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Supporting Students with Varied Spatial Reasoning Abilities in the Anatomy Classroom

Kelly Pedersen

Western University, kpeters7@uwo.ca

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Supporting Students with Varied Spatial Reasoning Abilities in the Anatomy Classroom

Summary

The study of anatomy requires abstract thinking and strong spatial reasoning. Traditional pedagogical approaches to teaching anatomy take advantage of the didactic lecture setting in which students are taught to memorize concepts and learn from two-dimensional pictures. Students are required to mentally formulate three-dimensional relationships based on what they see in two-dimensional pictures. This is a task that can be very difficult for many students. There is consistent evidence in the literature that states that students with low spatial abilities typically do not perform as well in an anatomy class as students with higher spatial abilities. This seminar will discuss the spatial abilities of students and how it relates to student performance in human anatomy classes. It will also explore teaching modalities that will allow for effective student learning among students of varying levels of spatial ability as well as make some suggestions for ways to increase a person's spatial ability. Information garnered from this workshop will help future educators in planning and executing their anatomy courses.

Keywords

Anatomy, spatial reasoning, teaching, 3D learning

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Supporting Students with Varied Spatial Reasoning Abilities in the Anatomy Classroom

SUMMARY

The study of anatomy requires abstract thinking and strong spatial reasoning. Traditional pedagogical approaches to teaching anatomy take advantage of the didactic lecture setting in which students are taught to memorize concepts and learn from two-dimensional pictures. Students are required to mentally formulate three-dimensional relationships based on what they see in two-dimensional pictures. This is a task that can be very difficult for many students. There is consistent evidence in the literature that states that students with low spatial abilities typically do not perform as well in an anatomy class as students with higher spatial abilities. This seminar will discuss the spatial abilities of students and how it relates to student performance in human anatomy classes. It will also explore teaching modalities that will allow for effective student learning among students of varying levels of spatial ability as well as make some suggestions for ways to increase a person's spatial ability. Information garnered from this workshop will help future educators in planning and executing their anatomy courses.

Keywords: Anatomy, spatial reasoning, teaching, 3D learning

LEARNING OBJECTIVES

By the end of this seminar, participants will be able to:

- Describe the relationship between spatial ability and performance in anatomy classes
- Recognize strategies in their own teaching that may privilege only students with higher spatial abilities
- Implement teaching modalities to include students with a variety of spatial abilities, and enhance overall student learning

REFERENCE SUMMARIES

Guillot, A., Champely, S., Batier, C., Thiriet, P., & Collet, C. (2007). Relationship between spatial abilities, mental rotation and functional anatomy learning. *Advances in Health Sciences Education*, 12(4), 491-507. doi:10.1007/s10459-006-9021-7

The mental rotation test is a 6-minute test, of 24 questions, where test takers are required to correlate two 3D rotated images to a principal image. This study investigates the relationship between the mental rotation test and spatial abilities and whether it is a good predictor of successful student learning in an anatomy classroom. Results shows the

mental rotation test accurately assesses the level of spatial ability of a student, and high MRT scores predict a learner's ability to succeed in an anatomy course. Visuo-spatial abilities are also correlated with anatomy examination results.

Rochford, K. (1985). Spatial learning disabilities and underachievement among university anatomy students. *Medical Education*, 19(1), 13-26.

This study discusses the underachievement of anatomy students and how it correlates to lower spatial abilities. Evidence shows that students who are spatially adept perform better on spatial multiple-choice questions than students who are not. The study ultimately recommends that different teaching techniques be implemented in the curriculum to accommodate students with lower spatial abilities.

Petersson, H., Sinkvist, D., Wang, C., & Smedby, O. (2009). Web-based interactive 3D visualization as a tool for improved anatomy learning. *Anatomical Sciences Education*, 2(2), 61-68.

This article investigates the efficacy of using videos of 3D anatomical structures in an anatomy setting. A 3D model and several 3D videos were developed to show the major blood supply of the body. Students were asked to use the movies and comment on their experiences. The results show that when compared to textbooks, students showed a positive attitude towards the virtual reality videos. There is also a potentially advantageous effect on student learning.

Korf, H., Wicht, H., Snipes, R. L., Timmermans, J., Paulsen, F., Rune, G., & Baumgart-Vogt, E. (2008). The dissection course - necessary and indispensable for teaching anatomy to medical students. *Annals of Anatomy*, 190(1), 16-22.

This article discusses nine arguments in support of a dissection-based anatomy course. It emphasizes that the dissection of the human body in an anatomy course setting is integral to effective learning of anatomy.

Sugand, K., Abrahams, P., & Khurana, A. (2010). The anatomy of anatomy: A review for its modernization. *Anatomical Sciences Education*, 3(2), 83-93.

This article discusses the current issues and limitations that anatomy professors are facing with teaching anatomy, which include decreased hours in the classroom and removing dissection from the anatomy laboratory. The authors put forth some suggestions that should be included in anatomy education that will optimize learners' experience and the overall quality of their anatomy education.

