Learning Approaches in Gross Anatomy among Physical Therapy Students: A Comparative Study

DICK HERLY R. CARSKIT
ORCID No. 0000-0003-2581-0934
dickoypt06@yahoo.com
Liceo de Cagayan University
Cagayan de Oro City, Philippines

DENISE O. ORONG
ORCID No. 0000-0002-9938-394X
nonoyorong@gmail.com
Liceo de Cagayan University
Cagayan de Oro City, Philippines

ABSTRACT

Anatomy is a foundation subject in the health professions curriculum. Learning human anatomy is an integral component of physical therapy education and professional practice. The physical therapy curriculum in the Philippines requires dissection of the human cadaver as the primary mode of instruction during laboratory sessions. With the advancement of technology, human anatomical models, and video presentations are now readily available for the students to use. However, consensus regarding the best learning approach to anatomy remains obscure, and the prerogative of availing all these resources in anatomy will impact on the school as well as on the students. This study aimed to compare the learning approaches in gross anatomy among physical therapy students. It utilized a comparative experimental method among 40 third year physical therapy students. Four (4) sets of 50 points labeling items administered immediately after every session serve as their post-tests. It is concluded that physical therapy students can learn knowledge in gross anatomy regardless of learning approach employed. Using textbook approach for independent study is comparable to the use of alternative learning approaches such as using cadaver dissection, video presentation, and anatomical model when students learn gross anatomy. Gaining knowledge in gross anatomy will be enhanced when

textbook approach is combined with either video presentation or anatomical model approach. However, the use of human cadaver dissection does not compliment with textbook approach to enhance learning gross anatomy.

INTRODUCTION

Anatomy is a foundation subject in the health professions curriculum. Learning human anatomy is an integral component of physical therapy education and professional practice. Mastery of the anatomical structures allows a physical therapist to understand better concepts in biomechanics and to formulate rational examination and evaluation, a precise diagnosis, and effectively implement plan of care which are abilities that represent the hallmark of quality rehabilitative care. The physical therapy curriculum in the Philippines requires dissection of the human cadaver as the primary mode of instruction during laboratory sessions. With the advancement of technology, human anatomical models, and video presentations are now readily available for the students to use. However, consensus regarding the best learning approach to anatomy remains obscure, and the prerogative of availing all these resources in anatomy will impact the school as well as the students.

The mainstay of teaching anatomy is via cadaver dissection, but some concerns about dissection were raised. Berube (1999) noted that many schools prompted to develop alternative means of learning anatomy besides cadaver dissection because of the rising cost and availability of human cadavers. Maintenance of cadaver laboratory and high student ratios (Plack, 2000) are additional concerns. The health risks and negative health effects (Malamed, 1995; Baan, 2009, IARC, 2004, NCI, 2011) involved from spending extended periods of time over formalinized wet specimens is one of the major concerns of staff and students regarding dissection on cadavers. Lempp (2005) added that the increased length of time required for the study of anatomy through dissection and difficulties in acquisition of cadavers are practical problems associated with this traditional approach.

Other approaches toward teaching anatomy such as computer-based, three-dimensional, interactive models of human anatomy have evolved over the last decade with advances in computer technology and web-based education curricula (Florance, 2000). Computer-based anatomy education is advantageous especially using the three-dimensional illustrations that can provide essentially unlimited depictions of anatomical structures and beneficial for the study of anatomical areas for which

cadaveric dissection access is limited (Tan, 2012). Because of this, some faculty is proposing that substituting other teaching approaches for cadaveric dissection will suffice, and that dissection may no longer be necessary.

With these pressing issues, the researchers look forward in comparing various approaches to learning anatomy among physical therapy students.

OBJECTIVES OF THE STUDY

This study aimed to compare the learning approaches in gross anatomy among physical therapy students. Specifically, this study sought to 1) determine the post-test scores in anatomy among physical therapy students after undergoing the textbook and alternative (dissection, anatomical model, video presentation) learning approaches; 2) determine if there is a significant difference in the post-test scores of physical therapy students utilizing the textbook and alternative learning approaches in anatomy, and 3) determine which of the alternative approaches is significant to enhance the learning of anatomy when combined with textbook approach among physical therapy students.

