# For To integrate or not to integrate? A study of the educational efficacy of an integrated embryology and gross anatomy online resource for Dental students.

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Mastery in anatomical sciences is critical for medical professionals for competent practice and patient safety. However, widespread curricular changes focused on integration of subjects and clinical content resulted in minimal contact hours for anatomical sciences and increasing reliance on adjunct online resources. Despite the central role online resources play in anatomical sciences, most remain subject-specific with minimal integration of other disciplines; thus, the educational effect of integrated online resources is unclear.

To that end, two versions of a head and neck gross anatomy tutorial were created; although the gross anatomy content was identical, the experimental tutorial also integrated embryology of the head and neck. In a Colorado Multiple Institutional Review Board (COMIRB) exempt (#20-2175) randomized single blind study, the first (DS1) and second year (DS2) dental students enrolled in a gross anatomy course were recruited. The DS1s had never been exposed to the content of the tutorial while the DS2s learned the content in the prior year. All participants completed a pre-test. Then the participants were assigned to access either the control or the experimental tutorial before completing a post-test, comprised of a

different set of questions on the same topics, and a survey. DS1s also completed a retention test three weeks after completing the post-test. Seventy-one DS1s, and 71 DS2s completed the study.

Both cohorts scored statistically higher in the post-test compared to the pre-test (Tukey HSD, all p's < 0.001, partial $\eta^2$ = 0.03), suggesting learning occurred between the two tests. Interestingly, the post-test performance increase for DS1s was significantly higher than for DS2s (main cohort effect: $F_{(1,2)}$ = 4.88, p < 0.05, partial $\eta^2$ = 0.06, Tukey HSD, p < 0.05). A two-way repeated-measures ANOVA revealed a significantly higher retention test score compared to the pre-test scores for DS1 (Tukey HSD: p < 0.01, partial $\eta^2$ = 0.08). This demonstrated that DS1s retained the acquired knowledge from the videos three weeks after initial exposure. A two-way ANOVA found that there was no significant interaction between experimental conditions in pre-test to post-test score improvements (interaction: $F_{(2, 157)}$ = 2.79, p = 0.06), indicating that integrated content had neither deleterious nor beneficial effect on learning. Students ranked perceived value of the resource for learning 3.68$\pm$0.82 on a 5-point Likert scale. A two-way ANOVA of the Likert ratings revealed no difference across the experimental conditions in perceived value (main effect group: $F_{(1, 2)}$ = 0.22, p = 0.64). Thematic analysis of the survey comments were similar across the experimental conditions with positive aspects noted for the visual aids, content, and video format. Notably, the experimental group indicated a positive perception of integrated embryology content attributed to providing context for gross anatomy.

These findings suggest that a digital tutorial on head and neck anatomy leads to significant learning and short-term retention, regardless of integrated embryology content presentation. However, its inclusion can be contextually valuable.