



Spatial Ability and Student Achievement in Ultrasound Scanning

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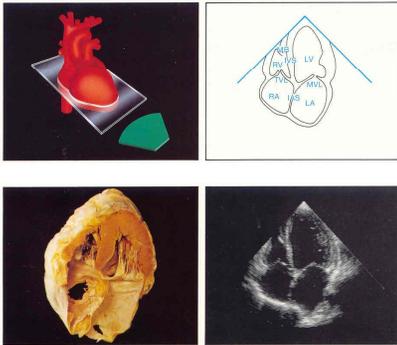


Purpose

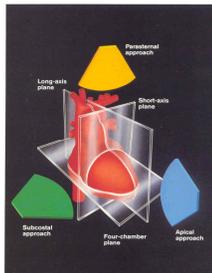
Sonographers generate multi-viewed, logical, sequential renderings of anatomical objects. It can be assumed that spatial ability is central to the perception, generation, and interpretation of these medical images. However, little is known about the relation between spatial ability and sonographers' performance. Currently, no empirical evidence has been identified in the literature that supports this assumption for Sonography. This study examines that relationship.

Introduction

Sonography is a developed skill in which sonographers image anatomical objects within patients to produce diagnostic images for the physician to interpret. An assumption can be made that learning to scan may be easier for those with high spatial ability than for those with low spatial ability. See examples of scanning planes below.



Visual-spatial ability refers to the mental ability to generate, retain, retrieve, and transform well structured images. Sonographers must be able to construct a series of images that logically represents the whole object. This requires an ability to mentally rotate and transform two dimensional images in order to create a series of views that represents the three dimensional object.



Traditional admissions criteria for sonography schools: SAT, ACT, GRE scores, GPA and interviews.

By observation, some students learned to scan much faster than others, regardless of their academic achievement or aptitude scores.

Problem: All sonography schools may be faced with admitting candidates with exceptional achievement and aptitude scores who perform well in didactic coursework, yet struggle with learning to scan.

This exploratory study focused on finding empirical evidence that spatial ability may contribute to the process of learning ultrasound scanning. If a positive relationship is found between the spatial scores and the scanning scores, administration of a spatial ability test may be an appropriate predictor of a student's aptitude for success in learning to scan.

CONCEPTUAL FRAMEWORK

Embraces Cognitive Learning and Constructivism

Constructivism is a philosophical explanation about the nature of learning which asserts that the world can be viewed by individuals in many different ways.

Knowledge is not something imposed on people from the outside; rather it is formed from within.

Each individual's construction of knowledge is unique, based on personal beliefs and prior experiences. All knowledge is thus subjective to personal perceptions, world views and innate abilities.

Research Questions

What are the levels and variations of spatial abilities among the sonography students?

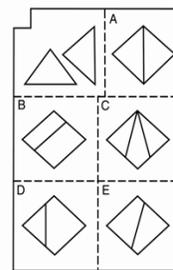
What is the relationship between the spatial ability test scores and student achievement in ultrasound scanning?

Materials and Methods

After obtaining IRB permission, seventeen sonography students drawn from two classes were studied. Six first-year cardiac students and eleven first-year abdominal - OB/GYN students participated. The groups were combined to increase the number of participants to an acceptable statistical power level of .83 for this study (N=17).

The **Revised Minnesota Paper Form Board Test (RMPFBT)**, a spatial visualization test, was administered by a proctor not associated with instruction or evaluation of the participants. The spatial ability scores were compared to the scanning competency scores at the end of the first 30 hours of instruction, and then to the overall average of the students' scanning scores for two semesters. The students used each other as models for scanning and the instructor evaluated each student as they scanned in the laboratory setting, according to the performance objectives outlined in the Sonographer Clinical Assessment Book (SCAN). See sample test item of the RMPFBT below.

There are two parts in the upper left-hand corner. Now look at the five figures labeled A, B, C, D, E. You are to decide which figure shows how these parts can fit together.

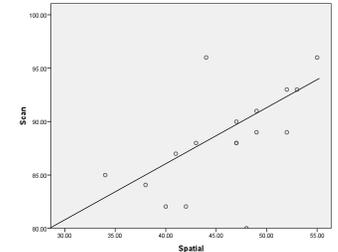


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Sample test question from the Revised Minnesota Paper Form Board Test Permission granted for use from Pearson, Inc.

Results

- Spatial aptitude** scores of all participants ranged from the 15th to the 90th percentiles.
- A **weak relationship** between the scanning scores and the spatial scores was seen after 30 hours of instruction (R=.26).
- For the two semester average, a **very strong relationship** between the scanning scores and the spatial scores was seen (R=.60). (In social science research, an R value of .60 is very strong.)

Statistical Data for Regression



Regression scatter plot for the students' two-semester averaged scanning scores compared to their spatial ability test scores. The graph shows a strong linear relationship between the two variables.

Conclusion and Discussion

- Regarding the first research question, the sonography students' spatial test scores ranged from the 15th to the 90th percentile, exhibiting a wide range of spatial ability in the sample population.
- The researchers had anticipated that students with high spatial ability scores would have higher scanning competency scores than those with low spatial ability. Surprisingly, a weak relationship was seen between spatial and scanning scores after the students' first scanning competency test. In contrast, a very strong relationship was seen for the two semester averaged scores for the combined groups.
- It is unknown why a weak relationship was seen after the first exam, yet a strong relationship was seen after averaging the students' scanning scores over two semesters. This needs further investigation. However, the strong relationship between the spatial and scanning score averaged over the two semesters may imply that spatial aptitude testing may be appropriate for the screening of candidates for admissions purposes. It may also be important to adjust instructional pedagogical techniques and/or curriculum to address the needs of students with low spatial abilities.