

DECLINE OF GROSS ANATOMY IN MEDICAL EDUCATION

I. Independent learning and the need for assessing effects of curricular change S.N. Zill, J.C. Edwards Sch. Med., Marshall Univ., Huntington, WV, USA



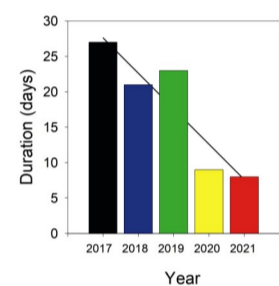
ABSTRACT: The importance of Gross Anatomy in medical education has declined in recent years as the result of curricular reforms at many schools. The goals of our ongoing observational study are 1) to adapt Anatomy instruction to the compression of content and reduction in duration of anatomy instruction, 2) to evaluate the effectiveness of pedagogical methods in conveying information essential to understanding body structure and 3) to attempt to reduce student stress. Our approach to pedagogical reorganization is to base anatomy instruction upon core clinical conditions. These conditions were not presented as clinical problems, as many students had limited prior training in medical terminology, but focused upon clinical symptoms, allowing for direct correlation of structure and function. Overall methodology has been multi-modal. Content was significantly reduced: for example, knowledge of muscle origins and insertions is no longer required, only muscle actions and innervations. Performance has been evaluated using a long-term data base of student scores on written and regional practical examinations. Results of written examinations were relatively constant during the period prior to the introduction of curricular changes but practical examinations could show large anomalous variability in some years (including data utilized in a previously published study of the effects of independent learning). To increase the accuracy of assessment we have developed a set of questions that were asked repetitively in successive years on written examinations. Current data on exam performance (including repeat questions) indicate that the pedagogical changes were effective during the initial period of curricular change and a survey of students indicated that these changes effectively decreased stress. However, performance in Head and Neck anatomy declined in 2020-2022 as curricular compression and increased reliance upon independent learning has intensified. We are currently assessing whether the decline was associated with the unique circumstances of the viral pandemic. The results to date suggest that 1) training in gross anatomy can be adapted to a limited duration but do not support reliance upon independent learning as a pedagogical method; 2) there is clearly a need to assess the effects of eliminating Gross Anatomy on medical practice. Support: NSF CRCNS Grant 2113028

CURRICULAR REVISION AND COMPRESSION OF DURATION OF ANATOMY INSTRUCTION

NEW INTEGRATED CURRICULUM

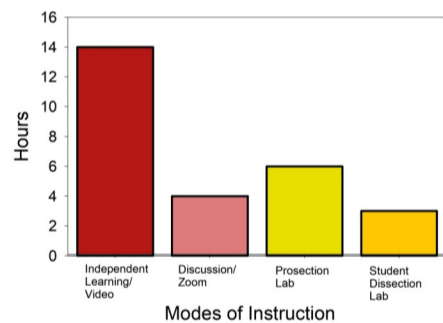
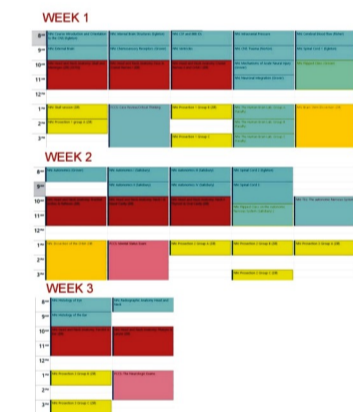
PHASE ONE: PART 1 — FOUNDATIONS OF HEALTH AND DISEASE				
Cellular and Molecular Basis of Health and Disease	Oncology and Hematology	Orthopedics and the Nervous System	Gastroenterology and Nutritional Sciences	Summer and Research Review
18 weeks	8 weeks	18 weeks	8 weeks	9 weeks
PhySics in Practice — Global and Local Issues in Medicine, Humanism and Ethics				
Risk Training: Economics and Law of Medicine, Clinical and Translational Science, Team Building and Communicating with a Patient				
Patient Care and Clinical Skills, Early Patient Interactions				
PHASE ONE: PART 2 — FOUNDATIONS OF HEALTH AND DISEASE				
Cardiovascular, Renal and Respiratory Systems	Hormones and Human Reproduction	USMLE STEP 1		
18 weeks	18 weeks			
Patient Care and Clinical Skills, Early Patient Interactions				

