Impact of simulator familiarization when investigating real-life correlation of a virtual-reality performance test

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Introduction: Virtual-reality simulators can provide a standardized training environment and un-biased performance metrics in surgery. However, correlation to real-life performance needs to be investigated before the extent of its usefulness in training programs of surgeons can be defined. Our objective was to investigate the correlation between performance on a virtual-reality simulator and real-life motion-tracking parameters. Furthermore, the impact of simulator familiarization was investigated.

Methods: The study was designed as a prospective cohort study. Eleven cataract surgeons with varying levels of experience from ophthalmology departments and private clinics in Denmark were included in the study. All participants performed and video-recorded three standard cataract surgeries before completing three repetitions of a competency-based test on the EyeSi virtual reality simulator. Primary outcomes were simulator metrics (total test score from first, second, and third repetition, respectively) and motion-tracking metrics (score, calculated by average path length x average number of movements from three real-life surgical videos of full procedures). All outcomes have previously shown evidence of validity[1,2].

Results: The number of cataract surgeries performed by each included surgeon varied from two to 24,200 (mean 3,656). Third repetition of a competency-based test on the EyeSi simulator was significantly correlated to real-life performance measured by motion-tracking software of cataract surgical videos, Pearson correlation coefficient of -0.70 (p=0.017). First and second repetition showed insignificant correlations indicating that surgeons had to familiarize themselves with the simulator before the simulator score became representative.

Discussion: The test scores from the first two repetitions on the EyeSi simulator showed no correlation with the motion-tracking scores, shifting from a tendency to opposite correlation in the first repetition towards stronger correlation in the second repetition. This shift seems primarily to be caused by the more experienced surgeons getting significantly better with time compared to the less experienced surgeons. It is probable that more experienced surgeons have a much more rapid acclimatization to the simulator based on their already acquired surgical skills. This effect is well recognized from other simulation-based studies and needs to be taken into account when assessing virtual-reality simulator data. One approach to minimize this type of bias is to deliver a 1-hour warm-up on the simulator prior to simulation-based assessment.


“See and Do” or “Do and See”: the optimal sequence of independent discovery and explicit instructions for surgical skills training

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Introduction: Current focus on competency-based education in medical training is leading to an increased emphasis on learner-centered teaching model. Recent studies demonstrate that allowing students to explore tasks on their own before providing explanations increases conceptual understanding and retention of knowledge. But the relationship between the role of discovery versus explicit instruction is still debated and the effect of sequence of teaching and independent practice in affecting skills learning is not known. Building upon the successful implementation of practice-before-instructions in other fields, we conducted an experiment investigating how sequencing of each learning opportunity affected technical skills in medicine in a search of appropriate autonomy and supervision balance.

Methods: First-year medical students (N=26) were randomized into two groups for learning a suturing task. Instructions-before-practice (I-P) group had access to teachers before independent practice, while practice-before-instructions (P-I) students were asked to explore the task on their own before having access to instructors. We collected data on students’ immediate performance, retention and transfer of skills to a more advanced version of the task.

Results: While both groups had similar retention performance, transfer performance was higher in P-I group than in I-P condition, F (1, 23)=6.35, p=.019, ηp²=.216.

Discussion: If the aim of learning is not simply a performance of the practiced task after a teaching session, but the students’ ability to adapt the learnt skill to a novel situation and prepare the students for future learning, a transfer test is an essential measure.
of the intervention. As the body of knowledge in the medical field is constantly growing, the future doctors are likely to encounter unanticipated situations that were not practiced in medical schools or residency. It is thus imperative that we provide students with the cognitive tools for adaptive learning that will serve them throughout their careers.

**Conclusion:** Discovery vs. explicit instruction is not a zero-sum proposition. Optimizing sequencing may have a significant impact in how students utilize learning opportunities. We discuss implications in relation to findings in other fields as well as for training medical skills.

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**#8D3 (127103)**

**Knowing How and Knowing Why: Integrated conceptual knowledge facilitates the acquisition, retention, and transfer of simulation-based procedural skills**

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**Introduction:** Transfer of procedural skills is a critical outcome of simulation-based training, yet how instructional design best promotes transfer is unclear. (1) Research on clinical reasoning has yielded ample evidence suggesting instruction which integrates conceptual knowledge of cause and effect mechanisms (e.g., basic science foundations) with information about clinical signs and symptoms of disease aids transfer of clinical reasoning skills. (2) Whether such conceptual integration is germane or extraneous to simulation-based procedural skills training is unclear. We studied the impact of instruction integrating conceptual why explanations with procedural how instructions on the acquisition, retention, and transfer of lumbar puncture (LP) skill in simulation-based training.

