Inter-blocking: Integrating a Process of Inquiry Mindset into Medical Education

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Abstract

Integrating basic science knowledge with clinical skills is essential for undergraduate medical training. While there are new medical curricula aimed to seamlessly meld these two aspects of medical education, it is unclear how recent developments in cognitive psychology education, such as interleaving, may inform a process of inquiry based curriculum during the early phases of medical education. Here, I offer a hybrid combination of interleaving and blocking theories, or inter-blocking, into an innovative early medical education curriculum centered on investigation by synthesizing strands of basic sciences and clinical skills. This conceptual framework lays the platform for future evidence-based medical and science education research into how modulating different degrees of interleaving and blocking may promote self-motivation, life-long learning, and inclusive communities of learners during the early phases of undergraduate medical education.

Keywords: Educational environment; Interleaving; Blocked Learning; Process of Inquiry

Introduction

In order to train future physicians as life-long learners, undergraduate medical education depends on integrating basic sciences with clinical skills to improve patient care and community wellness. In fact, there are several examples of medical programs that have developed Genetics and Society curriculum, as well as programs that integrate biomedical knowledge with clinical skills (DiGiovanni, et al., 2011, and Wiener, et al., 2010). However, there is a largely unexplored area of how cognitive psychology concepts, such as interleaving and blocking (Rohrer, 2012), may inform innovative teaching strategies for cultivating self-motivation and life-long learning during early phases of undergraduate medical education. By applying concepts of inter-blocking into reflective seminars and workshops during the first and second year transitions, teaching innovation through cross-cutting biomedical and clinical concepts may strengthen students’ self-motivation, as well as life-long learners as they develop their deep interest in clinical specialties throughout their medical education.
From Interleaving to Inter-Blocking for Curriculum Development

How would interleaving and blocking be integrated into the understanding of a patient’s spectrum of symptoms? In the case of developing clinical skills around consultation, there are two modes of learning: (1) linear stepwise blocking of basic and clinical concepts (Figure 1A); and (2) poly-helical approach that weaves different aspects of biomedical concepts into medical education (Figure 1B). Finally, a hybrid approach that fuses both interleaving and blocking, or inter-blocking, may also be used to center both biomedical and clinical skill modules around the process of inquiry (Figure 1C). It should be noted that the poly-helical approach may include elements of clinical skills, such as taking a patient consult, combined with aspects of genetic variants associated with cystic fibrosis or another human disease. A portion of the first and/or second year medical curriculum may include learning objectives that promote students’ self-motivation and life-long learning. For the reminder of my article, I will illustrate two examples of connecting process of inquiry into early phases of undergraduate medical curriculum.
Figure 1: Framework for integrating biomedical knowledge with clinical skills during undergraduate
**medical education.** (A) **Blocking model.** Stepwise progression of genomics/epigenetics (blue), cell biology (magenta), and anatomy/physiology (green), to understanding patient's syndrome/phenotype (black). (B) **Interleaving poly-helical approach to learning.** Within a biomedical course, strands of genomics/epigenetics (blue strand), cell biology (magenta strand), and anatomy/physiology (green strand) interlock to varying degrees along a student's progression to gain insight into a patient's syndrome/phenotype. (C) **Inter-blocking or hybrid model.** Under the theme of process of inquiry to determine patient's symptoms/phenotype of disease, modules of clinical skills may contains varying degrees of biomedical science strands that intersect with a students' ability to synthesize and incorporate didactic and experiential learning.

**Strategies for Implementing Process of Inquiry Mindset in the Classroom and Laboratory Settings**

A medical curricula that engages medical students in the process of inquiry may illuminate new vistas into creating new paths for therapies in the clinic. While there has been emphasis in integrating basic and clinical research and incorporating fourth year research experiences, less attention has focused on developing classroom and laboratory curricula that centers around student-initiated research proposal writing and reflective learning experiences. In order to facilitate the identification of evidence-based teaching parameters that promote active and meaningful learning of topics in embryology and pathophysiology, I propose that the development of new curricula that revolves around a spectrum of human diseases, such as facioscapulohumeral muscular dystrophy, cystic fibrosis, and cardiovascular disease, would enable first and second year students to draw links between biomedical and clinical skills. By encouraging Schön's reflection-in-action during their learning experiences in written project portfolios (Driessen and van Tartwijk, 2014), students would explore, synthesize, and evaluate how different aspects of anatomy, cell biology, bioethics, diversity, and epigenetics intersects in community wellness and how they can work in teams with both clinical and biomedical scientists.

Finally, integrating novel models for explaining biological mechanisms from undergraduate science education into medical curriculum may offer novel ways to interleave basic science and clinical skills. For instance, Trujillo and colleagues have put forth a novel model building extension of a tetrahedral Method, Analogy, Context, and ‘How’ Mechanism (MACH) in the undergraduate college setting in the United States (Trujillo, et al., 2015). Here, it would present an exciting opportunity to examine how the MACH approach would fit into an undergraduate medical curriculum. In order to phase-in the MACH approach in basic science and clinical skills blocks (Figure 1C), there are several ways basic science and clinical instructors can use to develop a process of inquiry-based course. Integrating the biomedical/clinical framework with diversity and transformative learning may promote new opportunities within a community of learners for both students and instructors across disciplines. First, we need to be mindful and listen to both clinical and biomedical sciences perspectives. A hybrid team of health science educators presents strengths for a process of inquiry based course. Second, we should embrace a Donald Schön mindset alongside active listening. Reflection-in-action provides health science educators an opportunity to develop creative ways to formulate inquiry-driven case studies that facilitates students' logic development. In addition, we get a chance to develop teaching partnerships and utilize constructive feedback from your colleagues.

As we enter into helping our students to integrate both basic sciences and clinical skills, we should keep in mind how variations of inter-blocking would catalyze a process of inquiry curriculum that instills self-motivation and life-long learning for medical students.
Take Home Messages

• Explore how cognitive psychology education concepts of interleaving, blocking, and hybrid approaches like inter-blocking may inform development of process of inquiry curriculum during early phases of medical education.

• Encourage reflection-on-action and reflection-in-action and peer-review into process of inquiry courses and writing portfolios for undergraduate medical education.

Notes On Contributors

Dr. Robert M. Kao is an assistant professor at Heritage University and a scholar in the University of Washington School of Medicine’s Teaching Scholars Program. He has a strong interest in teaching developmental biology, anatomy/physiology, genetics of disease, and lumen pathologies, or *lumopathies*, for undergraduates and graduate students in the health sciences.

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Appendices

Glossary Terms:

**Blocking**: Sequential arrangement of assignments or concepts taught in a linear stepwise fashion in a classroom setting (Rohrer, 2012).

**Interleaving**: Alternating the spacing of different assignments and/or concepts taught in the classroom setting (Rohrer, 2012).

**Inter-blocking**: a mixed hybrid of both sequential and altered spacing of different assignments and/or concepts taught for helping students develop a conceptual framework for process of inquiry in the classroom and laboratory.

**MACH**: A special model building extension of a tetrahedral Methods, Analogy, Context, and ‘How’ Mechanism (or MACH) developed by Trujillo and colleagues (Trujillo, et al., 2015).

Declarations

The author has declared that there are no conflicts of interest.

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