How learning methods in anatomy allow a boost of visuospatial abilities for undergraduate students

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In addition to the acquisition of an adequate terminology, a cornerstone in the anatomy education to undergraduate students begins with the learning of visuospatial information, including the shape of anatomical structures, their respective positions in 3D space, and their location in relation to other structures. Visuospatial abilities are assessed but are not taught. Since 15 years, the introduction course of anatomy is dispensed to 1500 students during the first year of the Bachelor Degree in various teaching sectors of the Faculty of Medicine at the University of Liège (Medicine, Dentistry, Physiotherapy, Science of Motricity, Biomedical Sciences and Pharmacy). Our educational approach aims at better individualizing theses complex tasks (observation skills, description and spatial visualization) during the learning process both by the methods used, than by the assessment system (Ernst et al., 2015)

In this study, the skill level related to the visuospatial abilities was assessed with the mental rotation test (MRT) (Vandenberg and Kuse, 1978). **Visuospatial anatomy comprehension** was evaluated using the spatial anatomy task (SAT) as described by Nguyen et al. (2012). The visuospatial properties of three tubular anatomical structures (the abdominal aorta, superior mesenteric artery, and duodenum frame) were used in three different tests involving mental rotation and 3D to 2D cross-section transposition. Finally, multiple-choice questions of increasing difficulty (SSAT) assessed **factual and spatial anatomy knowledge** in order to reach the level targeted by the learning outcomes.

945 undergraduate students from 6 different sections performed these 4 tests individually at three key moments of their learning process: at the beginning of the course (T1), after an initial online training (T2) and at the end of the period (T3).

Beside the fact that the score obtained for the MRT is correlated with those obtained for the SAT and SSAT tests, we showed that these scores evolve favourably with each attempt (p value <0.005 for MRT, SAT2, SAT3 and SSAT between T1 and T2 / p value <0.001 for SAT2, SAT3 and SSAT between T1 and T3).

The initial online training taking place between T1 and T2 seems to improve MRT and SAT 2 and 3 performances (p value <0.005). Practicing descriptive geometry (axis and planes benchmarks, cutting sections, 2D representations, confrontation of different views and sections) also seems to improve the SSAT results of some of the tested students.

Significant improvement in SAT2, SAT3 and SSAT performances (p value <0.005) between T1 and T3 could be related to the hybrid-training device which articulates, to varying degrees, face-to-face teaching and eLearning modules. One of our tool is the use of exercises where organs orientation in cross-sections is represented in different spatial views; students can do these exercises as self-evaluation with solutions commented in the form of short video sequences.

In conclusion, because it is know that visuospatial abilities affect anatomy learning and that our undergraduate students are heterogeneous related to these competences, we managed to propose adequate solutions for spatial difficulties during their learning process of anatomy.