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Development and evaluation of an endoscopic surgery course for medical students

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ABSTRACT

INTRODUCTION: Surgical training has changed with the introduction of endoscopic surgery. However, a gap in undergraduate medical training has become evident regarding theoretical principles of and basic skills training in endoscopic surgery. The objective of this study was to develop and evaluate a course in endoscopic surgery for medical students.

METHODS: Kern's six-step approach in curriculum development was used. A course including interactive, faculty-led didactic sessions (14 hours, distributed over three days) and simulation-based basic skills training in endoscopic surgery (nine hours, distributed over four sessions) was developed. Knowledge was tested using a 35-item test before and after the course, and finally the course was evaluated electronically. The project group in cooperation with the faculty developed the goals and objectives, the test and the evaluation questionnaire.

RESULTS: The test-scores significantly improved after the course, $p < 0.0001$, with a mean difference of 12.95 (95% confidence interval: 11.47-14.44). A total of 74% (14/19) responded that the course increased their interest in a career in a surgical specialty and 58% (11/19) were considering specialising in a surgical specialty.

CONCLUSIONS: A course in endoscopic surgery was developed based on Kern's six-step approach. The course was positively perceived by the students in terms of contents as well as structure and relevance.

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TRIAL REGISTRATION: not relevant.

During the past decades, surgical training has undergone major changes with the introduction of endoscopy surgery. Although many surgical procedures today are performed using endoscopic surgery, a gap in medical schools' curricula seems evident regarding the theoretical principles of and basic skills training in endoscopic surgery. Research into the role of simulation in surgical skills training has increased dramatically, and the benefits are well established [1, 2].

The current curriculum [3] at the University of Copenhagen, Denmark, includes some basic skills training in open surgery. However, endoscopic surgery, i.e. laparoscopy, requires specific skills which are not included in the current curriculum for medical students [4]. The curriculum includes a mandatory surgical clerkship in which the medical students might be required to assist during laparoscopic surgery. It was shown that when medical students received training in basic surgical skills before assisting in surgery, they achieved greater benefits from the clerkship, showed a higher level of confidence and comfort [5], and improved their knowledge and technical skill [5, 6]. Additionally, the surgical clerkship is valuable in regard to choosing a future career in a surgical specialisation [7]. A pre-graduate course in the theoretical principles of and basic skills training in endoscopic surgery can inform the students' career choice by making it clear if a career in surgery is aligned with their interests. Additionally, it can prepare students for future surgical training, ease their transition into clinical work and link pre- and postgraduate surgical skills training.

When developing a new course, the process of curriculum development can be challenging. Kern et al [8] proposed a six-step approach to curriculum development, which is a well-established model that aims to support medical educators and is applicable as a general approach in curriculum development.

The objective of this study was to describe the development and evaluation of a pilot course in the theoretical principles of and basic skills training in endoscopic surgery for medical students based on Kern's six-step approach.

METHODS

Curriculum development

The course was developed from September to November 2015 and was completed and evaluated in November 2015. Anchored in current curriculum development literature, Kern's six-step approach was used [8] (**Table 1**). To cover the theoretical principles of and basic skills training in endoscopic surgery, the course included a cognitive component and a psychomotor component. To ensure correct terminology when preparing the goals

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TABLE 1

Overview over the curriculum development process, based on Kern's model.

The 6 steps	General description of each step	The project group´s action
Problem identification/ general needs assessment	Identification and characterization of the problem to be addressed in the curriculum, evaluation of the differences in the current approach and the ideal approach to the problem: general needs assessment	The current surgical curriculum in medical school was explored and the ideal approaches to bridge the gap that currently exists were elucidated
Targeted needs assessment	Identification of the specific needs, preferences of the targeted learners and assessment of the targeted environment	The medical students' current level of knowledge was explored, as well as the learning environment, incl. current curriculum and other potentially influential environmental factors
Goals and objectives	The goals are general, broad educational objectives and not necessarily measurable The objectives are specific and measurable, and should include cognitive: knowledge, psychomotor: skills, and affective: attitudinal, objectives	The goals and objectives were defined, and to ensure correct terminology Bloom´s taxonomy[a] was used
Educational strategies	The educational methods should be based on the goals and objectives as it is important to ensure congruence between what we aim to teach and how it is taught Multiple educational methods should be considered as well as available resources	The course incl. interactive, faculty-led didactic sessions as well as simulation-based endoscopic skills training
Implementation	Obtain external/institutional support, identify and secure resources, anticipate and address potential barriers, ensure administration mechanism to support the curriculum and develop a plan for curriculum maintenance and enhancements	Support for development and evaluation of the present pilot course was obtained but no overall implementation plan was developed
Evaluation and feedback	To determine if goals and objectives are met, assessment of the individual learners and the curriculum is necessary, and it provides information for potential improvements	A 35-item test based on the general goals and objectives was developed The same test was used before and after the course The evaluation questionnaire included 13 items and focused on contents, structure and relevance of the course and interest in a surgical career

a) [9].

and objectives, Bloom's taxonomy was used [9]. The multiple choice questioner (MCQ) test was developed according to the principles of the National Board of Medical Examiners [10].

