Original Research

Correlation between students' and trainers' evaluations while learning delegated surgical procedures: A prospective cohort study

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ABSTRACT

Background: The delegation of procedures within the medical competence to the nurses can increase the effectiveness of the healthcare provided. The objectives of the study are (1) to assess the quality of training courses for delegated surgical procedures through implementation for graduate scrub nursing ("students") (2) and to evaluate the correlation between the evaluation of this training carried out by students and the self-assessment conducted by the faculty ("trainers").
Materials and methods: We set up a 49-h training for five groups of 10 students from July 2016 to July 2017 in our tertiary academic hospital. The course consisted mostly in simulations based on the "Zwisch" model and focused on acquiring the control of the gesture as well as on the development of critical reasoning. An evaluation of the training by the students but also a self-assessment of trainers were prospectively collected using the SFDP26 questionnaire.
Results: 52 active scrub nursing students and 21 trainers were included. 96% of students and 86% of trainers evaluated the training from "good" to "very good". Progress was observed for 41 (79%) of the students and 18 (86%) of the trainers, and 98% of students felt able to put their new skills into clinical practice after training. There was no difference between the total scores of students and teachers (p = 0.153). A statistically significant difference between the evaluations produced by the students and the self-evaluations produced by the trainers was observed for 8 of the 26 items of assessment. In case of inadequacy, the trainers' scores were always lower than those of the students.
Conclusions: Training in performing delegated surgical procedures by mixed cognitive and motor gestures learning, based on the development of critical thinking and simulations seems to be effective, with a significant improvement in students' knowledge and skills. Expectations of students and trainers are well correlated.

1. Introduction

The delegation of procedures within the medical skills to the nurses can increase the effectiveness of the healthcare provided, participates in a closer team collaboration between the various health providers and also contributes to increase the nurses' job satisfaction [1–3]. However, it may be difficult to determine what are the delegable procedures [4,5]. When performing surgical procedures, delegation of procedures to the scrub nurses is possible if they are authorized by a service protocol and if the nurses have been trained. Some surgical procedures,

such as dermal sutures or surgical site marking have already been successfully delegated to nurses who have undergone dedicated training ("Advanced Clinical Nurses") [6,7]. Other delegable procedures include the surgical installation of the patient, the placement and fixation of supra-aponeurotic drains, the subcutaneous closure, but also during surgery and in the presence the surgeon, a function of assistance with exposure, hemostasis and suction or a helper function for procedures of a particular technicality.

It is mandatory to implement an appropriate training to learn gestures to delegate these procedures while maintaining the safety of the

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patient. Acquiring control of a gesture can be difficult; control is defined by the ability to automatically perform this gesture thus freeing one's thought for reflection [8]. Gaining control of a gesture requires first a learning time then a regular practice to keep its execution memorized and to reach automaticity. Thus, knowledge about the procedure involved, supervised training and practical training are the cornerstones to achieve a sufficient level of expertise and experience [9]. In addition, the monitoring and auditing of the skills allows to refine the gained expertise with the ultimate goal of constantly improving quality [10].

1.1. Objectif

Therefore, we have implemented training sessions to teach delegated surgical procedures to the active graduate scrub nurses ("students"), as well as a simultaneous evaluation system. The objectives of this study are (1) to evaluate the quality of training in delegated surgical procedures implemented (2) and to assess the correlation between the evaluation of the training carried out by the students and the self-assessment carried out by the faculty ("trainers"). Our hypothesis is that the implementation of a composite training system for teaching surgical procedures based on critical thinking and simulations would match the expectations of students and trainers.

2. Material and methods

2.1. Participants

We led a prospective study from July 2016 to July 2017, within our scrub nurse school, attached to our tertiary academic hospital. After identifying scrub nurses already in practice who could benefit from the training, we divided them into groups of 10–12 students, distributed into 5 sessions over the study period. We paid attention to mix these groups according to various places of exercise, surgical skills, length of professional practice and sectors of public or private activities. This group allocation was intended to enrich the exchanges between students by providing diverse personal and professional experiences, while maintaining a balance between the groups.

Moreover, each intervention was supervised by a professional trainer, specialist in the field of the proposed course subject. Associating professionals from all surgical fields aimed at meeting the needs created by the growing demand for multidisciplinary within operating theatres.