Null Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

Ho1: There is no significant difference in the post-test scores of physical therapy students utilizing the textbook and alternative learning approaches in anatomy; and

Ho2: The alternative approaches are not significant to enhance the learning of anatomy when combined with textbook approach among physical therapy students.

MATERIALS AND METHODS

Materials

The materials needed were prepared and categorized according to the learning approaches employed in this study. In the textbook approach, clinical anatomy textbooks and laboratory guides were used by each of the students. During dissection, they utilized human cadaver, dissecting set, pairs of gloves and masks per session, and laboratory guides for a group of students. Those who were exposed to the anatomical model are provided with complete plastic-rubber detachable human anatomical model and laboratory guides. Acland Anatomy video, laptop computer,

LCD projector, and laboratory guides were used by those students who were exposed to the video presentation learning approach.

Method

This research utilized a comparative experimental method to compare the learning approaches in gross anatomy among physical therapy students.

The study was conducted in the Physical Therapy Department of the College of Rehabilitation Sciences of Liceo de Cagayan University. The dissection of the human cadaver and the study of the human anatomical models were done in the anatomy laboratory; video presentation was conducted in the Anatomy cubicle; and reference book reading/studying was held at the therapeutic exercise lecture room.

The subjects of this study were the third year physical therapy students who enrolled in gross anatomy 2 subject during the second semester of the academic year 2015-2016. Their grades in gross anatomy 1 during the first semester were ranked from highest to lowest and systematic random sampling was used in assigning the subjects into four groups (Groups A, B, C, and D) having ten students each. Each group was randomly assigned to a specific learning approach on a given topic each learning session. After four (4) trials, all groups were able to experience the learning approaches although at different topic and session.

This study utilized four (4) sets of 50 points labeling items administered immediately after every session and serve as their post-tests. Students were provided with session guide to ensure uniformity of the learning objectives and expected learning outcomes.

During anatomy session, each group was given a session guide for the specific learning activity. Groups who were assigned for cadaver dissection and human anatomical model study proceeded to the anatomy laboratory. The group who was assigned to study through Acland's video presentation went to the Anatomy cubicle. The group who was assigned to do textbook study stayed in the therapeutic exercise lecture room. For the purpose of this study, each learning session covered 1.5 to 2 hours depending on the assigned topic. After the learning sessions, post-tests which were composed of 50-item labeling exam were administered to all respondents within 30-45 minutes and were checked immediately to determine their scores.

There were four (4) trials during the entire course of data collection. Each trial composed of one learning session and a corresponding post-test which covered the anatomical structures of the head, neck, pelvis, and the back regions.

To determine the post-test scores in anatomy after undergoing the textbook and alternative (dissection, anatomical model, video presentation) learning approaches, the computation of their mean scores was employed. T-test was utilized to determine

if there was a significant difference in the post-test scores between textbook and alternative learning approaches in anatomy course. Regression analysis was done to determine which of the alternative approaches was significant to enhance the learning of anatomy when combined with the textbook approach.

RESULTS AND DISCUSSION

Table 1. Mean Results of Post-Tests for Textbook and Alternative Learning Approaches in Anatomy

Topics	Learning Approaches			
	Textbook	Alternative		
		Dissection	Video	Model
Pelvis	57.0	46.0	40.0	50.0
Back	65.4	51.2	58.0	64.0
Head	74.8	69.3	60.9	76.5
Neck	34.8	40.4	44.2	41.4
Mean Scores	**58.0**	**51.7**	**50.8**	**57.9**

Table 1 presents the results of post-tests for textbook and alternative learning approaches in anatomy among physical therapy students. Noted that independent study of students using anatomy textbook have the highest scores in pelvic and back region topics with mean scores of 57.0% and 65.4%, respectively, as compared to other learning approaches but they got the lowest mean score of 34.8% in the neck region topic. Students who utilized the textbook approach scored higher in the pelvic and back region topics. They stated that the textbook provided them a comprehensive and detailed presentation which they felt addressed the learning outcomes of the session. However, it did not give them a better presentation when they studied the neck region topic which resulted to low scores in their post-test. Those students who utilized the model approach in studying the head region got the highest mean score of 76.5%. The anatomical model can be disassembled, and reassembled which lead to better appreciation of the knowledge content in learning anatomy and this ability is almost exclusive only to model approach. In the case of the neck region learning area, students who used the video presentation approach got the highest mean score of 44.2%. However, they scored the lowest mean of 40.0% in the pelvic region topic. Video presentation in the neck region topic provided a 3-dimensional view and intelligently informative voice-over which contributed to higher mean scores in this particular topic during the post-test as stated by the students who utilized this approach. However, it did not provide much knowledge needed in the pelvic region

topic. The researchers believed that in the video presentation approach, the manner of presentation and amount of information was somewhat limited and tend to deal with generalities rather than specifics.