**Methods:** Medical students (*n = 30*) were randomized into two groups that received different instructional videos during a 1-hour self-regulated LP training session. One video demonstrated step-by-step instructions on how to complete LP, and the other provided the same procedural how instruction with integrated conceptual why explanations that emphasized relevant conceptual knowledge (e.g., anatomy, use of equipment). Raters used a global rating scale (GRS) to score participants’ LP performance on immediate post-test and one-week delayed retention and transfer tests (i.e., different patient positioning and anatomy). Participants also completed written procedural and conceptual knowledge tests prior to LP training and after the transfer test.

**Results:** Participants with integrated conceptual why instruction had better conceptual knowledge (*F*(1,27) = 21.33, *p < 0.001, η^2_p = .44) but not procedural knowledge (*p = 0.180*). ANCOVA revealed conceptual knowledge scores to be a significant positive covariate of LP performance across post-test and retention test performances (*F*(1,26) = 12.26, *p = 0.002, η^2_p = .32). Hierarchical linear regression revealed a similar positive relationship between conceptual knowledge and transfer performance (*ΔR^2 = 0.19, F*(1,27) = 6.20, *p = 0.019*); after controlling for conceptual knowledge, participants’ group allocation was not a significant predictor of transfer performance.

**Discussion:** Though our integrated why intervention improved conceptual knowledge scores significantly, it did not appear to have a direct effect on participants’ LP retention and transfer. Rather, we found that regardless of group, trainees with greater conceptual knowledge performed better on retention and transfer tests. We interpret this to suggest that integrating ‘why’ explanations into training had an indirect, positive effect on participants’ LP retention and transfer that was mediated by improved conceptual knowledge. Our results show that conceptual knowledge is a significant predictor of transfer performance. We recommend that future research focus on the role of participants’ prior knowledge in this process, as well as how best to deliver and integrate conceptual knowledge to improve the outcomes of procedural skills training.

**Conclusion:** Instruction that integrates conceptual knowledge with procedural knowledge appears to be an important factor influencing procedural skills acquisition, retention, and transfer that is unaccounted for in current best practices for instructional design of simulation-based training. (1)

**References:**

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**#8D4 (127384)**

**The transfer of learning from the classroom into the clinical workplace: a systematic review**

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**Introduction:** Although medical students are increasingly exposed to clinical experiences as part of their training, these often occur in parallel with other aspects of the pre-clerkship curriculum, rather than in an integrated fashion. (1) This integration is important as...
it allows students to learn how, when, where and why to apply the knowledge gained in the classroom into practice. Therefore, there is a need to make a more explicit connection between learning in the classroom and its application in the workplace. This systematic review aims to synthesise the existing evidence about instructional interventions that link the classroom and the clinical workplace.

**Methods:** Electronic databases (AMED, CINAHL, EMBASE, ERIC, Medline, RDRB, PsycINFO and WoS) were searched. Study selection, quality appraisal and data analysis were done by two independent reviewers. The coding form was piloted on the selected studies and iteratively refined until the form adequately captured all necessary data. Data were extracted by one researcher and independently checked by a second reviewer. Differences in opinion were resolved through discussion. In the case of important missing data, attempts were made to contact the authors of the original paper.

**Results:** 20 papers out of 6586 met the inclusion criteria. Only seven out of the twenty studies used a control group, four studies measured the outcomes after an extended period of time and only two studies reached the “does” level of Miller’s pyramid. Three types of interventions were identified. Most interventions involved the supervisor providing feedback. Due to the large heterogeneity, no meta-analysis could be performed. The study with the largest effect size included a 3-minute video to refresh students’ prior knowledge and skills while caring for real patients.

**Discussion:** Small-scale interventions can bring classroom learning and workplace practice into closer alignment, and these appear to be necessary accompaniments to curricular structures that parallel classroom learning with workplace experiences. Given that only 20 studies met the inclusion criteria of this systematic review, it is possible that many interventions linking the classroom with the workplace exist but simply have not been reported. This field of medical education would benefit from more primary research, specifically studies containing detailed descriptions of the interventions, as well as description of the contexts in which they are taking place.

**Conclusion:** Some weaknesses in the methodological approaches of interventional studies were identified, many of which are regarded as common features of research relating to medical education. Future research would benefit from more rigorous methodological approaches and studies that measure outcomes of the intervention on the “does” level of Miller’s pyramid, over an extended period of time after the intervention, and compare results with a control group. Moreover, future research needs to establish whether feedback and reflection, that explicitly link what was learned in the classroom with workplace experiences, strengthen the connection between the two settings and enhance the transfer of learning.