2.2. Learning gestures

Education was faced with a double challenge: the acquisition of control of the delegated procedure but also the development of critical thinking to encourage the student to choose the right strategy to implement in frequent practice situations among the different learned gestures. We therefore set up a training relying on the modern requirements of pedagogy [11,12]: a small number of students in the workgroup, a versatility of skills, alternating theoretical and practical training, and with both laboratory and clinical simulations.

The entire 49-h training course recommended by decree was focused on seven days for each of the five sessions not to penalize the professional activity of the students, on a single site. Each course in a session focused on a single objective and lasted 2–3 h. A didactic document and training support were prepared beforehand and given to the participants at the beginning of the training, including the objectives, the provisional schedule and selected relevant literature. On the first day of the session, a collective and oral self-assessment using short multiple-choice questions was proposed to all students to assess their prior knowledge, thus allowing the students to grasp the challenges of learning. The training was divided into two parts: didactic courses for one and a half days to properly lay down the legislative framework

relating to the training (responsibilities, methodological bases, setting up of protocols) and five and a half days of simulation (stitches and drain, surgical assistance for exposure, endoscopic surgery assistance, hemostasis and suction, installation of the patient). Finally, the session was closed by a debriefing on the whole training.

The simulations were organized in such a way as to progress continuously, inspired by the "Zwisch model" [13], model with 4 general steps: "(1) Show and Tell; (2) Smart Help; (3) Dumb Help and (4) No Help". Each simulation was based on a specific clinical situation, evolving according to the actions undertaken by the student [14]. The small size of 10–12 students per session allowed an individualized training by letting each student evolve at its own pace at each step of the simulations. The students were mainly working by subgroups of 3: a student doing the procedure, the other helping and the third as an observer. The student realizing the gesture would proceed to the next step only when he felt that the current step was properly integrated. Students who reached the last step of "No Help" could then take the role of "Smart Help" or "Dump Help" for another student. This reflexive system also allowed to take a critical look at the gesture, finding himself alternately in the situation of the student or the trainer [15]. To increase students' attention to simulations, the debriefing was conducted by the student not involved actively in the simulation but who had observed it from an external point of view [16].

2.3. Evaluation method

We evaluated the quality of the training using a validated evaluation questionnaire (26-item Stanford Faculty Development Program, SFDP26) [17] via an online survey among students and trainers to judge the correlation between these two evaluations. This questionnaire is part of the System for Evaluation of Teaching Qualities (SETQ) which includes (1) a self-assessment by the trainer (2) an assessment by the student (3) then a feedback and (4) a follow-up to improve teaching. The SFDP26 questionnaire therefore exists in several versions for an evaluation of training by the students but also for a self-evaluation of by the trainers. Both versions share 25 basic items covering 7 dimensions of teaching quality: learning climate, control of session, communication of goals, promoting understanding and retention, evaluation, feedback and promoting self-directed learning. They differ in the title and the phrasing of the questions ("during the training, the trainers generally …" for students or "during the training, in my role as a trainer, usually I …" for trainers). Each of the 25 items could be rated in 5 categories: strongly disagree, disagree, neutral, agree, strongly agree. Each questionnaire concludes with a rating item about the overall educational quality from very bad (1) to very good (5). The rating of each item from 1 to 5 points depending on the category allows the calculation of a score for each of the seven dimensions and for the notation on overall teaching effectiveness. A calculation of a total score, ranging from 26 points for the minimum score to 130 points for the highest score, allows to evaluate the whole training.

We also collected data on the reference specialty, the seniority, the kind of practice and two questions scored 5 points each concerning the evolution of the level of knowledge/skills before and after training. For students only, one last yes or no question on the feeling of being prepared to perform the delegated surgical procedure in a real clinical situation ended the survey.

2.4. Ethical consideration and survey analysis

Ethical principles were upheld in this study. The confidentiality of the training schools has been preserved throughout the process. Authorities of the faculty gave their consent to advertise the research and to invite potential participants to take part. At the first session, the researcher explained the study's objectives. Both students and trainers were assured of the anonymity of their response and were advised about the intention to publish the results. Participation was strictly

voluntary, and participants were advised they could choose not to fill the questionnaire without any explanation and this would not impact validation of their training. Informed consent was obtained at the beginning of the online questionnaire filling. Finally, the work has been reported in line with the STROCSS criteria [18].

