

Introduction

Studying human anatomy involves many challenges, including the learning of unfamiliar anatomical terms. Many of these words are from Greek and Latin origin, which make the process of learning them even harder. This problem is of personal relation to the both of us, as studying anatomical terms in our first year of university was very difficult; especially while adapting to a new school environment and lecture teaching styles.

The approach for this research project is to see the ability of unconventional methods to increase the **recall** and **spelling** ability of first year students in anatomy courses. The ultimate goal for the project is to determine any correlation between the completion of these crossword puzzles (verified by an online assignment management system) and the students' success on a subsequent midterm exam, which will include some of those terms.

The results obtained from this can be a stepping point to expand to new forms of untraditional study methods, that will not only will be useful to study anatomical terms but can be used throughout multiple disciplines.

Methodology

Two different sections of the course were involved in this study: ANP1106A and ANP 1106C. Each section had different crosswords with different words. The crosswords were created as interactive web pages using Eclipse software¹ (Fig. 1) and made available to students via the assignment function of Brightspace.

Two pairs of crosswords of twenty words each were created that incorporated terminology and course content² pertaining to skin & bone tissue and bones & joints, respectively. On the midterm exam, thirty words were evaluated for recall and spelling as outlined in Table 1. Twenty-four of these words came from crosswords that were available to one or the other group of students and six words varied between exam versions and were not included in either crossword.

Spelling outcomes for the 24 puzzle words were evaluated on a scale of 0 (no idea) to 4 (completely correct). The outcomes were analyzed via T-test to determine if practice with crosswords improved recall and/or spelling.

Table 1	ANP1106A Puzzle	ANP1106C Puzzle
Skin & Bone Tissue	Alopecia	Lunula
	Canaliculi	Hypodermis
	Osteocalcin	Hirsutism
	Spinosum	Periosteum
	Diaphysis	Sebaceous
	Perichondrium	Papillary
Bones & Joints	Manubrium	Gomphosis
	Crista Galli	Pulposus
	Trochanter	Supination
	Dorsiflexion	Hallux
	Temporomandibular	Lambdoid
	Pterygoid	Synchondroses

