



How Biomedical Misconceptions May Arise and Affect Medical Students' Learning: A Review of Theoretical Perspectives and Empirical Evidence

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Abstract

The debate on whether biomedical knowledge contributes significantly to the clinical reasoning process is on-going. Despite this debate, one cannot underestimate that subjects such as anatomy and physiology play a key role in the understanding of the human body. Misconceptions that exist or arise in biomedical subjects, such as physiology and anatomy, can impact on the learning processes of medical students. The present paper presents an overview of research in the field of biomedical misconceptions and consists of two parts. First, the authors draw on three theoretical frameworks, constructivism, concept formation and element interactivity in complex reasoning, to offer insight as to why misconceptions in biomedical subjects could potentially arise and exist. In the second part, the authors synthesize empirical studies on biomedical misconceptions that draw on similar theoretical frameworks. The limited research available in this field suggests that the three theories discussed in this paper do provide valuable insights into how misconceptions in anatomy and physiology can hamper coherent knowledge construction, and potentially play an obstructive role when students are required to perform complex cognitive tasks such as clinical reasoning. © 2016 King Saud bin AbdulAziz University for Health Sciences. Production and Hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Misconceptions; Medical students; Knowledge construction; Theoretical perspectives

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1. Introduction

In a recent study to explore the nature and frequency of misconceptions in anatomy and physiology under first year medical students at the University of Cape Town, the researchers asked participants to comment on their study methods with regards to the two subjects. This question was included in the study to gain insight into how students interact with new information they encounter. Below are some of the comments made by students.

“I would memorize it. Contrary to popular belief, memorizing a physiological process is much more effective as you are assured that by memorizing the content that you'll use the correct terminology in a test.”

“Open the textbook and study it flat out.”

“Just read the material over and over again, there is not much understanding to do.”

“Make up a song or acronym or whatever, just memorize it.”

This paper provides a literature review of theories and synthesizes empirical studies concerning misconceptions in the domain of biomedical subjects. The paper is not exploring study methods of medical students, but the authors took cognizance of the above mentioned remarks to guide us towards a theoretical understanding of why and how biomedical misconceptions potentially arise. In the literature various terms, such as “misconceptions”, “naïve beliefs and “alternative conceptions” are used interchangeably to describe the notion of an incorrect understanding of concepts against a certain scientific paradigm.^{1,2} For the purpose of this paper a distinction is made between lack of knowledge and misconceptions.³ Misconceptions are persistent ideas that exist even after instruction.³ Whilst incomplete knowledge can be addressed by simply adding coherent and scientifically proven knowledge in order to come to grips with new

information, misconceptions are robust and resistant to change.^{2,4}

Research over the past three decades has shown that students arrive at tertiary institutions with pre-instructional views that are not necessarily supported by current scientific views.¹ One could argue that pre-instructional views that contradict current scientific ideas can easily be eliminated during teaching and learning activities at a tertiary level. However, if these beliefs are firmly held and resistant to change because the framework of these beliefs provided sufficient answers for students to navigate their way successfully through prior cognitive challenges, educators are faced with a challenge. Whether biomedical courses, such as anatomy and physiology, form part of an integrated curriculum, for example drawing on PBL cases, or whether medical curricula offer anatomy and physiology as stand-alone courses during the pre-clinical years, one cannot underestimate that these biomedical subjects are core to a medical student's understanding of the human body. If undergraduate medical students resort to memorizing, and thus not actively seeking understanding when they encounter new information, as was demonstrated in the above mentioned comments, existing misconceptions could continue to inform the learning process or new misconceptions could potentially arise.

The field of research into misconceptions in biology is still emerging as compared to the efforts in the physical sciences. This can be seen from research in conceptual change of science education over the last 20 years as it appears in an analysis of the Students' and Teachers' Conceptions and Science Education (STCSE) data-base, a comprehensive bibliography of papers on studies of conceptions and misconceptions.⁵ Analysis of the STCSE database shows that more than four times as many publications are available in the realm of physics and chemistry as in biology.⁵ A comprehensive framework making sense of alternative conceptions, and well developed hypotheses about reasons why some biological conceptions are difficult for novices

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