CONTENT AND ORGANIZATION

The seminar will run for approximately 105 minutes.

Subject	Duration (min)
1) Introduction to spatial abilities and anatomy	15
2) Group Discussion	10
3) Didactic Lecture in Anatomy	5
4) Group Discussion	10
5) Demonstration Activity	15
6) Teaching modalities to accommodate a class of students with varying spatial abilities	30
7) How do I increase my spatial ability?	15
8) Question period	5

1) Introduction to Spatial Abilities and Anatomy

Activity: Lecture/presentation style

Purpose: To familiarize participants with what spatial abilities are, how they affect the study of anatomy, and relationships between spatial abilities and student learning of anatomy.

obtain a copy of the mental rotation test to introduce to participants and have them attempt 1-2 questions to help them recognize their own spatial ability

2) Group Discussion

Activity: Participants will have several minutes to brainstorm/discuss topics in anatomy that are spatially challenging for students to learn and understand. With the remaining time, the instructor will gather, in chart form, the topics of consideration.

Possible topics include: embryological anatomy, peritoneum/pleura, ear, pharynx/larynx and neuroanatomy

Purpose: To identify topics in anatomy that are difficult to conceptualize spatially and require special consideration when teaching

Materials: Chart paper/markers

3) Didactic Lecture in Anatomy

Activity: Lecture on the formation of mesentery and peritoneum

Purpose: To expose participants to a difficult anatomical concept using a traditional style of teaching

4) Group Discussion

Activity: In groups, discuss how the lecture style of teaching affected their learning of a spatially difficult concept in anatomy

Purpose: To identify the strengths and weakness of the lecture style of teaching

5) Demonstration Activity

Activity: In groups, participants will be given a box of miscellaneous items. Their task is to use the items in the box to teach the rest of the group a spatially challenging topic in anatomy.

Purpose: To expose participants to the demonstration method of teaching that allows for increased understanding of spatially challenging topics and to encourage participants to be creative with their teaching

Materials: boxes containing the following items - string, plastic sheets, clay, buttons, a ball, paper, pens, anatomy textbook, any other miscellaneous items

6) Teaching Modalities to Accommodate a Classroom of Students with Varying Spatial Abilities

Activity: Introduction of teaching techniques different from the traditional didactic lecture

- dissection/prosection
- 3D/stereoscopic models
- clinical based anatomy activities

Set up stations for groups who will describe other teaching techniques to rotate. The groups will learn at each station for approximately 8-9 minutes. Allow for approximately one minute for groups to rotate to the next station.

Purpose: To explore all the potential teaching modalities that can be incorporated into the classroom to enhance overall student learning

Dissection/prosection station

Objective: demonstrate/describe how real human specimens can reinforce spatially challenging topics (ex. pathways of nerves and blood vessels)

- enriching experience for many students
- process of dissection helps with exploration of the human body and appreciation for the layers within the body
- have participants handle dissected specimens

Materials: prosected specimens, trays, gloves, sheets (to cover specimens with), probes, tweezers

3D/Stereoscopic models

Objective: demonstrate/describe what the strengths of 3D modelling are and how 3D modelling can be incorporated into the classroom

- introduce 3D modelling of various parts of the body
- have participants apply 3D models
- beneficial when dissection is not an option or there is limited funds
- being able to manipulate structures to the users' choosing allows for better understanding of anatomical relationships and helps to isolate areas of difficulty (NB: those students with low spatial ability will likely only look at key views, whereas students with high spatial ability will be more likely to learn from all views)

Materials: projector, computer, 3D anatomical software, 3D goggles,

Clinically based anatomy activities

Objective: describe how to effectively incorporate clinically-based learning into the anatomy lab and classroom

- introduce clinical anatomy activities/assignments that students can do to reinforce what they have learned
- ex. clinical cases involving imaging (MRI, CT, etc) that require students to problem solve and use their anatomical knowledge of spatial relationships
- if dissection is available, have students perform certain procedures on cadavers and talk about the anatomical relationships of structures involved in the surgical area

Materials: x-ray, CT, MRI images, clinical scenario examples

7) How do I increase my level of spatial ability?

Activity: Anatomy drawing exercise

Challenge participants to draw a 3D anatomy picture of any relationship that they want

Purpose: Expose participants to strategies that will help increase their own spatial ability as well as suggest activities that instructors can do with their students to help increase their students' level of spatial ability.

-drawing is a great way to develop spatial skills and it is easy to challenge your students to do so

-other examples of how to increase spatial ability include videos games, 3D puzzles, spatial intelligence games and PRACTICE!

PRESENTATION STRATEGIES

I chose mostly activities and group discussions to engage participants and allow for a hands-on approach to teaching. I want participants to have 'self-realizations' while going through this seminar. I wanted to avoid lecture/presentation style as much as possible because it is harder to keep participants engaged in the content, and it does not enforce what I am trying to teach in my seminar. Since most of the seminar content includes group activities and discussion, providing the participants with a set amount of time for each activity is paramount to keeping the pace of the seminar.