

What Happens to Misunderstandings of Biomedical Concepts Across a Medical Curriculum?

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Background: Accurate knowledge of biomedical concepts is essential for understanding human body structure and function. However, there is significant evidence indicating that students entering university have misconceptions about fundamental concepts in anatomy and physiology that can affect the acquisition of new knowledge. Although misconceptions of biomedical concepts have been demonstrated repeatedly, research on the extent and nature of commonly misunderstood fundamental biomedical concepts across a medical curriculum is scarce (1,2). In the current study, we first examined whether common misunderstandings persist throughout a medical curriculum, followed by a detailed analysis to identify their nature.

Methods: A 2-tier test was designed and administered to 987 medical students over two academic years across years one to six of the programme. The test comprised 8 questions covering the respiratory and cardiovascular systems, cell division, and homeostatic processes. First, proportions of incorrect responses per year of the programme were determined quantitatively to establish the prevalence of misunderstandings. Second, for four questions where misunderstandings persisted qualitative analysis was performed to establish what underlies the misunderstandings.

Results: There was a significant decrease in the proportion of incorrect responses by students' academic year (one-way ANOVA, $[F(6, 986) = 96.05, P < 0.001]$). Novices (within first week of year 1) and end-of first-year students showed a similar proportion of incorrect responses ($P > 0.05$). However, incorrect responses decreased significantly between first year and second year students ($P < 0.001$). Thereafter, from second to final year, the proportion of incorrect responses remained stable ($P > 0.05$), with approximately 35% of incorrect responses. Final year students performed marginally better than novices in two questions, whereas five questions showed no decrease of incorrect responses between second and final years.

Conclusions: Our results show that certain misunderstandings emerged consistently across years one to six of the curriculum. Fifteen categories of common misunderstandings of fundamental biomedical concepts were found in all years of training after quantitative analysis of open-ended questions. These findings have implications for teaching practices, especially on concept learning. Therefore, it is important for educators to be aware of the nature of commonly misunderstood biomedical concepts, and to implement measures for the counteracting of existing and prevention of the development of new misconceptions.

Reference:

1. Chi MT. Three types of conceptual change: belief revision, mental model transformation, and categorical shift. In: International Handbook of Research on Conceptual Change, edited by Vosniadou S. New York: Routledge: 2008. p. 89–110.
2. Ahopelto I, Mikkilä-Erdmann M, Olkinuora E, Kääpä P. A follow-up study of medical students' biomedical understanding and clinical reasoning concerning the cardiovascular system. *Adv Health Sci Educ Theory Pract* 16: 655–668, 2011. doi:10.1007/s10459-011-9286-3.

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