The project group and course faculty

The project group consisted of the primary author and three researchers in assessment and medical education with previous experience in endoscopic surgery. The course faculty consisted of experienced medical doctors in general surgery, gynaecology, urology and respiratory medicine. In collaboration with the course faculty, the project group developed the curriculum, including the goals and objectives and the items of the test.

The course

The cognitive component comprised faculty-led, interactive didactic sessions distributed over three days (a total of 14 hours). The overall goal of the cognitive component was to provide the participants with an overall introduction to the theoretical principles of endoscopic surgery. In this course, endoscopic surgery covered laparoscopy, colonoscopy, gastroscopy, bronchoscopy and cystoscopy. The following sub-topics were included: general introduction and principles of endoscopic surgery (incl. advantages and drawbacks, and pre- and post-operative care), endoscopic equipment (incl. function and handling), pneumoperitoneum, role of the personnel in the operation theatre, common endoscopic procedures (incl. techniques and complication management) and robot-assisted surgery. The psychomotor component included endoscopic simulation training distributed over four sessions (a total of nine hours). The overall goal was to introduce the participants to different types of basic endoscopic simulation training. The simulation training included basic tasks on virtual reality simulators, laparoscopic box-trainers, a robot-assisted laparoscopic surgery simulator and a video-bronchoscopy simulator. On the laparoscopic simulators, the tasks included: grasping, cutting, clip-applying, suturing, camera navigation and a procedure (salpingectomy). On the bronchoscopy simulator, the tasks included anatomy identification. Three medical students assisted the participants during the simulation training; including introduction of the simulators and the basic surgical tasks, and provided feedback on request.

TABLE 2

Results from the course evaluation (five-point Likert scale). The values are n (%).

	5-point Likert scale					
Evaluation item	**1-5**	**1**	**2**	**3**	**4**	**5**
Did you find the course relevant?	Not relevant – very relevant	0	0	1 (5)	12 (63)	6 (32)
Do you think the course is a relevant supplement to your current curriculum?	Not relevant – very relevant	0	0	0	8 (42)	11 (58)
The contents level of the course?	Too advanced – appropriate	0	1 (5)	0	2 (11)	16 (84)
To what degree did the course meet your expectations?	Did not meet expectations – did meet expectations	0	0	0	10 (53)	9 (47)
Are you satisfied with the contents of the course?	Not satisfied – very satisfied	0	0	3 (16)	9 (47)	7 (37)
How did you find the overall teaching level?	Poor – very good	0	0	2 (10)	7 (37)	10 (53)
How was your experience with the simulation training?	Poor – very good	0	0	1 (5)	6 (32)	12 (63)
Did you find the number of hours for the simulation training appropriate?	Too few hours – appropriate no. of hours	1 (5)	1 (5)	4 (21)	7 (37)	6 (32)
How was your overall experience with the course?	Poor – very good	0	0	2 (11)	4 (21)	13 (68)
Did you find the course relevant for your future education/career?	Not relevant – very relevant	0	2 (11)	4 (21)	7 (37)	6 (32)
Would you recommend the course to fellow medical students?	Not recommend – definitely recommend	0	0	1 (5)	1 (5)	17 (90)

Study participants

The participants were recruited through the student newspaper and student associations for general surgery and gynaecology. The invitation included participation in two projects; 1) a randomised controlled trial [11], studying simulation-based training in camera navigation and transfer of skills to the operating room, followed by 2) participation in a course in endoscopic surgery. The inclusion criteria were: 1) medical student in the fourth, fifth or sixth semester, enrolled at the Faculty of Health Sciences at the University of Copenhagen, 2) informed consent for the trial. The exclusion criteria were: 1) previous participation in projects involving laparoscopic training, 2) experience with laparoscopic surgery (> 0 procedures), and 3) lack of ability to lead a conversation in Danish.

Setting and simulators

The training was imparted at Copenhagen Academy for Medical Education and Simulation, Rigshospitalet, Copenhagen, Denmark and The Juliane Marie Centre for Children, Women and Reproduction, Rigshospitalet, Copenhagen, Denmark. The simulators used were: Laparoscopic box-trainers, virtual reality simulators (LapSim, Surgical Science, Sweden), a video-bronchoscopy model (AirSim Advance, TruCorp, Ireland) and da Vinci equipment for robot-assisted surgery (da Vinci, Intuitive Surgical, USA).

Assessment

A 35-item test was developed based on the general goals and objectives. The course faculty prepared relevant items in their respective areas of expertise, which were reviewed by the project group. All items included four alternatives, based on the one-best-answer principle [10]. The maximum score was 35. The same test was administered before and after the course.

Evaluation

The items in the evaluation questionnaire were developed by the project group and focused on the contents, structure and relevance of the course, and on the student's future interest in a surgical career. The evaluation included 13 questions of which two were open-ended and 11 questions were evaluated on a five-point Likert scale (**Table 2**). The two open-ended questions included considerations about future specialisation and whether the course had an impact on their considerations concerning a future career. To optimise the response rate, one electronic reminder was sent out.

