

Mind Map Teaching of Gross Anatomy is Sex Dependent

Mapa Conceptual en la Enseñanza de la Anatomía Macroscópica es Dependiente del Sexo

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SUMMARY: The aim of this study was to evaluate the effectiveness of using Mind Maps in teaching anatomy and compare it with traditional based slide. This cross-sectional research was carried out in 2009 on 79 second year medical undergraduate students at Ahvaz Jondishapour University of Medical sciences. Four class lectures on the topics of head and neck osteology were taught. The lectures were slide based designed that were chosen from the chapters in the anatomy textbooks and presented by means of a video projection power point system. The students divided randomly into two groups; one group educated by traditional slides while the other by mind map based designed ones. At the end of the term, a multiple-choice involved forty test was undertaken from two groups. The data was investigated using analysis of variance (ANOVA) and paired T test ($p < 0.05$). The mean scores of females in mind map group were higher than that for traditional one ($p < 0.04$), while there were no significant differences in the mean scores of the men of two groups. The mean scores of females were significantly higher than the males in mind map group ($p < 0.02$) and although the mean scores of females in traditional group was higher it was not significant. This paper has shown the efficacy of using mind maps for teaching gross anatomy as a study aid, even when use has been limited to a single exposure. The study found sex-dependent of learning, suggesting that sex may determine the optimal neural network for designing teaching protocols. Indeed, for females, that have obtained better scores, the use of bilateral neural network seems to facilitate the learning process by mind map teaching of anatomy.

KEY WORDS: Anatomy; Mind map; PowerPoint slides; Teaching; Visual note takings; Sex.

INTRODUCTION

Transmission of visual information by the teachers has a remarkable role in education of gross anatomy (Carmichael & Pawlina, 2000; Cottam, 1999).

The oldest visual learning method is to demonstrate gross anatomy by dissection of cadavers. But this method has two limitations for learners; the rigidity and unpleasant smell of cadavers reduces incitation and the presence in dissecting rooms, only works for a small group (Dobson, 2007; Ellis, 2001; Goodwin, 2000; Raftery, 2006).

Other Visual learning methods which are constructed based on diagrams included: concept maps, tree diagrams, organization charts, spider diagrams and mind maps.

Mind Mapping develops according to the visual note taking evidences of some famous scientists, cave drawings

of primitive man and hieroglyphics of ancient Egypt. Mind maps contribute both sides of the brain by integrating the mind with visualized pictures that leads to improve learning process (Buzan, 1991). An extensive study was carried out to find out if mind mapping proved valuable for executive courses. This study showed that most of the students appreciated the use of mind mapping for recall and creative thinking (Mento *et al.*, 1999). The efficacy of mind mapping for improving long-term memory in medical students was shown (Farrand *et al.*, 2002). Another two studies investigating that mind mapping is effective tool for improving the performance of students in a nursing research course (Rooda, 1994).

To present visual information, the most common method is to project power point designed slides (LaPorte *et al.*, 2002). This method has many advantages: commercially available collection of slides, home made slides with a camera

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and a simple copy stand, creation of a slide collection that can be reconfigured to cover any topic in anatomy, projection of the slides to any size that is limited only by the expanse of the screen and focal length of the projector lens, the lecturer then can point out the items of interest to the students (Cook, 1998).

But the images are static, all of the information present on the slide is presented instantaneously, often overwhelming or distracting the students (Tarpley & Tarpley, 2008).

Although learning anatomy depends on the transmission of visual information and mind maps focuses to transmit visual information more effectively, but there is not enough data to show how mind maps act during education of gross anatomy. Previously, we showed the efficacy of mind map teaching of gross anatomy for students of medicine and that the process of learning by this method is sex dependent (Ghanbari *et al.*, 2010). Here we showed the detail of sex differences in learning of gross anatomy achieved by mind map teaching and explained the causes of these differences.

MATERIAL AND METHOD

This cross-sectional research was carried out in 2009 on 79 second year medical undergraduate students at Ahvaz Jondishapour University of Medical sciences. The ethnicity of these subjects was 100% of Caucasians. Four class lectures in the topics of head and neck osteology were taught. The lectures were slide based designed that were chosen from the chapters in the anatomy textbooks and presented by means of a video projection power point system. The students divided randomly into two groups; one group educated by traditional slides while the other by mind map based designed ones (Table I).

