

# Building towards Expertise in CME (Continuous Medical Education): Suggestions for a New Paradigm

Marcel Martin<sup>1,2</sup>, Paul Ouellet<sup>1,3</sup> and Zeeshan Aslam<sup>2,4</sup>

1. Department of Surgery, Université de Sherbrooke, Sherbrooke, Quebec, Canada

2. Critical Care Department, Dr Everett Chalmers Hospital, Horizon Health Authority, New Brunswick, Canada

3. Vitalité Health Authority, North West Zone, New Brunswick, Canada

4. Department of Critical Care-Internal Medicine, Dalhousie University, Halifax, Nova Scotia, Canada

**Abstract:** To build towards expertise, one has to accept to modify his way of practicing, including: (1) a need to reflect on and about the action; (2) a continuous concern about our competence to practice; (3) tireless effort to combine metacognition and mental practice in a trans-disciplinary approach; (4) adding research with neuroscience, understanding neuroplasticity, modulation and artificial intelligence. Usual practice actually does not include a continuous concern for CME (continued medical education) and is intermittent at best. This new paradigm constitutes the basis of our approach. Expertise starting in 2015 is described as an asymptotic curve unable to be obtained with usual practice and intermittent education. We suggest a new way of conceiving CME combining practice, reflection on action and *in-situ* simulation laboratory near work. We are describing TEE (technology-enhanced education) coupled with certain neuro-enhancers to achieve a break in the asymptotic curve of expertise. This is in reality a new conception of CME in medicine.

**Key words:** Continuous medical education, practical knowledge decision-making, simulation laboratory and post-simulation era, neuroscience with modulators, mental practice and artificial intelligence.

## 1. Introduction

Continuous education is a mandatory condition of practice “*sine qua non*” to maintain at least a competence in complex system like medicine [1, 2]. Continuous education should not mean intermittent one with inappropriate activities to learn and retain during these active practicing years. Retrospectively, the pre-doctoral PBL (problem based learning) approach alone has been an incomplete one mainly used for decision-making and theoretical knowledge training [3]. The practical field of procedural knowledge has been left aside in curriculum like the development of spatial intelligence [4].

These reductionist aspects of our curriculum in medicine led to an incomplete metacognition development [5] where procedural knowledge, third space visualisation, anatomy and spatial intelligence

were neglected.

Arky [6] in his time mandates continuity in pre-/post-doctoral and continuous education curriculum. This remained only a dream and continuous education has now to be rebuilt again with a complete change in philosophy [7]. In our present work, we insisted on simulation laboratory [8] as an opening to an integration of procedural knowledge, mixed with decision-making, intuition, uncertainties [9, 10] empathy and resilience [11], development of spatial intelligence and creativity. We feel all of the above must be approached in simulation with a global philosophy including technical and non-technical skills and kinetics of decision-making, interdisciplinary approach for both procedural and theoretical knowledge. All those learning elements are included in complex scenarios.

From the world of simulation, the second part of the revolution is the inclusion of neuroscience [12] in cognitive psychology to develop a better

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**Corresponding author:** Marcel Martin, retired professor of surgery, staff physician, research field: medical education.

metacognition [13] and allow a personalised approach in the development of expertise [14]. The neuro-enhancement phenomenon [15], based on neuroplasticity [16] and epigenetics [17] needs to be included for the understanding of neuroplasticity, connectomics [18] and neuro-imaging [19]. The final aspect of this revolution must be the mental practice [20] with the understanding of motor to mental gradient in skill learning [21, 22].

Skill learning should include gradient between cognition, plasticity, epigenetics [23], modification following physical exercise [24] and their influence on learning. All of these elements will finally help in understanding metacognition and contextualisation of knowledge. We are witnessing a post simulation era where mental world and practice with virtual reality would replace the actual simulation laboratory.

One appropriate question is raised. Why such an approach for CME? Two main facts transpire:

- (1) In cognitive psychology, we are utilising more and more TEE (technology-enhanced education);
- (2) Our learning approach in medicine is partly transferable to STEM (science, technology, engineering and mathematics) and biotechnology education.

Therefore, it is fair to say that, in complex systems, learning should be more and more focused on a transdisciplinary approach.

## **2. Simulation**

Five main subjects are thoroughly discussed in simulation laboratory literature:

- (1) scenarios with more or less high fidelity;
- (2) complex scenarios;
- (3) near work space teaching (*in situ*) with debriefing [25];
- (4) teaching in a distributed fashion [26], with or without cognitive task analysis [27];
- (5) decomposition of movements [28], consisting of multidisciplinary approach [29] with video-cameras [30] for further modeling [31].

For the last twenty years, these laboratories have been the revolutionary tool in teaching medicine. Digging on metacognition and cognitive psychology and because of the understanding of the motor to mental gradient in skill learning in sports, mental representation and mental practice started recently to complement the physical practice and to replace it almost completely. Parallel to this approach, neuroscience has helped to understand neuroplasticity, epigenetics and connectomics. Neuroimaging offers a possible follow-up on the road towards expertise.

## **3. Mental Practice and Neuro-Enhancers**

Mental practice and representation with all the other neuro-enhancers described recently at least five elements; three of which are environmental (Points (1)-(3)) and two are structural (Points (4) and (5)):

- (1) exercise [24];
- (2) practice [32];
- (3) videogames [33];
- (4) biochemical approach with methylene blue or methylphenidate [34];
- (5) electro-mechanical stimulation of the brain [35].

All of these mandate a strategic approach [36] and a strict neuro-ethics [37]. With the recent description of asymptotic [38] curve of expertise, the use of a global strategic approach will contribute to achieve expertise in complex systems. In the coming years, the methodology for efficient learning will change drastically. Result evaluation is mandatory. Recent literature on cognitive psychology is rapidly growing. One example is with the use of music instrument in learning toward neuroplasticity [39], coupled with physical exercise [40] and mental practice with mindfulness meditation [41] to control emotional stress and learning. Among the enhancement literature, Hardy et al. [42] proved the effect of cognitive enhance learning (Videogame Lumosity) in the Grand Index Score being enhanced in speed of processing, short term memory, working memory, problem solving and

fluid reasoning assessments [42]. Alam et al. [43] have shown that multiple choice scores can be optimized with “e-learning” sessions by combining mental practice with modeling [43]. Several combinations of enhancement are possible and the operation strategy must be studied in different situations. On the other hand, neuroscience and cognition, especially in *I:E* (inhibitory:excitatory) balance synapses [43, 44] concerning neuroplasticity, should be better understood to optimize the strategy of TNT (targeted neuroplasticity training).

#### 4. Summary

This reflective revolution in education should also include the development of artificial intelligence in a brain-machine interface. However, the application of brain-machine interface mandates a brain control over the machine. Robotics must not replace human brain but must enhance its possibilities. Integration and adaptation must prevail in any learning approach. On the other hand, by achieving better understanding of cognition and metacognition with neuroimaging, we feel global knowledge will evolve on two fronts:

(1) Precision in education will be used with personalized cognition and contextualized with different cognitive approaches;

(2) With combined utilization of neuroscience, artificial intelligence and metacognition evolution will reach for solving the recent asymptotic curve of expertise but not without a strict necessity of neuro-ethics.

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