Effects of Image-based and Text-based Activities on Student Learning Outcomes

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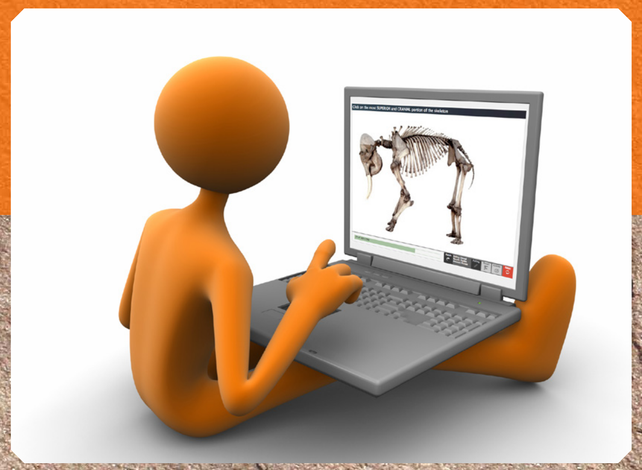

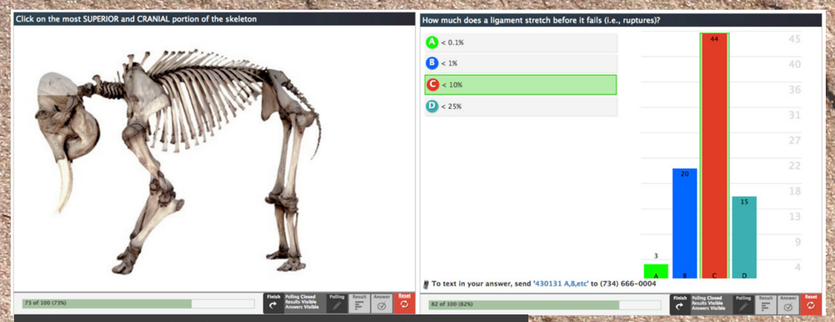

Figure 1: Example of image- and text-based activities

Abstract

Research on benefits of visual learning has relied primarily on lecture-based pedagogy, not accounting for the processing time students need to make sense of both visual and verbal material[1]. In this study, we investigate the potential differential effects of text-based and image-based student learning activities on student learning outcomes in a functional anatomy course. When controlling for demographics and prior GPA, participation in in-class image-based activities is significantly correlated with performance on associated exam questions, while text-based engagement is not. Additionally, students rated activities as helpful for seeing images of key ideas and as being significantly less mentally taxing than text-based activities.

Methods

The study analyzes data from a University of Michigan class, Human Musculoskeletal Anatomy, a sophomore-level course required for all students majoring in Movement Science.

Each class session consists of lecture segments punctuated with active learning activities in which students work independently or in pair-share dyads to answer interactive questions asked through LectureTools, interactive presentation software (Fig. 1 example of in-class activities). Both text-based and image-based activities are included in each class session.

Student participation on all learning activities is tracked using LectureTools analytics data. Student learning outcomes are assessed via exam question scores. Regression analyses are used to look for correlations between student scores on exams and student participation in learning activities.

Additionally, students were asked to participate in a end-of-semester survey, which asked them to reflect on how much "mental activity" (i.e., cognitive load) was required when participating in image- and text-based activities. Survey questions were modeled on the instrument for measuring cognitive load described by Lin & Atkinson[2]. Student response rate was 88%.

Table 1: Descriptive and Inferential Statistics for Model

					Estim.	SE	*p*-value
Intercept					34.6547	9.0839	0.0003
Image Participation	Min=7	Max=74	Mean=54.18	SD=15.47	0.7844	0.2927	0.009
Text participation	Min=2	Max=47	Mean=33.33	SD=10.68	0.2391	0.4090	0.56
URM status*	non-URM (coded 0): 80 (92%)		URM (coded 1): 7 (8%)		4.6957	7.0671	0.51
Gender	Female (coded 1): 63 (67%)		Male (coded 0): 31 (33%)		-13.7643	4.0102	0.0009
GPA	Min=0.00	Max=4.00	Mean=3.07	SD=0.92	4.6383	2.0907	0.03

R^2=0.418.
*Race/ethnicity data not available from 7 students.

References

[1] J. M. Tangen, M. D. Constable, E. Durrant, C. Teeter, B. R. Beston, and J. A. Kim. The role of interest and images in slideware presentations. *Computers and Education*, 56:856-872, 2001.

[2] L. Lin and R. K. Atkinson. Using animations and visual cueing to support learning of scientific concepts and processes. *Computer and Education*, 56: 650-658, 2011.

Findings

Nearly all students (95%) agreed or strongly agreed that LectureTools learning activities were helpful for "seeing images of key ideas in the course." Additionally, on a scale of 1 to 8, with one corresponding to "easy" and 8 corresponding to "demanding" mental activity, students rated image-based activities as 4.14 (SD=1.83) and text-based activities as 4.78 (SD=1.81), a statistically significant difference (p<0.0001). In the active learning setting, image-based activities give students more time to process information, thus reducing cognitive load and potentially increasing deeper learning.

Participation in both text-based (r=0.46) and image-based (r=0.47) in-class activities is correlated with exam performance questions (p<.0001). As displayed in Figure 2, students at the bottom quartile of exam performance tended to also be at the bottom for number of questions attempted and performance on them. Similarly, students receiving the top 25% exam grades tended to be at the top for performance and above the median for attempts. However, a linear regression suggests that controlling for incoming GPA, gender and Underrepresented Minority (URM) status, participation in image-based activities raises exam scores by a small amount (p<.01) while engagement with text-based activities does not at a statistically significant level (Table 1).

Holding all other variables constant, on average, women scored about 14 exam points lower than men. However, female students completed significantly more image-based activities than men (57 vs. 49, two-tailed t-test, p<.05), making their exam scores equal to those of the less participatory men.

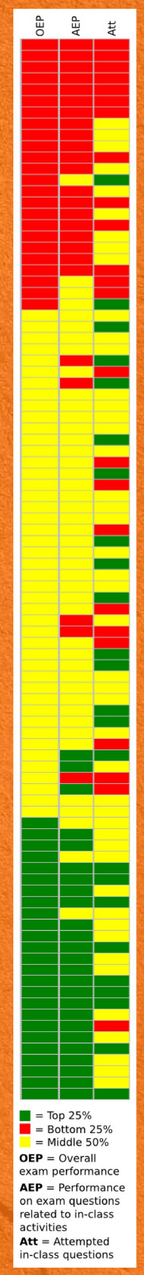

Figure 2: Exam performance and attempted in-class questions (each student is represented as a single row.)

Acknowledgements

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