DURATION OF INSTRUCTION IN HEAD AND NECK ANATOMY



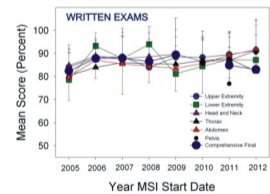
SCHEDULE OF HEAD AND NECK INSTRUCTION

HEAD AND NECK ANATOMY SESSIONS (IN RED) OVERALL INSTRUCTIONAL PEDAGOGIES

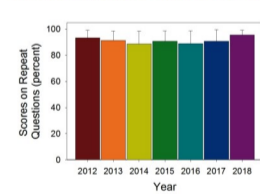


METHOD: ASSESS EFFECTS OF CURRICULAR CHANGE USING A LONG-TERM DATA BASE AND 'REPEAT' QUESTIONS

DATA BASE OF EXAM PERFORMANCE



PERFORMANCE ON REPEAT QUESTIONS



ADAPTING GROSS ANATOMY TO A COMPRESSED TIME FRAME - A new integrated curriculum was initiated at JCESOM that compresses basic science training to 18 months and further reduced the duration of study of Gross Anatomy. Instruction in head and neck anatomy (by flipped lecture videos and some in-class sessions) has been reduced to eight days in 2021-2022. Laboratory sessions involved study of prosections but two regions were preserved for student laboratory dissection (Brainstem in Cranial Cavity, Orbit). Performance has been assessed through a data base of written and practical exam scores over an extended period (2005-2022) maintained by the principal investigator. A set of 'repeat' questions was also developed to more accurately assess performance. Results of written examinations have been constant through a series of curricular revisions.

GOAL OF THIS STUDY: BEGIN TO ASSESS EFFECTS OF REDUCTION/ELIMINATION OF GROSS ANATOMY IN MEDICAL EDUCATION

INSTRUCTION IN HEAD AND NECK USING MULTIMODAL PEDAGOGY: CONTENT REDUCTION AND EFFECTS ON PERFORMANCE - Instruction in anatomy was based upon a core of clinical conditions that were correlated with pathology and neurology and previously tested in Step One Board Examinations. Clinical syndromes were not presented as case studies (many students lack the background for meaningful diagnostic analysis) but as correlates of anatomical structure and function. Anatomical detail was retained when it was essential for understanding the functional consequences of structure. For example, the description of the actions of the extraocular muscles included both their effects in translation and rotation, permitting understanding of compensatory head tilt following nerve palsy. In the past year, some topics have also been eliminated and not tested (but these subjects could be covered in proposed Anatomy courses later in training). Student performance in Gross Anatomy initially decreased somewhat but was still maintained at a high level. However, there was a substantial decrease in performance on written exams in 2021 when pedagogy heavily relied upon independent learning. In contrast, scores on practical examinations have been sustained in association with preserving laboratory sessions for student dissections of several important regions (Cranial Cavity/Brainstem, Orbit).

APPROACH: INSTRUCTION BASED ON CLINICAL SYMPTOMS: DEFICITS ARE MANIFESTATIONS OF STRUCTURE/FUNCTION

SPECIFIC HEAD AND NECK TOPICS

CHELOSCHISIS
PALATOSCHISIS
DACYRYSTENOSIS
TREACHER COLLINS SYNDROME
BRANCHIAL CLEFT SYNDROMES
THYROIDGLAND DUCT CYST
FRACTURE CRIBIFORM PLATE
IPSI LATERAL VISUAL LOSS (SLOW, RAPID)
ABDUCENS PALSY
TROCHLEAR PALSY
OCULOMOTOR PALSY
CILIOPRETINAL ARTERY OCCLUSION
CENTRAL RETINAL ARTERY OCCLUSION
HORNER'S SYNDROME
CAVERNOUS SINUS THROMBOSIS
EPIDURAL HEMATOMA

CLINICAL HISTORY OF HEAD AND NECK	CLINICAL ANATOMY OF HEAD AND NECK PART 1
<p>CLINICAL HISTORY OF HEAD AND NECK</p> <p>1. General - Headache - Facial pain - Swallowing difficulty - Voice changes - Hoarseness - Stridor - Dysphagia - Odynophagia - Hemoptysis - Epistaxis - Unilateral nasal discharge - Unilateral facial numbness - Unilateral facial weakness - Unilateral facial paralysis - Unilateral ptosis - Unilateral pupil dilation - Unilateral pupil constriction - Unilateral eye pain - Unilateral eye redness - Unilateral eye tearing - Unilateral eye discharge - Unilateral eye swelling - Unilateral eye protrusion - Unilateral eye retraction - Unilateral eye deviation - Unilateral eye fixation - Unilateral eye nystagmus - Unilateral eye strabismus - Unilateral eye diplopia - Unilateral eye blurred vision - Unilateral eye decreased vision - Unilateral eye increased vision - Unilateral eye color change - Unilateral eye shape change - Unilateral eye size change - Unilateral eye position change - Unilateral eye movement change - Unilateral eye reflex change - Unilateral eye accommodation change - Unilateral eye convergence change - Unilateral eye divergence change - Unilateral eye accommodation change - Unilateral eye convergence change - Unilateral eye divergence change</p>	<p>CLINICAL ANATOMY OF HEAD AND NECK PART 1</p> <p>1. General - Head - Neck - Face - Oral cavity - Pharynx - Larynx - Trachea - Esophagus - Thyroid gland - Parathyroid glands - Salivary glands - Ears - Nose - Throat - Lungs - Heart - Stomach - Intestines - Liver - Gallbladder - Pancreas - Spleen - Kidneys - Adrenal glands - Testes - Ovaries - Uterus - Vagina - Cervix - Vagina - Uterus - Ovaries - Adrenal glands - Kidneys - Testes - Spleen - Pancreas - Gallbladder - Liver - Stomach - Intestines - Esophagus - Trachea - Larynx - Pharynx - Oral cavity - Face - Neck - Head</p>