Table I. Summary of demographic findings.

	Mind map slides		Traditional slides	
	Age	Number	Age	Number
Male	20.8	14	21.1	13
Female	20.4	25	20.7	27
Mean total	20.6	39	20.9	40
Significance	0.88	0.021	0.87	0.018

Mind map slides were designed according to Buzan's recommendations. Smart draw software which downloaded freely from the site: <http://www.smartdraw.com> was used as the base of mind map slides. In this regard, the figures of the bones were arranged in the center of the slide and the related concepts such as surfaces, borders, relations, foramens and fissures connected to the central figures with lines or

arrows. These conceptual items surrounded by frames and painted with different colors.

The two lectures were individually presented by a staff of anatomy department which was blinded to the research protocol. This study was approved by the research committee in Ahvaz Jondishapour University of Medical sciences. At the end of the term, students of two groups were tested on a 40-item multiple-choice examination and the scores ranged from 0 to 20. The demographic findings and the data obtained from the scores analyzed with SPSS version 15 for Windows.

Independent t test was used to compare the scores of two groups; mind map vs. traditional slides. Quantitative variables such as age and the number of individuals were analyzed using paired T test ($p < 0.05$). Analysis of variance (ANOVA) was accomplished to evaluate if the scores of two groups is differed by gender.

RESULTS

In this experimental attempt to utilize the mind map teaching technique, the anatomy program of students of doctor of medicine students in Jondishapour University of Medical sciences was evaluated. Permission of conduct the study was obtained from the adjutancy of basic science of the Jondishapour University of Medical Sciences.

Demographic findings showed that there were no significant differences in the mean age of two groups. According a greater distribution (proportion) of female students ($n=52$) than the males ($n=27$), the number of female individuals were significantly higher than the males for both mind map ($p < 0.021$) and traditional ($p < 0.021$) groups.

The mean scores of females in mind map group were higher than that for traditional one ($p < 0.04$), while there were no significant difference in the mean scores of the men of two groups (Fig 1A). The mean scores of females were significantly higher than the males in mind map group ($p < 0.02$) and although the mean scores of females in traditional group was higher but it was not significant (Fig 1B, C).

DISCUSSION

The results of the study indicated that the mind map group received significantly higher scores than the traditional group. These findings were similar to those of West *et al.* (2000), Hsu (2004), Laight (2004) which indicated the

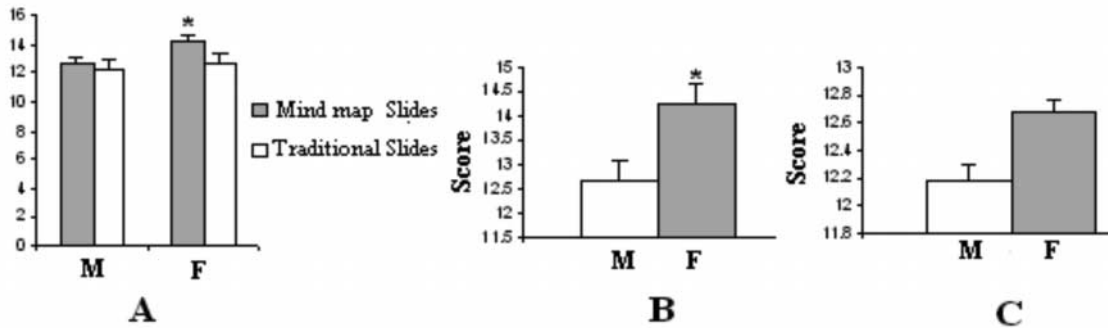


Fig. 1. Comparison of the scores between the mind map and traditional groups. A: Comparison of the scores between the mind map and traditional groups according the sex. B: Comparison of the scores in the mind map group achieved by two sexes. C: Comparison of the scores in the traditional group achieved by two sexes (M; Males, F; Females), * $p < 0.05$.

improvement of learning by applying mind mapping for students of nursing.

There was a statistically significant difference in total scores for the mind maps between the two groups. Therefore the mind map technique has the potential for improvement of learning in both medical and physical therapy courses.

