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Self-Explanation as a Strategy for Supporting the Development of Diagnostic Reasoning in Medical Students: An Exploratory Study on Knowledge Development

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Abstract

Purpose: Self-explanation (SE) has been shown to support the development of diagnostic reasoning in medical students. However, no study has documented how SE influences the development of the knowledge that underpins this reasoning. This study was a first step to explore this. More specifically the aim was to compare the use of biomedical and clinical knowledge by medical students who use SE while solving the same clinical cases one week apart.

Methods: Fifty-three medical clerks previously took part in a study to determine the impact of combining SE with listening to examples of SE on solving clinical cases one week later. In the present study, the authors analyzed the SE verbatim of the 15 students in the control group, who only used SE while solving cases. Four cases per participant were analyzed, for a total of 60 transcribed SE recorded at two different times, one week apart (T1 and T2), and for two clinical cases. The verbatim transcripts were coded according to a pre-determined coding grid: paraphrases, clinical inferences, biomedical inferences, monitoring, and errors. Code frequencies were compared at T1 and T2 using a paired t-test.

Results: No significant difference between the two times in any of the categories: clinical inferences ($p=0.28$), biomedical inferences ($p=0.08$), paraphrases ($p=0.97$), monitoring ($p=0.60$), and errors ($p=0.65$).

Discussion: Our results did not show quantitative changes of biomedical or clinical knowledge expressed by students using SE when tested at one week interval. The level of students and the short observation period may explain the negative findings. Alternatively, the assumption that knowledge transformation could be captured by simple quantitative measures might be too simplistic. To document and qualify the effects of SE on the medical knowledge, future studies will need to combine different instruments and/or observe its development over a longer period of time.

Keywords: Clinical reasoning; Diagnostic reasoning; Knowledge building; Self-explanation

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1. Introduction

In the past decades, several researchers have focused on the multiple facets of clinical reasoning, a core competency in medical practice.[1,2] One key finding is the core role of specific knowledge in clinical reasoning.[1–3] Clinical reasoning is developed gradually over the course of a student's medical training, with repeated clinical exposure to actual patients playing a central role in this development.[2,3] Medical students' transition from the preclinical phase of their training to their clerkship is a potential turning point for partial integration of the knowledge needed to develop clinical reasoning. The challenge for programs and teachers is to seize these opportunities and to implement strategies that will enable students to actively build their knowledge based on real clinical situations that they have experienced.[4]

Schmidt's theory of expertise[3] describes the development and restructuring of students' knowledge over the course of their training. According to this theory, students go through four transitional stages in the development of their expertise in medicine. The first stage is characterized by knowledge in the form of rich, elaborate causal networks that explain the causes and consequences of disease in terms of underlying biological or pathophysiological processes. The second stage occurs when the students are exposed to clinical problems. This causes their networks of causal knowledge to gradually become "packaged" under more abstract concepts in a phenomenon known as "knowledge encapsulation." The third stage is characterized by the emergence and enrichment of illness scripts, cognitive entities preferentially containing clinical knowledge about the characteristics of disease, such as predisposing factors, common clinical manifestations (signs, symptoms), and a brief description of the dysfunction. At this stage, the "encapsulated" biomedical knowledge is not strongly expressed but contributes to the coherence of the script. At the fourth stage, the knowledge acquired during the previous stages is enriched by the addition of clinical experiences with actual patients.

One of the techniques studied in various fields and put forth to support learning when solving problems is self-explanation (SE).[5,6] SE is an active learning technique that consists in the student generating explanations for himself based on learning material (e.g., a text, a problem, an example of a solution to a problem) in order to improve his understanding. SE enables the student to develop his knowledge, generate inferences, integrate new information to his previous knowledge, monitor his knowledge and, consequently, review its representations stored in memory.[6,7] Also, in a recent literature review in the field of science and mathematics, Richey & Nokes-Malach[8] examined how different techniques, including self-explanation, specifically contribute to the development of characteristics of expert knowledge. These authors concluded that in these fields, there are data supporting that SE helps to create links between the different types of knowledge, supports the coherence of these links, and helps to identify and resolve contradictions in prior knowledge.

In medical education, SE appears to be a promising learning technique to support the development of diagnostic reasoning in students.[4,9] In fact, diagnostic performance has been shown to improve in medical clerks who use SE while solving clinical cases compared to those who solve the same cases in silence.[10] This improvement, measured one week later, is observed when the clinical topic approached by the student is less familiar to him, and is more evident when performance is measured for different clinical cases or transfer cases.[10,11]

Based on the underlying mechanisms of SE[6] and in transposing them to the development of clinical reasoning, this technique could potentially help students to organize their knowledge, make links between their biomedical and clinical knowledge, and review or refine their illness scripts.[12] In fact, when the student generates SE while solving a clinical case that is less familiar to him, he reactivates and expresses his biomedical knowledge more than in a situation of familiarity.[12] It is therefore plausible to think that SE, in a less familiar situation, allows the student to give meaning to the clinical information by making additional links between his biomedical and clinical knowledge, thus allowing him to increase the coherence of the illness scripts that he is in the process of forming. Once the student made connections between the clinical elements and the underlying relevant biomedical knowledge, he or she would not necessarily need to explicitly revisit the later when subsequently facing a similar clinical situation. Similarly, following a narrative review of the teaching techniques for clinical reasoning at the undergraduate level, Schmidt and Mamede[4] put forth the assumption that self-explanation while solving problems could speed up the encapsulation of students' biomedical knowledge.[4]

Despite the evidence of the positive impact of SE on students' diagnostic performance, its effects on specific knowledge in medicine remain hypothetical for the

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