ELIMINATING/DELAYING LEARNING OF BASIC ELEMENTS OF ANATOMY

STUDY PROSECTIONS WITH LABELED PHOTOS: CAROTID ARTERY: ONE SIDE: SURGICAL APPROACH, OPPOSITE: FULL DISSECTION



REDUCE MEMORIZATION OF ANATOMICAL DETAIL

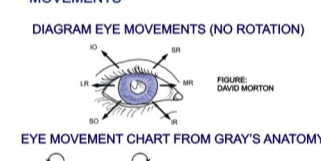
TABLE OF MUSCLES OF NECK AND HEAD
<p>TABLE OF MUSCLES OF NECK AND HEAD</p> <p>1. General - Head - Neck - Face - Oral cavity - Pharynx - Larynx - Trachea - Esophagus - Thyroid gland - Parathyroid glands - Salivary glands - Ears - Nose - Throat - Lungs - Heart - Stomach - Intestines - Liver - Gallbladder - Pancreas - Spleen - Kidneys - Adrenal glands - Testes - Ovaries - Uterus - Vagina - Cervix - Vagina - Uterus - Ovaries - Adrenal glands - Kidneys - Testes - Spleen - Pancreas - Gallbladder - Liver - Stomach - Intestines - Esophagus - Trachea - Larynx - Pharynx - Oral cavity - Face - Neck - Head</p>

SOME LECTURES ALSO ELIMINATED OR GREATLY REDUCED (EXAMPLES):

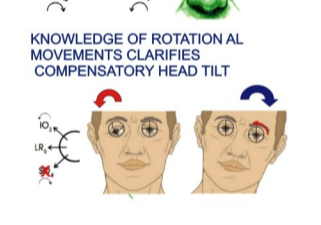
- CRANIOVERTEBRAL JOINT
- CRANIAL NERVE
- HITCHHIKING PATHWAYS
- DETAILED BRANCHES OF NERVES AND ARTERIES

THESE TOPICS COULD BE COVERED LATER IN THE CURRICULUM (I.E. ANATOMY COURSE IN FOURTH YEAR)

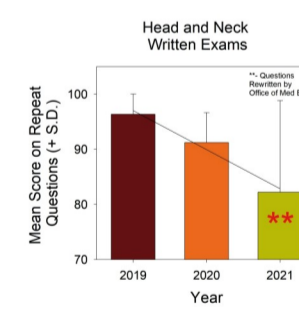
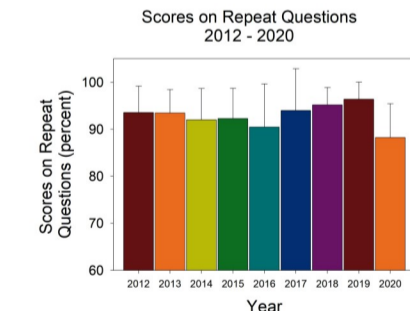
RETAIN CLINICALLY RELEVANT ANATOMY THAT GIVE INSIGHT INTO FUNCTION: EYE MOVEMENTS