We performed three kinds of analysis. First, we compared the results of self-evaluation by trainers with those of students by the Kruskal-Wallis H test for each of the 26 ordinal items. Next, we compared the levels of knowledge and skills before and after training for students and trainers by a Wilcoxon rank test for paired samples. Finally, we assessed the correlation for average scores for each dimension of teaching quality using the U Mann-Whitney test. The results are presented as a mean ± standard deviation, number of subjects or proportions. The significance level was set at 0.05 and the analyses were performed using SPSS v22 (IBM®).

3. Results

3.1. Population

Fifty-four active graduate scrub nursing students completed training, 52 (96%) answered the questionnaire. Twenty-seven were polyvalent and 25 specialized. The nurses had an average seniority of 17.8 years (3–36) and a large majority (50) had a public activity.

Regarding trainers, 26 specialists participated in training among which 21 (81%) responded to the questionnaire. Seventeen trainers practiced as specialized surgeons and 4 trainers were nurses or nursing managers. Trainers had an average seniority of 12.6 years (2–40) and 20 of them had a public activity.

3.2. Item and overall evaluations

Fig. 1 shows the detailed distribution of students and trainers for each item in the questionnaire.

Students' evaluations of the training were positive with at least 71% of students ticking categories 4 and 5 ("agree" and "strongly agree") on all items. The only two items that scored 1 ("strongly disagree") were "discourage external interruptions" and "explicitly encouraged further learning". Regarding the overall teaching effectiveness, 96% found it "good" to "very good".

The trainers' evaluations were less positive with 42% of trainers ticking the 4th and 5th categories across all items. Items having been evaluated as 1 "strongly disagree" were also "discourage external interruptions" and the 3 items on the "promoting understanding and retention" dimension. Regarding the overall teaching effectiveness, 86% found it "good" to "very good".

3.3. Increase of the level of knowledge and skills and subjective perception

Fig. 2 shows the detailed results about the level of knowledge and skill increase before and after training.

The students showed a significant improvement from an average score of 3.19 ± 0.81 to 4.11 ± 0.55 (p < 0.001). The trainers also showed an improvement from an average score of 3.57 ± 0.93 to 4.71 ± 0.46 (p < 0.001). A progression was observed for 41 (79%) students, including 7 with a gain of 2 categories, and 18 (86%) trainers, of whom 6 had a gain of 2 categories. No student or trainer showed a regression, with a decrease in category.

Regarding the subjective perception of training by students, to the question "do you feel able to use your new skills in clinical practice", 51 of the 52 students (98%) answered positively.

3.4. Correlation between students' evaluation and self-evaluation of trainers

The total score for students was 111.79 ± 12.99. Trainers self-assessed lower compared to students, with a total score of 106.43 ± 14.63. There was no statistically significant difference between the total scores of students and trainers (p = 0.153).

As shown in more details in Fig. 1, an inadequacy was observed for 8 of the 26 evaluation items: "called attention to time" (p = 0.011), "avoided digressions" (p = 0.002), "stated relevance of goals to learners" (p = 0.007), "prioritized goals" (p = 0.043), "evaluated learners' knowledge of factual information" (p = 0.031), "evaluated learners' ability to analyze or synthesize knowledge" (p = 0.008), « explained to learners why he/she was correct or incorrect" (p = 0.024) and "overall teaching effectiveness" (p = 0.017).

But finally, Table 1 shows that significant differences between the evaluations produced by the students' and trainers' scores have been found only for one of the seven dimensions ("control of session") and for the "global" rating.

4. Discussion

Our study shows a good overall evaluation of the training implemented with 96% of the students and 86% of trainers having rated it from "good" to "very good". A statistically significant discrepancy between the evaluations produced by the students' scores and trainers' self-evaluations were observed for only one of the seven dimensions and for the "global" rating.

4.1. Learning gestures

This teaching aimed at both developing the critical thinking of the students and acquiring the control of the gestures.

Indeed, it was suggested that cognitive training improves the ability to properly perform a surgical technique [19]. To achieve this goal, we chose a composite training, delimited for each course to a single concrete situation where the student had to determine the appropriate strategy and then carry out the appropriate gesture. The challenge was not to induce clear separation between simulation training and clinical practice as the student might feel like playing a role instead of integrating the teaching into his clinical practice.