These findings were similar to those of Farrand et al. They investigated that the mind map study technique by allowing 50 undergraduate medical students use the mind map or self-selected study technique to recall factual material. The results revealed that mind map group performed 10% better than the self-selected group.

Analysis of the data indicated that the mind map teaching was affected by the gender of correspondence.

Anatomical studies revealed that males have more overall volume of gray and white matter than females, which may mean that females might use more neural resources (e.g., in both hemispheres) to achieve the same cognitive performance (Good et al., 2001).

Consistent with this hypothesis, it has been revealed that females have a relatively larger isthmus segment of the callosum, perhaps reflecting a sex-specific difference in the inter-hemispheric connectivity (Steinmetz et al., 1992; Steinmetz et al., 1995).

Moreover, a recent study on the relations between brain structure and individual differences in general intelligence quotient (IQ) showed that, compared to men, women have more white matter and fewer gray matter relative to a given level of intelligence (Haier et al., 2005).

Finally, as the first evidence, it showed that sex may determine the neurofunctional predictors of visual word

learning. It appears that, when learning a new writing system, the optimal neural resources recruitment might vary for males and females. For males, the greater reliance on the left fusiform will result in better performance, whereas for females, the use of bilateral neural network seems to facilitate the learning (Chen et al., 2007).

In conclusion, it is likely the male and female brains are designed differently, and different operations might be implemented to achieve equal performance. Taken together, our study found sex-dependent of learning, suggesting that sex may determine the optimal neural network for designing teaching protocols.

This paper has shown the efficacy of using mind maps as a study aid, even when use has been limited to a single exposure. The increased use of mind maps, and the emergence of educational materials supporting the use of mind maps, within medical curricula, should therefore be cautiously welcomed. The mind map technique would seem to be particularly suited to medical curricula based around problem based learning, as both approaches support, and encourage students to adopt a deeper level of learning.

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RESUMEN: El objetivo de este estudio fue evaluar la efectividad del uso de mapas conceptuales en la enseñanza de la anatomía y compararla con la tradicional basada en diapositivas. Esta investigación de corte transversal se llevó a cabo en el año 2009 en 79 estudiantes de pregrado del Segundo Año de Medicina en la Universidad de

Ciencias Médicas Ahvaz Jondishapour. Fueron analizadas cuatro clases conferenciales en los temas de cabeza y cuello óseo. Las conferencias diseñadas se basaron en el uso de diapositivas las que fueron seleccionadas desde los capítulos de libros de Anatomía y se presentaron por medio de proyección de videos utilizando el sistema power point. Los estudiantes fueron divididos aleatoriamente en dos grupos: un grupo educado por diapositivas tradicionales mientras que el otro se basó en el diseño de mapas mentales. Al final del ciclo de conferencias, una prueba de opción múltiple de cuarenta preguntas se aplicó en ambos grupos. Los datos fueron investigados mediante el análisis de varianza (ANOVA) y prueba de la t de Student ($p < 0,05$). Las puntuaciones medias de las mujeres en el grupo de mapa mental fueron mayores que las del grupo diapositivas ($p < 0,04$), mientras que no hubo diferencias significativas en las puntuaciones medias de los hombres de ambos grupos. Las puntuaciones medias de las mujeres fueron significativamente mayores que los hombres en el grupo de mapa mental ($p < 0,02$) y aunque las puntuaciones medias de las mujeres en el grupo diapositivas fue más alto, no fue estadísticamente significativo. En este trabajo se ha demostrado la eficacia del uso de mapas mentales para la enseñanza de anatomía como una ayuda al estudio, incluso cuando el uso se ha limitado a una sola exposición. El estudio encontró que el aprendizaje depende del sexo, lo que sugiere que el sexo puede determinar una red neuronal para el diseño de protocolos óptimos de enseñanza. En efecto, para las mujeres, que tienen mejores calificaciones, el uso de redes neuronales bilaterales parece facilitar el proceso de aprendizaje mediante la enseñanza de mapas mentales en la Anatomía.

PALABRAS CLAVE: Anatomía; Mapa mental; Diapositivas de PowerPoint; Enseñanza; Toma de nota visual; Sexo.

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