Results

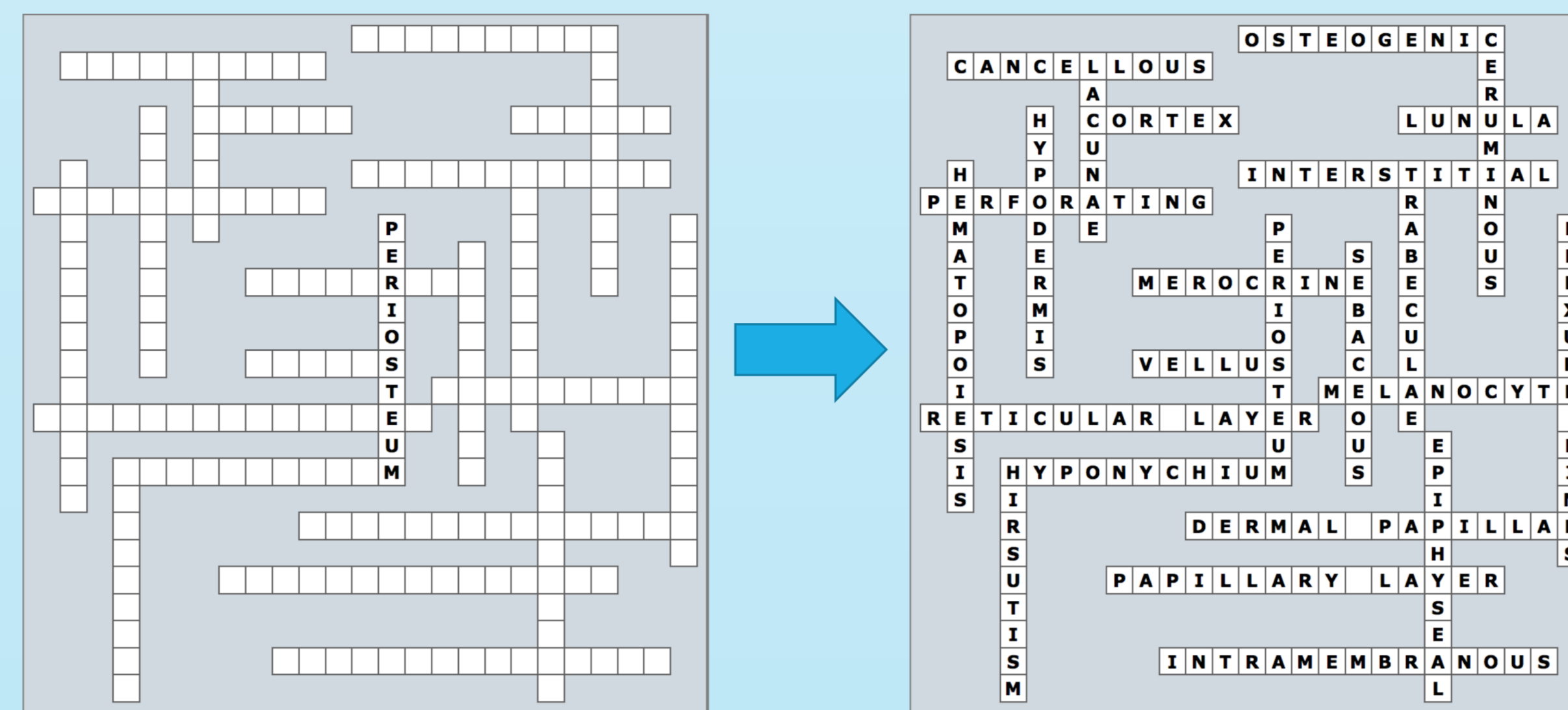


Figure 1 – Incomplete and complete crossword using Eclipse Crosswords.

Table 2 indicates the number of students that completed and submitted each crossword puzzle. Enrolment in ANP1106C was ~23% higher than in ANP1106A, although class sizes declined slightly for both sections during the first few weeks of classes. For statistical analysis, 100 students in each class were chosen randomly for evaluation of recall and spelling outcomes.

	ANP1106A	ANP1106C
Completed Puzzle 1	259	309
Completed Puzzle 2	239	279
Wrote Midterm 1 on time	232*	285*

Table 2 – Class statistics on crosswords accessed and writing the midterm (*Some students deferred their midterm exam and a small number of students dropped the course or switched sections).

Tables 3 and 4 shown on the right outline the recall and spelling outcomes for each crossword puzzle word on the midterm exam. For each class, words were grouped according to whether or not the students in that class practiced with those words in a crossword or did not.

Table 3 demonstrates an increase in spelling correctness for the 12 words that ANP1106A students had in their puzzles. 55.08% of students from ANP1106A spelled them correctly compared to only 42.83% ($p = 0.019$) of students in ANP1106C (did not have those words in their crosswords). It also demonstrates a improved recall, as only 26.00% of students from ANP1106A had no idea compared to 40.17% ($p = 0.007$) of students in ANP1106C.

Table 4 demonstrates no change spelling correctness or incorrectness with the second set of words that were included in the crossword puzzles for ANP1106C students but not those in ANP1106A ($p = 0.88$ for correctly spelled words and $p = 0.58$ for absence of recall). While these appeared to be words of similar difficulty, perhaps some were words with which students were familiar, even without crossword puzzle practice?

To explain these results, further tests were conducted. The first compared students who spelled words correctly across both classes. This revealed that there is no difference between the two classes, but at a close p value to the alpha of the test (p value = 0.14, $\alpha = 0.05$).

Collected Data

Word	In Crosswords (ANP106A)		Not In Crosswords (ANP1106C)	
	100% Correct	0% Correct	100% Correct	0% Correct
Alopecia	64	18	51	38
Canaliculi	46	28	35	37
Osteocalcin	46	38	27	66
Perichondrium	42	51	26	68
Spinosum	68	19	62	27
Diaphysis	75	17	72	22
Manubrium	54	28	53	36
Crista Galli	63	15	43	38
Trochanter	63	29	49	45
Dorsiflexion	58	15	36	31
Temporomandibular	32	21	25	24
Pterygoid	50	33	35	50
Mean ± SEM	55.08 ± 1.23	26.00 ± 1.09	42.83 ± 1.49	40.17 ± 1.49

Word	In Crosswords (ANP106C)		Not In Crosswords (ANP1106A)	
	100% Correct	0% Correct	100% Correct	0% Correct
Hypodermis	82	12	84	9
Lunula	51	10	41	11
Sebaceous	40	40	48	31
Pulposus	30	37	27	35
Gomphosis	36	42	36	39
Hirsutism	26	36	23	35
Hallux	60	26	56	19
Periosteum	61	27	63	22
Lambdoid	62	25	60	22
Papillary	71	23	67	22
Supination	48	46	47	40
Synchondroses	25	58	26	57
Mean ± SEM	49.33 ± 1.84	31.83 ± 1.40	48.17 ± 1.87	28.50 ± 1.37

Table 3 and 4 – Spelling outcomes for two sets of words for two classes taking ANP1106.

Conclusion

The results partially support our hypothesis and we conclude that there may be a correlation between doing the crossword puzzles and being correctly able to recall new terminology. According to the results, one of the tests shows a significant increase in the ability to write anatomical words after completing crossword puzzles. Further evaluation will involve a second midterm as well as the remaining students in each class to complete the data analysis. If successful, such an interactive way of teaching could be incorporated into other courses to help students learn in a different and effective way and make their learning path smoother and more interactive.

References

- Many thanks to our supervisor Dr. Jacqueline Carnegie (Department of Cellular and Molecular Medicine, Faculty of Medicine) for starting this project and guiding us through the process.
- ¹<http://www.eclipsecrossword.com>
- ²Marieb, E. N., & Hoehn, K. (2014). *Human anatomy & physiology*. Hoboken, NJ: Pearson Education, Inc.

Contact Info: Sam Touma (stoum030@uottawa.ca) and Armin Farhoudi (afarh084@uottawa.ca)