Statistics

Data were analysed using SPSS version 22.0 (IBM, Armonk, New York, USA). The mean difference of the pre- and post-test score was analysed using paired Student's t-test. A two-sided significance level of $p < 0.05$ was used.

Ethics

Participation in the course was voluntary, and participants could withdraw at any given point. All results of the test and evaluation were handled anonymously and could in no way influence the students' future career. No ethical approval was necessary for the present study according to Danish provisions.

Trial registration: not relevant.

RESULTS

Of the 34 included medical students, a total of 26 (mean age 22 years, 53% females) agreed to participate in the course and 23 completed the full course. The three dropouts were due to private reasons.

A significant difference between the pre- and post-

Simulation-based laparoscopy training.

test score was found, $p < 0.0001$, with a mean score of 14.3 (95% confidence interval (CI): 12.9-15.7) on the pre-test and 27.2 (95% CI: 25.7-28.7) on the post-test; the mean difference was 13.0 (95% CI: 11.5-14.4).

A total of 19 students completed the online evaluation. Overall, the evaluation was very positive, both regarding course contents, structure and relevance (Table 2). The two open questions, 74% (14/19) noted that the course had increased their interest in a career in one of the surgical specialisations or supported their previous considerations with respect to a career in surgery, 21% (4/19) reported that the course had not affected their considerations about their future career, and 5% (1/19) did not know if the course had affected their thoughts about their future career. Regarding considerations on future specialisation, 58% (11/19) were considering specialising in surgery, 21% (4/19) considered other areas than surgery and 21% (4/19) had not yet considered specialisation.

DISCUSSION

Overall, the students perceived the course positively regarding contents, structure and relevance. The evaluation suggested that the course was both relevant, a good supplement to the current curriculum for medical students and useful as guidance for their future career. Three quarters of the students implied that the course had confirmed or increased their interest in surgery, and more than half of the students were strongly considering a career in surgery.

The course was developed using the well-established Kern's six-step approach to ensure a structured development process [8]. Based on the gap in the present surgical curriculum, we developed goals and objectives covering the theoretical principles of and basic skills training in endoscopic surgery. We used didactic sessions in combination with simulation-based skills training as educational methods and experienced teachers were in charge of their respective area of expertise. The subjects included in the didactic sessions as well as the skills training were based on the developed goals and objectives, and the students' knowledge was tested using a 35-item test based on the goals and objectives. The course was evaluated as a whole using an evaluation questionnaire.

The limitation of the evaluation questionnaire lies in the potential risk of selection bias and the use of a non-validated evaluation questionnaire. Participation was voluntary and participants were recruited mainly from student organisations with an interest in surgery; and they could therefore potentially represent a highly motivated group. Optimally, the evaluation questionnaire should have been validated and suggestively expanded, regarding course contents and structure, to further learn from the students' experiences with the course. Another interesting area to further examine is the course's potential impact on career choice. In the present study, this was only briefly included, but students implied that the course had a positive impact on their present considerations about the surgical specialisations.

The students reported positive experiences with the simulation-based skills training, but some requested more time for practice. Unfortunately, due to resource and time restrictions, the skills training offered in our course was time-limited and structured only to give the students a chance to try different aspects of simulation-based skills training. Ideally, the skills training should be practiced in a deliberate, proficiency-based manner and distributed over time [12, 13].

Regarding the assessment, both technical skills and knowledge should have been tested using validated methods, and transfer of skills should have been evaluated. In this course, a non-validated knowledge test was used. Ideally, the MCQ test should have been validated [14] as this is an effective tool for cognitive assessment. Nevertheless, test development is a complex and time-consuming process, and such development was therefore omitted due to time and resource restrictions.

Implementation of a course in endoscopic surgery can bridge the gap in the present surgical curriculum, and is suggested to help cultivate the medical students' surgical interest and to enhance experience and learning during the clerkship. A down-scaled version of the course could be integrated in the current curriculum and offered to all medical students; or the full version could

be offered as an option to students with a special interest in the surgical specialisations. It was demonstrated that participation in surgical skills courses increases the likelihood of a subsequent career within a surgical specialisation [7, 15]. The course is both preparatory for a future career in surgery, but could also act as guidance and a tool for medical students helping them choose their specialisation. Since participation in a surgical skills course before onset of specialist training improves knowledge and technical skills [5, 6, 16], the trainee might already have acquired the basic surgical techniques and hereby have improved the educational efficiency during specialist training [17], and this might ease the transition into a surgical specialisation. The timing of the course is suggested to be close to graduation to minimise any decay of skills [5, 18]. Medical schools are encouraged to implement a course in endoscopic surgery to link, support and improve the pre- and postgraduate training of future surgeons.

CONCLUSIONS

We developed a pilot course in endoscopic surgery that was overall perceived positively by the students both for its contents, structure and relevance. Implementation of a course in endoscopic surgery for medical students is proposed with a view of linking the pre- and postgraduate education of future surgeons.

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