Learning gestures is mainly done by imitation and by "trial and error" [20]. Learning by imitation is an exchange between a student and a trainer which requires that the student would understand the purpose of the gesture and that he has previously learned the essential prerequisites to understand it [21]. As the observation alone cannot be used to acquire all the dimensions of the procedure, the prerequisites for simulations have been the subject of dedicated didactic teaching courses prior to simulation. Then, the first phase consists in an observation: the trainer first performs the gesture in real-time, then repeats it in slow motion. Then the student makes the gesture with the help of the trainer who identifies the defects and makes the student repeat the right gesture. A second stage of observation may be necessary because when an experienced surgeon operates, he may use some "tips and tricks" that can go unnoticed for the unexperienced observer. "Trial and error" learning also makes sense in the training of students who already have professional experience as to change the course of a person's actions and correct execution. It enables them to practice and correct their flaws [9]. Moreover, while learning a new gesture or correcting a known one, it is useful to break it down into small sequences, to make the understanding of sequences of gestures easier, starting with the easiest to reach the most complex stage. This allows to lower the stress generated by all the information given all at once and avoid situations of failure. To achieve this, we chose to perform simulations on the model "Zwisch", preferred to the model described by Peyton ("Demonstrate", "Talk the trainee through", "Trainee talks trainer through" and "Trainee does"), less discriminating in its steps [22], or to the "See one, Do one, Teach one" approach [9] (inadequate and empirical method) or to the "Reverse Training" approach (learning method of procedure from the end and up the steps to the beginning, for example, attach the point of stitches, then pass the wire and attach
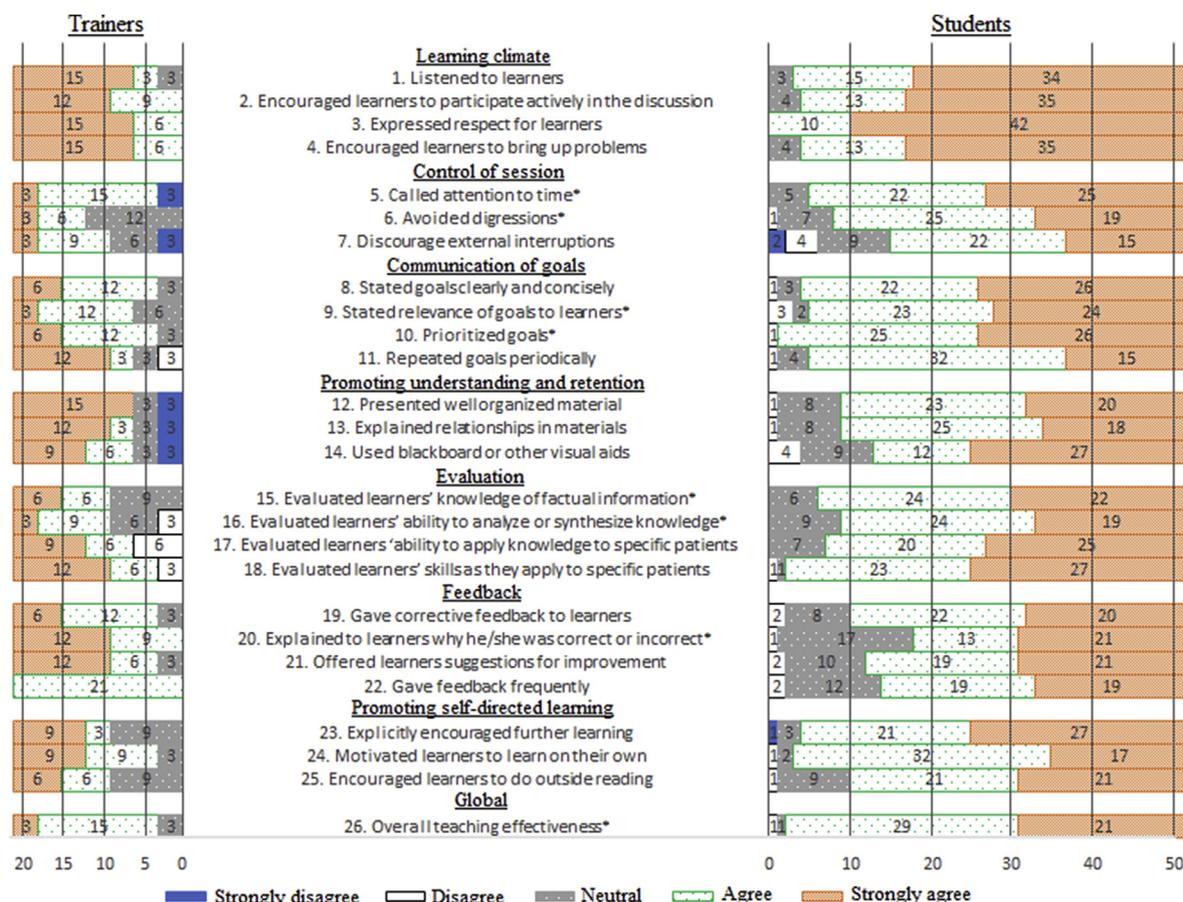
Fig. 1. Distribution of students and trainers for each of the 26 items of the questionnaire. Number of participants by category for each of the 26 items of the questionnaire, * significant difference.
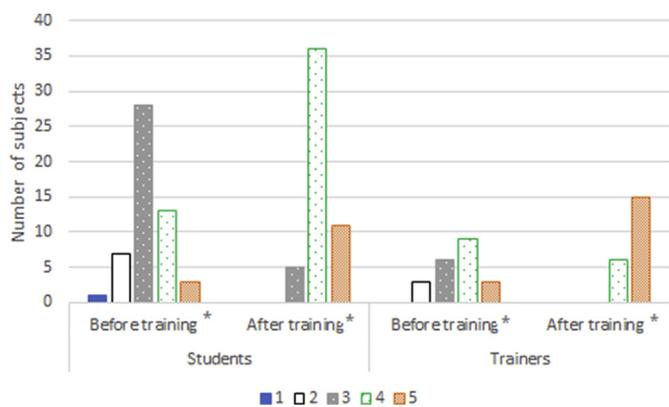