As to the overall mean, independent study using the textbook and model approaches have mean scores of about 58% while video presentation and cadaver dissection approaches have closer mean scores of about 51% and 52%, respectively. The students learned better in the model approach because it allowed manipulation with a texture and consistency that is conducive to learning. Valdecasas *et al.* (2009) enumerated several reasons why models are useful. First, it provides the impression of the real object because it offers a high degree of similarity to the original in terms of shape, size, and color. Topological and spatial relationships are possible because it allows dynamic disassembly, relocation, and repositioning of various tissues and organs. Rizzolo and Stewart (2006) remarked that simulated dissection (use of model in this study) benefits the development of spatial reasoning skills needed to understand images, drawings, and computer simulations of anatomical materials. This supports the result of this study wherein those that utilized the model approach scored higher than those that utilized the video presentation and cadaver dissection approaches. However, the scores of students using the textbook and model approaches were almost the same for the reasons that textbooks were easy to use, aligned with the course syllabus, and contain excellent graphics. Active engagement of the student in self-directed study can enhance the knowledge and understanding of anatomy (Choi-Lundberg *et al.*, 2016). The dissection and video presentation approaches significantly scored lower than the abovementioned learning approaches in anatomy. The effectiveness in learning gross anatomy between traditional teaching methods (chalk and board lectures with cadaver dissection) versus modern integrated teaching method (power point lectures, computer-based dissection visuals, and cadaver dissection) was evaluated by Kumar *et al.* (2013) and found out that those students taught under the modern integrated teaching method significantly scored higher than those taught under the traditional teaching methods ($p < 0.05$) and that the difference in the averages between the two groups was also significant ($Z > 1.96$). The researchers observed in this current study that during cadaver dissection approach, students spent more time in dissecting the cadaver rather than achieving the expected learning outcomes and gaining knowledge in each learning session. This resulted to low mean scores obtained in the post-test.

Table 2 shows the performance of physical therapy students using the textbook and alternative learning approaches in Anatomy. Between textbook and dissection approaches, the difference is 6.15, it has a T-calculated value of 1.40, a P-value of

0.164, and interpreted as not significant since the critical value is more than the calculated value. Between textbook and video presentation approaches, the difference is 7.60, it has a T-calculated value of 1.85, a P-value of 0.068, and interpreted as not significant since the critical value is more than the calculated value. Between textbook and model approaches, the difference is -0.58, it has a T-calculated value of -0.13, a P-value of 0.899, and interpreted as not significant since the critical value is more than the calculated value. Between textbook and combined alternative learning approaches, the difference is 4.39, it has a T-calculated value of 1.14, a P-value of 0.258, and interpreted as not significant since the critical value is more than the calculated value.

Table 2. T-Test Results of the Post-Tests Mean Scores of Physical Therapy Students between Textbookand Alternative Learning Approaches in Anatomy

Learning Approaches		Mean	T-Test Result
Textbook		57.30	T- Calculated Value = 1.40
Dissection		51.20	DF= 77
	Difference	6.15	P-Value=0.164
			Decision: Critical value > Calculated value
			Interpretation: **Not Significant**
Textbook		57.30	T- Calculated Value = 1.85
Video presentation		49.70	DF= 73
	Difference	7.60	P-Value=0.068
			Decision: Critical value > Calculated value
			Interpretation: **Not Significant**
Textbook		57.30	T- Calculated Value = -0.13
Model		57.90	DF= 77
	Difference	-0.58	P-Value=0.899
			Decision: Critical value > Calculated value
			Interpretation: **Not Significant**
Textbook		57.30	T- Calculated Value = 1.14
Combined Dissection, Video presentation, and Model		52.90	DF= 65
			P-Value=0.258
	Difference	4.39	Decision: Critical value > Calculated value
			Interpretation: **Not Significant**

