**10F1 (33)**

**Co-productive learning health care practices**

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**Introduction:** Health care is characterized by increasing complexity with large amount of actors, technologies and calls for patients’ involvements. A great deal of knowledge opportunities are however lost to patient and professional when they need it. There are urgent needs of reform in health care practices (Frenk). To better understand how everyday learning happens and can be developed in practice can contribute to such needs, physicians’ being important enabler.

Theoretical perspectives of professional practices include what a group of people do in a particular time and at a particular place as meaningful activities. The way a specific practice is arranged both socially and materially forms practitioners’ understandings and actions. These arrangements, unique in each practice, are defined as practice architectures (Kemmis). By applying practice architectures’, we provide answers and can contribute to how to improve practices and learning.

The aim is to deepen understandings of learning and interaction in health care practices through (I) investigating health professionals’ pedagogical processes in interaction with patients and (II) physicians’ own learning and support of the learning of others in daily work. Through focusing a specific health care practice, (III) investigate how social and material conditions influence interactions between participants and (IV) how junior physicians’ learn when they participate.

**Method:** The first study used individual interviews of three professions in several disciplines, focus groups in each profession and team interviews (I, II). In the second data was a changed model of ward round practice in a destined room with one patient at a time, aiming to improve patients’ active participation and collaboration between professionals. It was interpreted through an inductive and theory driven interactive research approach with a field study design (II, IV).

**Results:** I. There was significant amount of pedagogical processes embedded in daily work with patients, usually not planned and summarized in the concept of “read (needs of learning) – guide (how to support learning) - learning support”. II. During daily work physicians dynamically alternated between their own learning and the support of the learnings of patients/staff/generations of physicians in individual patient processes and in interconnection with physicians versatile mobility across different contexts, with their participation in multiple communities of collaboration and through tensions between responsibilities. III. The practice architecture in the changed ward rounds formed co-productive learning rounds in interplay between patients “double participation” (as people and as information on screens) and groups of professionals. IV. Specific socio-material interconnections caused junior physicians’ overly involvement in administrative work, distancing them from patients, and left them working in solitude from other professionals’. Observing other professionals’ provision of medical care refined the junior physicians’ theoretical knowledge, but their learning through their own actions providing medical care was limited.

**Discussion & Conclusion:** There are strong needs to reveal and increase awareness of learning and learning support as important parts of daily health care work, which to date are almost silent discourse. Contextualized health care practices have opportunities to change into co-productive learning practices being sources for continual improvements. Not taking junior physicians’ learning in practices into consideration risks marginalization of their professional development. The theoretical lens of practice architecture helps us to understand relationships between practice, learning, and change. And also a concrete transformational resource for making practical judgements about what to be done at specific workplaces getting continuing learning the heart of the practices.


**10F2 (35)**

**Influence of Different Scoring Algorithms for Multiple True-False Items on the Measurement Precision of Multiple Choice Exams**

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**Introduction:** High measurement precision in assessment is of main concern in medical education. It ensures competent candidates pass and incompetent candidates fail an exam, and not vice versa. Measurement precision can be estimated globally, as well as specifically at the cut score. Multiple True-False (MTF) items are a multiple-choice question format that prompts true/false decisions to all options to an item, enabling partial knowledge to be rewarded. Rewarding partial knowledge, in return, can affect measurement precision. MTF items are either
scoring dichotomously by rewarding no partial knowledge (DS), to reward every bit of partial knowledge (PS1/n) or to reward partial knowledge, but with a threshold to suppress marginal knowledge and guessing (e.g. above 50% correct true/false decision to an item, PS50). This PhD thesis analyzes the influence of different scoring algorithms for MTF items on the measurement precision of medical exams.

**Methods:** To investigate the influence of scoring algorithms, we performed three studies. First, we analyzed the effect of scoring on global reliability, i.e. Cronbach’s alpha. In a second study, we analyzed how to calculate measurement precision at the cut score by introducing the concept of conditional reliability, using both Item Response Theory (IRT) and Classical Test Theory (CTT). In the third study, we analyzed the influence of scoring algorithms of MTF items on the measurement precision at the cut score by determining the conditional reliability and conditional Standard Error of Measurement (cSEM) at the cut score, and the number of candidates with ambiguous results.

**Results:** We could show that rewarding partial knowledge in MTF items indeed influences measurement precision, both at a global level as well as at the cut score. In the first study, we could show that crediting partial knowledge with a threshold (PS50) leads to high global reliability. In the second study, we introduced the concept of conditional reliability to analyze measurement precision at the cut score, showing that results are quite contrary in IRT and CTT and argued to use it in IRT. In the third study, we showed that scoring MTF items with PS50 leads to high conditional reliability and low cSEM at the cut score, as well as the lowest number of candidates with ambiguous results.

**Discussion and Conclusion:** With this PhD project, we comprehensively analyzed the influence of scoring for MTF items on the measurement precision in summative medical exams. By examining the effect of different scoring algorithms, we advanced the understanding regarding measurement precision introducing the concept of conditional reliability to assessment in medical education. Since rewarding partial knowledge above a certain level showed high global reliability, high conditional reliability and low cSEM at the cut score, as well as the lowest number of candidates with ambiguous results, we recommend using this scoring algorithm. To use real data, we simulated different scoring algorithms on existing items that were originally constructed for rewarding partial knowledge (PS50). It would be interesting to analyze whether these results hold true if items are constructed with another scoring algorithms in mind.