Fig. 2. Improvement of the level of knowledge and competence before and after training. From 1: "very bad" to 5: "very good", * significant difference.

point …) [9].

4.2. Learning climate

Teaching conditions are an essential factor to a appropriate and effective course. The first option was to conduct a routine clinical course associated with a direct observation of procedural skills. Although clinical teaching in operating rooms has shown a real efficiency [23,24], it would be difficult to be pursued on an ethical and legal point of view, with concerns about the patients' safety. The use of simulation models can enable the students to learn safely. The climate is adapted to effective learning by creating a safe and stress-free environment, that permits repetition of the gesture several times [25,26]. The transfer of simulation to the real clinical situation is subsequently easy thanks to the automatisms and the feeling of confidence gained by the student [27,28]. However, the benefit for the patients, corresponding to the Kirkpatrick's four-level model of educational evaluation, is difficult to estimate [29].

4.3. Evaluation method

Through an appropriate evaluation method, the strengths and weaknesses of an education program can be highlighted. This is the preliminary step towards improving this program, the positive aspects can be improved, and the deficiencies eradicated [30]. An effective evaluation tool helps the faculties to evaluate their activities (formative evaluation) but also for the allocation of resources, the promotion of education or an annual performance review (summative evaluation). Unfortunately, no evaluation tool covers all aspects of clinical teaching in a meaningful way and their validation is often limited to assessing their internal consistency and reliability [31]. Specific rating scales are regularly used for the assessment of nurses in operating rooms [32] but they are more suited to evaluate a clinical competence than for evaluating the quality of teaching. We chose the SFDP26 score for students and trainers as well because it is a validated instrument [33] that allows to directly check the correlation between each of the answers. The questionnaire was used by more than 100 universities to assess the benefits of teaching seminars [34,35]. The perception of the student can be very different from the trainer's [36] and may also depend on factors associated with the teaching method such as enthusiasm or courtesy shown by the trainer [37]. Studies showed that trainers have a low ability to self-evaluate with precision [38,39], and we found that the

Table 1
Correlation between student evaluation and trainer self-evaluation.

Dimension	Items	Maximum score	Students	Trainers	P value
Learning climate	1–4	20	18.60 ± 1.89	18.57 ± 2.04	0.952
Control of session	5–7	15	12.42 ± 1.81	10.71 ± 2.72	0.009*
Communication of goals	8–11	20	17.35 ± 2.3	16.29 ± 2.67	0.171
Promoting understanding and retention	12–14	15	12.54 ± 2.11	12.00 ± 3.99	0.616
Evaluation	15–18	20	17.31 ± 2.39	15.57 ± 3.63	0.093
Feedback	19–22	20	16.38 ± 3.19	17.14 ± 1.15	0.541
Promoting self-directed learning	23–25	15	12.85 ± 1.88	12.14 ± 2.41	0.227
Global	26	5	4.35 ± 0.62	4.00 ± 0.55	0.017*
Total	1–26	130	111.79 ± 12.99	106.43 ± 14.63	0.153

Mean ± SD, * significant difference.

trainers are more severe with themselves than students are.