Since all the t-test results were interpreted as not significant, this means that textbook approach and alternative learning approaches do not differ significantly in terms of gaining knowledge in anatomy, therefore, using textbook approach is as effective as the alternative learning approaches. Textbook approach ensures that students will actively engage in self-directed study to enhance their knowledge and understanding of anatomy (Choi-Lundberg *et al.*, 2016). In the study of Plack (2000), it was found out that the use of computer- assisted instruction is as effective as traditional dissection in teaching human gross anatomy to first-year entry-level physical therapy students, and there was no significant difference between groups

on subject knowledge gained in human gross anatomy. Regardless of whether textbook approach or alternative learning approach will be employed, the student will gain knowledge in anatomy. Such it would help guide faculty in selecting and recommending a range of learning resources to the students to support their self-directed study (Choi-Lundberg *et al.*, 2016) and achieve the expected learning outcomes resulting to high scores in the post-tests.

Table 3. Results of Regression Analysis between Textbook and
Alternative Learning Approaches in Anatomy

Alternative Approaches	Coefficient	SE Coefficient	T-Value	P-Value	Interpretation
Dissection	0.3049	0.1610	1.89	0.066	Not Significant
Video presentation	0.7916	0.1523	5.20	0.000	Significant
Model	-0.3824	0.1467	-2.61	0.013	Significant
S= 14.18	R-Sq= 56.4%			R-Sq(adj)= 52.7%	
F= 15.21	P-Value= 0.000 Interpretation: Significant				

Table 3 shows the regression analysis of using textbook approach versus the alternative learning approaches in anatomy.

The dissection approach has a coefficient value of 0.3049, SE Coefficient value of 0.1610, a T-value of 1.89, a P-value of 0.066, and interpreted as not significant. The dissection approach is less likely to predict that it will enhance learning anatomy among physical therapy students when combined with the textbook approach. Davies *et al.* (2014) in their study emphasizing the importance of collecting student preferences to optimize teaching methods used in the undergraduate anatomy curriculum found out that all students were strongly in favor of access to cadaveric specimens and that other teaching methods (e-learning, anatomical models and surgical videos) were considered educational tools. However, in this study, it was found out among physical therapy students that cadaver dissection is less likely to enhance learning anatomy when combined with the textbook approach.

The video presentation approach has a coefficient value of 0.7916, SE Coefficient value of 0.1523, a T-value of 5.20, a P-value of 0.000, and interpreted as significant. When combined with the textbook approach, the video presentation is likely to predict that it will enhance learning anatomy among physical therapy students. Video presentation approach presents material in a creative and simplified manner and poses several advantages over other learning approaches like students can slow, stop, reverse, and replay the video. The interactive environment provides immediate feedback, allows for repetition at will, and puts the student in control of the direction and pace of learning (Kesner *et al.*, 2005).

The model approach has a coefficient value of -0.3824, SE Coefficient value of 0.1467, a T-value of -2.61, a P-value of 0.013, and interpreted as significant. The model approach when combined with the textbook approach is likely to predict that it will enhance learning anatomy among physical therapy students. The hands-on approach, disassembly, and reassembly of the parts of complex systems of the anatomical models is far superior to the simple passive observation that rigid, single-piece models (or cadaver) allow and is a crucial tool for learning anatomy (Valdecasas *et al.*, 2009).

Overall, S=14.18, R-Sq= 56.4%, R-Sq (adj)= 52.7%, F=15.21, P-value=0.000, and interpreted as significant. The alternative learning approaches are likely to enhance the learning in anatomy among physical therapy students when combined with the textbook approach except for the dissection approach. Gabard *et al.* (2012) concluded in their study that evidence supports a trend of decreasing time on cadaver dissection and increasing time on technology-based instructional methods although it is still the most common instructional technique in anatomy among medical and physical therapy schools.