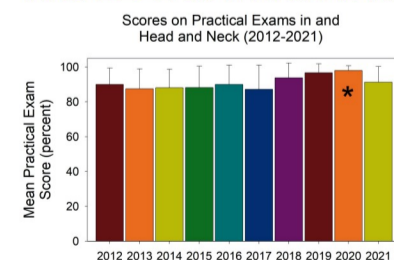
KNOWLEDGE OF ROTATIONAL MOVEMENTS CLARIFIES COMPENSATORY HEAD TILT



DECLINE IN PERFORMANCE ON WRITTEN EXAMS AFTER 2019 WITH INCREASED RELIANCE ON INDEPENDENT LEARNING



IN CONTRAST, PERFORMANCE ON PRACTICAL EXAMS HAS BEEN MAINTAINED AT A HIGH LEVEL



ACTIVE LEARNING BY STUDENTS DISSECTING IN THE GROSS ANATOMY LABORATORY



EFFECTS OF INDEPENDENT LEARNING RECONSIDERED - Independent learning has a number of institutional advantages as it is inexpensive and requires few (or no) faculty specifically trained in Gross Anatomy. However, independent learning pedagogies limit social interactions, including peer learning. On-line instructional videos are often superficial or have extreme information density. Last, the extended data base of performance we have generated has shown that errors in assessment of independent learning can occur when evaluation is done over limited time periods. A previous, published study from our school (Serrat et al., Anat. Sci. Educ. 7:406-16, 2014) evaluated the effectiveness of independent learning modules in student examinations over a three year period and concluded that use of independent learning improved performance. However, study of a more extensive data base showed that the practical exam used as a baseline (2010-2011) was an outlier in which the entire class had a failing average. In addition, there is no increase in performance when the average of practical exam scores over the preceding five years is used as a baseline. In the present study, performance on written exam questions was significantly higher in areas that students actively dissected in the Gross Anatomy laboratory than in subjects studied only by on-line, independent learning. Conclusions about the effectiveness of independent learning are not currently supported by the data and require further study.

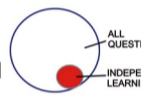
EFFECTIVENESS OF INDEPENDENT LEARNING RECONSIDERED

- ADVANTAGES OF INDEPENDENT LEARNING
- 1) INEXPENSIVE
 - 2) REQUIRES FEWER (OR NO) TRAINED FACULTY
 - 3) VIEWED AS 'ACTIVE' LEARNING THAT IS ENTIRELY SELF-MOTIVATED

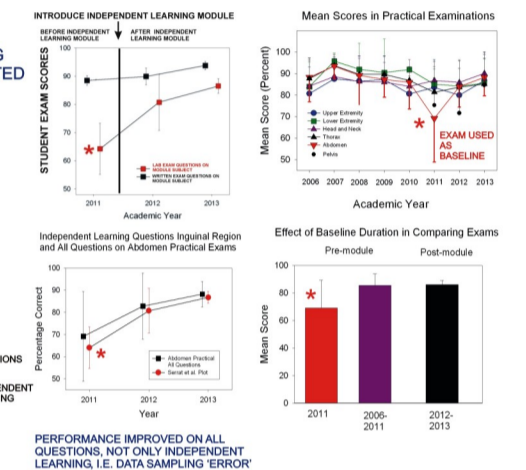
DISADVANTAGES

- 1) HIGHLY LIMITED (OR NO) SOCIAL INTERACTION
- 2) LIMITED (OR NO) LEARNING FROM PEERS AND INSTRUCTORS
- 3) EXTREME INFORMATION DENSITY IN SELF-CONTAINED PRESENTATIONS

DATA SELECTION

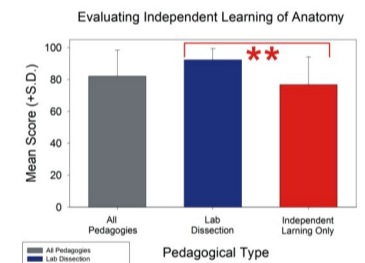


FLAWED DATA IN STUDY DONE AT MARSHALL UNIVERSITY: INDEPENDENT LEARNING ENHANCED PERFORMANCE



CURRENT EVALUATION OF INDEPENDENT LEARNING OF HEAD AND NECK ANATOMY

Performance on written exam questions was significantly higher in areas that students actively dissected in the Gross Anatomy laboratory than in subjects studied only by on-line, independent learning.



CONCLUSIONS:

- 1- Student performance in Gross Anatomy was sustained by organizing pedagogy based on clinical symptoms following a substantial compression of the duration of study of anatomy due to curricular revision. Student scores in Head and Neck anatomy decreased after instruction relied heavily upon independent learning.
- 2- Analysis of questions on written examinations showed that performance was significantly higher in areas (Brainstem and Cranial Cavity, Orbit) that students actively dissected in the Gross Anatomy laboratory than in subjects studied only by on-line, independent learning.
- 3- While considered institutionally beneficial, independent learning may be disadvantageous for many students. A previous evaluation of the effectiveness of independent learning at our school was flawed by lack of a long-term assessment of performance.
- 4- Further study is needed on the effects of eliminating/reducing Anatomy on retention, vocabulary and medical practice. Additional training in Gross Anatomy in the fourth year of medical school is a potential solution.

DISCUSSION: IS THE AMERICAN ASSOCIATION FOR ANATOMY FIDDLING WHILE GROSS ANATOMY BURNS?

GROSS ANATOMY IN MEDICAL EDUCATION



AMERICAN ASSOCIATION FOR ANATOMY