⁰ clinical examinations,²¹ real-time telementoring,²² and procedural skills.²³ The innovative features of the Internet provide

Table 4: Preferences of participants for surgical educational resources across various forms of jobs.

Resources	Mean rank			Chi-Square	Asymp. Sig. (2-tailed)
	Hospital	University	Private clinic		
National congress	197.29	195.91	175.67	1.356	0.508
International congress	189.21	181.72	127.45	10.435	0.005*
Direct experience in operating room	209.78	217.59	217.99	0.531	0.767
Short observership at centres of excellence	181.38	142.05	167.95	6.747	0.034*
Tutoring with a skilled colleague	199.40	218.04	212.08	2.611	0.271
Hands-on courses with animals in your country	175.08	168.83	165.86	0.375	0.829
Hands-on courses with animals in other country	158.84	169.89	158.92	0.624	0.732
Master class in laparoscopy	146.69	134.32	180.93	5.801	0.055
Short (3-month) fellowship	156.05	160.70	165.38	0.348	0.840
Internet-based courses	145.51	139.28	190.06	7.567	0.023*
Use of DVD and multimedia	174.16	168.16	206.15	3.610	0.165
Use of lap trainer	168.96	155.67	166.47	0.756	0.685

Note: Chi² value of Kruskal–Wallis test. * represents the level of significance at 5%.

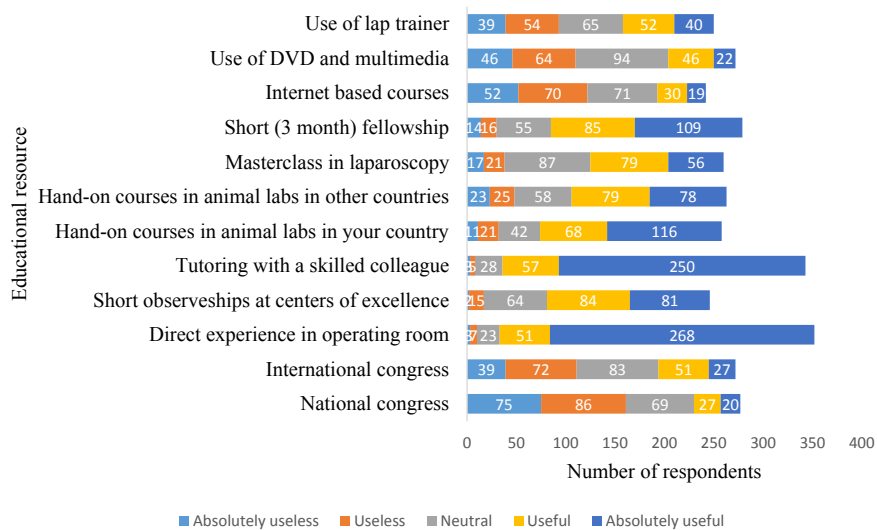


Figure 3: Preferred choice of surgical educational resources in the future (n = 636).

rapid incorporation of web-based educational tools into surgical training and remove geographical boundaries, allowing for the global sharing of knowledge and skills. Looking into these outright benefits, surgical educators must be proactive in embracing the Internet and web-based curricula for surgical education. However, further evidence-based studies are required to validate and incorporate Internet-based tools into surgical education.

Differences in participant perceptions based on gender, geographical representation, and primary workplace were evident in this study. These differences reflect the personal and workplace demands that influenced the respondents' learning needs. Participants in this study showed diverse learning styles and preferences, a finding that endorses Adnan Al Shaikh's findings, who also reported several learning styles of paediatricians at King Saud bin Abdulaziz University for Health Sciences Jeddah.²⁴ The majority of respondents in our study preferred hands-on surgical training. According to the Kolb's Learning Styles Inventory,²⁵ hands-on learning belongs to the accommodating learning style. The professionals possessing accommodating learning styles take a practical and experiential approach to learning,²⁶ and use a trial-and-error method of problem solving. These people are attracted to new challenges and experiences, and carry out innovative plans.²⁷ These characteristics signal unique professional behaviours. By understanding the specific learning needs of accommodating learners, surgical educators can tailor educational resources to this learning type for maximum benefit.

Conclusion

Surgical trainees prefer hands-on training in operating rooms, tutoring by skilled colleagues, and short fellowships. A significant number of male participants preferred

Internet-based surgical education. AIMS and other surgical training centres can provide educational platforms for direct supervised training under skilled trainers. The results of this study can be helpful to surgical educators in redesigning surgical curricula and training programs to match trainee preferences. Such interventions in surgical education demand resources, budget, trained faculty, and technically sound personnel. The findings of this study signal the profound importance of surgical training centres for the acquisition of surgical skills. Our regional Saudi surgical trainees can benefit from such training platforms, particularly from cross-institutional cohesive and collaborative ventures.