4.4. Strength and limits

The type of training implemented has its limits. It requires very large human resources, and these resources are often underestimated by the universities. The autonomy of the student concerning his ask or need for recommendations and the implementation of this new knowledge in clinical practice has only slightly been taken into account in this course because of the protocolized nature of the procedure, while this skill has shown its effectiveness [40]. On the other hand, even if e-learning and online simulations have shown some effectiveness especially in the development of critical thinking [41], we chose not to integrate it into our teaching. Indeed, because of the teaching of gestures, it seemed to us that it resulted in an excessive dissociation between learning and clinical practice. Finally, the new virtual reality technologies have not been implemented also due to the lack of validated simulators in our laboratory for this type of learning.

However, this first evaluation therefore makes it possible to create a specific plan of action based on the feedback to improve future training orientations. It will allow to redesign the workshops to adjust for trainers and students' goals. This will also be a basis for reassessing the human and financial resources needed for this teaching. In the future, we will have to evaluate the skills acquired in real clinical situations. Finally, the principle could also be extrapolated to nursing students in initial training or even to the "boot-camp of surgery" for surgical residents.

5. Conclusion

Training to perform delegated surgical procedures by mixed cognitive and motor gestures learning, based on the development of critical thinking and simulations seems to be effective, with a significant improvement in students' knowledge and skills. The expectations of students and trainers are mainly correlated; however, the teachers carry a more severe judgement on the quality of the training. It will be useful to know if the information gathered by this evaluation will allow to fill the inadequacies highlighted and improve the teaching quality for future training.

Ethical approval

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Author contribution

MC, SM: study design, data acquisition, data analyses, manuscript

preparation.
MB,AW: study conception, data analyses, manuscript preparation, critical revision.

Conflicts of interest

None.

Trial registry number

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NCT03957889.
https://clinicaltrials.gov/ct2/show/NCT03957889?id=NCT03957889&rank=1.

Guarantor

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All authors give their final approval of the version to be published, and their agreement to be accountable for all aspects of the work. MC, SM: study design, data acquisition, data analyses, manuscript preparation. MB, AW: study conception, data analyses, manuscript preparation, critical revision.

Institution(s) at which the work was performed

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Declarations of interest

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Ethical review committee statement

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Appendix A. Supplementary data

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References

[1] A.J.E. Carter, A.H. Chochinov, A systematic review of the impact of nurse practitioners on cost, quality of care, satisfaction and wait times in the emergency department, Can. J. Emerg. Med. 9 (2007) 286–295, https://doi.org/10.1017/S1481803500015189.

[2] F.L. Cole, E. Ramirez, Activities and procedures performed by nurse practitioners in emergency care settings, J. Emerg. Nurs. 26 (2000) 455–463, https://doi.org/10.1067/men.2000.110585.

[3] A.S. Kendrick, D.L. Ciraulo, T.S. Radeker, P.L. Lewis, C.M. Richart, R.A. Maxwell, D.E. Barker, P.W. Smith, Trauma nurse specialists' performance of advanced skills positively impacts surgical residency time constraints, Am. Surg. 72 (2006) 224–227.

[4] B. Hoctor, Nurse cannulation: introducing an advanced clinical skill, Emerg. Nurse 17 (2009) 16–18.

[5] B. Henderson, Should nurses have a greater role in primary care? Can. Med. Assoc. J. 129 (1983) 1125.

[6] R. Middleton, Suturing as an advanced skill for Registered Nurses in the emergency department, Aust. J. Rural Health 14 (2006) 258–262, https://doi.org/10.1111/j.1440-1584.2006.00826.x.

[7] J. Schäfli-Thurnherr, A. Biegger, C. Soll, G.A. Melcher, Should nurses be allowed to perform the pre-operative surgical site marking instead of surgeons? A prospective feasibility study at a Swiss primary care teaching hospital, Patient Saf. Surg. 11 (2017).