**1O3 (40)**
**Quantifying Two Dimensional (2D) and Three Dimensional (3D) Anatomical Learning Using a Neuroeducational Approach**

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**Background:** Advances in computer visualization enabling both 2D and 3D representation have generated tools to aid perception of spatial relationships and provide a new forum for instructional design. To date, studies examining the effectiveness of these educational tools have been comparative, using performance measurement as proxy variables for learning. A key knowledge gap in the field of health professional education is the lack of understanding of how the brain processes and learns from spatially presented content. Direct monitoring of the neural processes as learners interact with 2D and 3D representations could provide an alternative quantitative measure to direct best practices in spatial teaching and learning. Event-related brain potential (ERP) measurement by electroencephalography (EEG) has been used to examine changes in signals associated with reinforcement learning during development of perceptual expertise (1). N250 is an ERP associated with visual object recognition and amplitude increases for familiarly perceived objects. Reward positivity is an ERP associated with positive feedback and scales like a prediction error as a subject learns, there is a diminished amplitude in response to positive feedback. The objective of this study was to compare 2D and 3D spatial learning in anatomy using a reinforcement-based learning paradigm to determine whether differences in N250 and reward positivity ERP components track learning. Methods: Health sciences students (n = 61) learned to identify and localize anatomical structures through a feedback-dependent trial and error process. Participants learned either from 2D, 3D, or a combination of 2D and 3D neuroanatomical models as EEG and behavioural (accuracy) data was recorded. Mean ERP waveforms of N250 (measured at the O1 electrode site when a participant was shown an anatomical model) and reward positivity (measured at the FCz electrode site following feedback presentation) were compared across learning.

**Results:** Regardless of model type all participants successfully learned how to identify neuroanatomical structures and significantly improved on post task knowledge tests. N250 is significantly greater when participants view 3D versus 2D represented anatomical images. Behavioural learning curves and reward positivity did not significantly differ when learning from 2D compared to 3D models. However, interleaved training incorporating 2D and 3D model types provided an advantage in retention and transfer activities represented by a decreased reward positivity. Similar to a behavioural learning curve representation (2), reward positivity amplitude changes across learning are symbolic of learning phases can be graphically represented. Discussion and Conclusions: This study demonstrates the application of neuroscientific research methodologies in an educational
setting to better understand perception and learning in
spatial anatomy. Despite the lack of differences in
behavioural-based learning outcomes for 2D versus 3D
models, neural evidence reveals new insights. Participants
learning from 3D models had greater object recognition
while interleaved training provided advantages for
memory retention. In applied settings, educators should
consider these findings in the design of learning
interventions that employ stereoscopic anatomical
models. Validation of quantitative neurophysiological
variables that measure learning will enable a direct
measure of knowledge acquisition that can be used to
strategically assess and optimize new forms of teaching,
learning, and evaluation.

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The Influence of Peers on Medical Students’ Learning of Psychomotor Skills Necessary for Physical Examination

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**Introduction:** Clerkship programs directors of and the students themselves are concerned about the insufficient mastery of the physical examination (PE) of the students upon their entry into clerkship, whereas the PE is an essential element of the diagnosis for the doctors. Most medical schools use small group learning activities to teach PE during undergraduate training. Little is known about the factors that affect the learning of PE in small-group environments, particularly with respect to the influence of peers in these activities.

**Methods:** This PhD thesis included a series of studies conducted with second-year medical students at Sherbrooke University to test whether peer observation, peer feedback and the order of practice influenced the acquisition of psychomotor skills needed to master PE.

**Results:** A first study showed that students with the opportunity to observe a peer performed better than those who did not have this opportunity (83.9% vs 75.9%, p = .05). A second study has shown that the observation of a good peer performance influences positively the acquisition of PE (81.1% vs 68.3%, p > .002). Peer observation seems to help, by giving students a mental image of the performance to be learned that is closer to their ability to reproduce the gestures taught. Peer feedback involves feedback on the performance of colleagues in small group training sessions. A third study showed that peer feedback contributed positively to the mastery of PE (89.5% vs. 86.2%, p = .02). Students receiving peer reviews learn more. However, this influence, studied in a subsequent study, remains complex. No characteristic of peer feedback, either quantity or specificity, seems to explain the positive effect of peer feedback when learning PE.

**Discussion:** Many students are generally reluctant to be the first to practise in a small group, so we checked in two other studies if the order of practice in a small group makes the difference. The data show that at the end of the training session, the students have a similar performance (regardless of the order they practise (p = .706) or the amount of feedback received (p = .096).

**Conclusion:** In conclusion, it appears that PE small group training is useful for students as learning is positively influenced by peer observation and feedback. The use of small groups to learn physical examination in health science training programs is a method of choice, not only for logistical reasons, but also for the contribution of peers to the mastery of PE of their colleagues.