Conflicts of interest

The authors have no conflict of interest to declare.

Authors' contributions

AF conceived the idea, and distributed and collected the data. SYG performed statistical analysis and wrote initial and final drafts. AF, SYG, RP, and SG reviewed initial and final drafts of the manuscript.

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Appendix 1

Survey on the use of surgical educational resources in minimally invasive surgery

1. Name and Surname (optional) _____
2. Your email address _____
Age _____ Sex Male Female
3. Year of degree _____ Year of specialization _____
4. Geographic position: North Center South
5. Type of job Hospital University Private clinic
6. Do you perform surgical laparoscopic procedures? Yes No
7. If yes, what type of surgery? (Multiple answers are admitted)
 Cholecystectomy Appendectomy Gastrectomy
 Hernia repair Colectomy Spermatic vein ligature
 Renal cyst resection Simple nephrectomy Radical nephrectomy
 Nephroureterectomy Radical prostatectomy Ovarian cyst resection
 Ovariectomy Tubal ligation Diagnostic laparoscopy
 Other _____
8. If you plan to learn laparoscopy, what educational tools do you prefer?
 National congress International congresses
 Direct experience in operating room Short observerships at centres of excellence
 Tutoring with a skilled colleague Hands-on courses with animals in your country
 Hands-on courses with animals in other countries Masterclass in laparoscopy
 Short (>3 months) fellowship period Internet-based courses
 Use of DVDs and multimedia Use of lap trainer
 Other, please specify _____
9. How do you rate the following educational resources based on past experience (1 = “totally useless” (Minimum), 5 = “absolutely useful” (Maximum))?
 National congress International congress
 Direct experience in operating room Short observerships at centres of excellence
 Tutoring with a skilled colleague Hands-on courses with animals in your country
 Hands-on courses with animals in other countries Masterclass in laparoscopy
 Short (>3 months) fellowship period Internet-based courses
 Use of DVDs and multimedia Use of lap trainer
 Other, please specify _____
10. According to your preferences, which educational resources would you like to use again in the future to improve or learn a new set of skills? (1 = “totally useless” (Minimum), 5 = “absolutely useful” (Maximum))
 National congress International congress
 Direct experience in operating room Short observerships at centres of excellence
 Tutoring with a skilled colleague Hands-on courses with animals in your country
 Hands-on courses with animals in other countries Masterclass in laparoscopy
 Short (>3 months) fellowship period Internet-based courses
 Use of DVDs and multimedia Use of lap trainer
 Other, please specify _____
11. Are you aware of institutions that organize educational courses with hands-on training in wet-lab (live animals) and dry-lab (plastic mannequin and virtual simulator) in Europe?
 Yes No Specify _____
12. Are you aware of institutions that organize educational courses with hands-on training in wet-lab (live animals) and dry-lab (plastic mannequin and virtual simulator) in your country?
 Yes No Specify _____
13. Would you like to attend a course to learn laparoscopy using animal models?
 Yes No Don't know
14. What are the greatest obstacles to your participation in these courses?
 Location Cost
 Knowledge of the English language
 Difficulty in duplicating the surgical act once in your hospital
 Ethical concerns
 Difficulty coupling job with these activities
15. Are you aware of the definitions, scope and techniques of laparoendoscopic single site surgery (LESS)?
 Yes No

16. **Have you performed LESS procedures?**
Yes No Please specify _____
17. **If NO, would you like to learn LESS?**
Yes No
18. **Where did you learn about LESS, and what is your opinion about it? (1 = “totally useless” (Minimum), 5 = “absolutely useful” (Maximum))?**
National congress International congresses
Direct experience in operating room Short observerships at centres of excellence
Tutoring with a skilled colleague Hands-on courses with animals in your country
Hands-on courses with animals in other countries Masterclass in laparoscopy
Short (>3 months) fellowship period Internet-based courses
Use of DVDs and multimedia Use of lap trainer
Other, please specify _____
19. **What experience do you like more? (1 = “totally useless” (Minimum), 5 = “absolutely useful” (Maximum))?**
National congress International congress
Direct experience in operating room Short observerships at centres of excellence
Tutoring with a skilled colleague Hands-on courses with animals in your country
Hands-on courses with animals in other countries Masterclass in laparoscopy
Short (>3 months) fellowship period Internet-based courses
Use of DVDs and multimedia Use of lap trainer
Other, please specify _____
20. **What is your opinion of the following sentences regarding LESS? (1 = “I totally disagree”, 5 = “I totally agree”); LESS is:**
Experimental surgery
A type of surgery limited to centres of excellence
Dangerous surgery
Surgery that will replace some standard techniques
“Marketing strategy”
A sophisticated technique developed to introduce something new
A technique promising a painless and faster post-operative recovery
“Trendy surgery”
A type of surgery that is too complex and discourages many surgeons
A type of surgery that could be learned through the appropriate training

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