[8] E. Vanyolos, I. Furka, I. Miko, A. Viszlai, N. Nemeth, K. Peto, How does practice improve the skills of medical students during consecutive training courses? Acta Cir. Bras. 32 (2017) 491–502, https://doi.org/10.1590/s0102-865020170060000010.

[9] L. Benjamin, Training in surgical skills, Community Eye Health 15 (2002) 19–20.

[10] S. Lo, N. Aslam, Audit of the management of facial lacerations in accident and emergency department: wound closure without appropriate training or guidelines, J. Eval. Clin. Pract. 11 (2005) 95–96, https://doi.org/10.1111/j.1365-2753.2004.00510.x.

[11] P. Bradley, J. Bligh, Clinical skills centres: where are we going? Med. Educ. 39 (2005) 649–650, https://doi.org/10.1111/j.1365-2929.2005.02189.x.

[12] P. Benner, Educating nurses: a call for radical transformation-how far have we come? J. Nurs. Educ. 51 (2012) 183–184, https://doi.org/10.3928/01484834-20120402-01.

[13] D.A. DaRosa, J.B. Zwischenberger, S.L. Meyerson, B.C. George, E.N. Teitelbaum, N.J. Soper, J.P. Fryer, A theory-based model for teaching and assessing residents in the operating room, J. Surg. Educ. 70 (2013) 24–30, https://doi.org/10.1016/j.jsurg.2012.07.007.

[14] R. Kuiper, C. Heinrich, A. Matthias, M.J. Graham, L. Bell-Kotwall, Debriefing with the OPT model of clinical reasoning during high fidelity patient simulation, Int. J. Nurs. Educ. Scholarsh. 5 (2008) 1–14, https://doi.org/10.2202/1548-923X.1466.

[15] K. Cadman, E. Clack, Z. Lethbridge, J. Millward, J. Morris, R. Redwood, Reflection: a casualty of modularisation?: enquiry based reflection research group, Nurse Educ. Today 23 (2003) 11–18, https://doi.org/10.1016/S0260-6917(02)00158-2.

[16] G. Leigh, L.B. Miller, K.B. Ardoin, Enhancing observers' learning during simulations, J. Contin. Educ. Nurs. 48 (2017) 454–457, https://doi.org/10.3928/00220124-20170918-06.

[17] D.K. Litzelman, G.A. Stratos, D.J. Marriott, K.M. Skeff, Factorial validation of a widely disseminated educational framework for evaluating clinical teachers, Acad. Med. 73 (1998) 688–695.

[18] R.A. Agha, M.R. Borrelli, M. Vella-Baldacchino, R. Thavayogan,

D.P. OrgillSTROCSS Group, The STROCSS statement: strengthening the reporting of cohort studies in surgery, Int. J. Surg. Lond. Engl. 46 (2017) 198–202, https://doi.org/10.1016/j.ijsu.2017.08.586.

[19] J.A. Kohls-Gatzoulis, G. Regehr, C. Hutchison, Teaching cognitive skills improves learning in surgical skills courses: a blinded, prospective, randomized study, Can. J. Surg. 47 (2004) 277.

[20] J.A. Taylor, R.B. Ivry, The role of strategies in motor learning: the role of strategies in motor learning, Ann. N. Y. Acad. Sci. 1251 (2012) 1–12, https://doi.org/10.1111/j.1749-6632.2011.06430.x.

[21] J.L. Starkes, Motor experts: opening thoughts, Adv. Psychol. Elsevier, 1993, pp. 3–16.

[22] M. Krautter, R. Dittrich, A. Safi, J. Krautter, I. Maatouk, A. Möltner, W. Herzog, C. Nikendei, Peyton's four-step approach: differential effects of single instructional steps on procedural and memory performance : a clarification study, Adv. Med. Educ. Pract. (2015) 399, https://doi.org/10.2147/AMEP.S81923.

[23] H. Hengameh, R. Afsaneh, K. Morteza, M. Hosein, S.M. Marjan, A. Ebadi, The effect of applying Direct Observation of Procedural Skills (DOPS) on nursing students' clinical skills: a randomized clinical trial, Glob. J. Health Sci. 7 (2015).

[24] N. Roghieh, H. Fateme, S. Hamid, H. Hamid, The effect of formative evaluation using "direct observation of procedural skills" (DOPS) method on the extent of learning practical skills among nursing students in the ICU, Iran, J. Nurs. Midwifery Res. 18 (2013) 290–293.

[25] S. Barry Issenberg, W.C. Mcgaghie, E.R. Petrusa, D. Lee Gordon, R.J. Scalese, Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review, Med. Teach. 27 (2005) 10–28, https://doi.org/10.1080/01421590500046924.

[26] K.J. Richardson, F. Claman, High-fidelity simulation in nursing education: a change in clinical practice, Nurs. Educ. Perspect. 35 (2014) 125–127.

[27] B. Holland, K. Landry, A. Mountain, M.A. Middlebrooks, D. Heim, K. Missildine, Weaving the tapestry of learning: simulation, standardized patients, and virtual communities, Nurse Educ. 38 (2013) 269, https://doi.org/10.1097/01.NNE.0000435265.53612.06.

[28] F. Lund, J.-H. Schultz, I. Maatouk, M. Krautter, A. Möltner, A. Werner, P. Weyrich, J. Jünger, C. Nikendei, Effectiveness of IV cannulation skills laboratory training and its transfer into clinical practice: a randomized, controlled trial, PLoS One 7 (2012) e32831, , https://doi.org/10.1371/journal.pone.0032831.

[29] D. Kirkpatrick, Evaluation of training, in: R.L. Craig, L.R. Bittel (Eds.), Training and Development Handbook, McGraw-Hill, New York, 1967.

[30] C.F. Seifert, G. Yukl, R.A. McDonald, Effects of multisource feedback and a feedback facilitator on the influence behavior of managers toward subordinates, J. Appl. Psychol. 88 (2003) 561–569.

[31] C.R.M.G. Fluit, S. Bolhuis, R. Grol, R. Laan, M. Wensing, Assessing the quality of clinical teachers: a systematic review of content and quality of questionnaires for assessing clinical teachers, J. Gen. Intern. Med. 25 (2010) 1337–1345, https://doi.org/10.1007/s11606-010-1458-y.

[32] J.J. Isaacson, A.S. Stacy, Rubrics for clinical evaluation: objectifying the subjective experience, Nurse Educ. Pract. 9 (2009) 134–140, https://doi.org/10.1016/j.nepr.2008.10.015.

[33] D.K. Litzelman, G.R. Westmoreland, K.M. Skeff, G.A. Stratos, Factorial validation of an educational framework using residents' evaluations of clinician-educators, Acad. Med. 74 (1999) S25–S27.

[34] K.M. Skeff, G.A. Stratos, J. Berman, M.R. Bergen, Improving clinical teaching. Evaluation of a national dissemination program, Arch. Intern. Med. 152 (1992) 1156–1161.

[35] K.M. Lombarts, M.J. Bucx, O.A. Arah, Development of a system for the evaluation of the teaching qualities of anesthesiology faculty, Anesthesiology 111 (2009) 709–716.

[36] M.G. Hewson, N.M. Jensen, An inventory to improve clinical teaching in the general internal medicine clinic, Med. Educ. 24 (1990) 518–527.

[37] M. Iwaszkiewicz, D.A. DaRosa, D.A. Risucci, Efforts to enhance operating room teaching, J. Surg. Educ. 65 (2008) 436–440, https://doi.org/10.1016/j.jsurg.2008.07.006.

[38] J.A. Claridge, J.F. Calland, V. Chandrasekhara, J.S. Young, H. Sanfey, B.D. Schirmer, Comparing resident measurements to attending surgeon self-perceptions of surgical educators, Am. J. Surg. 185 (2003) 323–327.

[39] D.A. Davis, P.E. Mazmanian, M. Fordis, R. Van Harrison, K.E. Thorpe, L. Perrier, Accuracy of physician self-assessment compared with observed measures of competence: a systematic review, J. Am. Med. Assoc. 296 (2006) 1094–1102, https://doi.org/10.1001/jama.296.9.1094.

[40] H. Smith-Strøm, K. Oterhals, E.C. Rustad, T. Larsen, Culture crash regarding nursing students' experience of implementation of EBP in clinical practice, Nord. J. Nurs. Res. 32 (2012) 55–59, https://doi.org/10.1177/010740831203200412.

[41] L. Posey, C. Pintz, Online teaching strategies to improve collaboration among nursing students, Nurse Educ. Pract. 6 (2006) 372–379, https://doi.org/10.1016/j.nepr.2006.07.018.