CONCLUSIONS

This study concluded that physical therapy students can learn knowledge in gross anatomy regardless of learning approach employed. Using textbook approach for independent study is comparable to the use of alternative learning approaches such as using cadaver dissection, video presentation, and anatomical model when students learn gross anatomy. Gaining knowledge in gross anatomy will be enhanced when the textbook approach is in combination with either video presentation or anatomical model approach. However, the use of human cadaver dissection does not compliment with the textbook approach to enhance learning gross anatomy.

RECOMMENDATIONS

In the light of the finding and conclusion of the study, the following are recommended:

1. Instructional facilities such as viewing room and well-ventilated study area must be provided to the physical therapy students for them to view anatomical video presentations and independent study.

2. Acquire state-of-the-art human anatomical models and latest human anatomy videos to enhance the textbook-based knowledge of physical therapy students.

3. There is a need to review and align the physical therapy program outcomes

with the teaching-learning approaches and laboratory resources needed in learning gross anatomy.

4. Further studies involving technology-based instructional methods in anatomy should be conducted to determine the best instructional method suited for the new generation learners.

5. For future researchers, compare the use of prosected versus dissected human cadaver in learning gross anatomy.

LITERATURE CITED

Baan, R., Grosse, Y., Straif, K. (2009). Special report: Policy: A review of human carcinogens-Part F: Chemical agents and related occupations. Lancet Oncology. 2009;10(12):1143–1144.

Berube, D., Murray, C., Schultze, K., & Cadaver (1999). Computer use in the teaching of gross anatomy in physical therapy education Journal of Physical Therapy Education; Fall 1999; 13, 2; ProQuest

Bukowski, E.L. (2002). Assessment outcomes: Computerized instruction in a human gross anatomy course. Journal of Allied Health (Fall 2002)

Choi-Lundberg, D.L., Low, T.F., Patman, P., Turner, P., Sinha, & Sankar N. (2016). Medical student preferences for self-directed study resources in gross anatomy. Anatomical Sciences Education 9.2: 150-160.

Davis, C.R., Bates, A.S., Ellis, H., & Roberts, A.M. (2014). Human Anatomy: Let the students tell us how to teach. Anatomical Sciences Education 7.4: 262-272.

Florance, V. (2010). Better Health in 2010: a report by the AAMC's better health 2010 Advisory Board. Association of American Medical Colleges (Available at:www.aamc.org/betterhealth/)

Gabard, D.L., Lowe, D.L., & Chang, J.W. (2012). Current and future instructional methods and influencing factors in anatomy instruction in physical therapy and medical schools in the U.S. Journal of Allied Health 41.2: 53-62.

Granmo, M. & Bengtsson, F. (2015). Teaching anatomy in the multimedia world-using digital tools for progressive learning over time. Creative Education 6.11:1193 -1200.

Haase, P. (2000). The challenges of teaching an old subject in a new world--a personal perspective/discussion. Clinical and Investigative Medicine 23.1

International Agency for Research on Cancer (2005). Press release 153. IARC classifies formaldehyde as carcinogenic to humans. June 15, 2004. Available at: http://www.iarc.fr/ENG/Press_Releases/pr153a. html.

Johnston, A.N.B., Massa, H., & Burne, T.H.J. (2013). Digital lecture recording: A cautionary tale. Nurse Education in Practice 13.1:40-7.

Kesner, M.H. & Linzey, A.V. (2005). Can computer-based visual-spatial aids lead to increased student performance in Anatomy & Physiology. The American Biology Teacher: 206-207, 209-212.

Lempp, H.K. (2005). Perceptions of dissection by students in one medical school: beyond learning about anatomy. A qualitative study. Med Educ 2005: 39 (3):318-325.

Malamed, S. & Seiden, D. (1995). The future of gross anatomy teaching.Clinical Anatomy. 8: 294–296.

McKenzie, A.L. & Gutierrez, B. (2007). The Varied-Integrative-Progressive (VIP) model for anatomy instruction in physical therapist education. Journal of Physical Therapy Education 21.2): 17-29.

National Cancer Institute Fact sheet (2011). Available at www.cancer.gov/cancertopics/ factsheet/Risk/formadehyde. Accessed

Ogard, W.K. (2014). Outcomes related to a multimodal human anatomy course with decreased cadaver dissection in a doctor of physical therapy curriculum. Journal of Physical Therapy Education 28.3: 21-26.

Pathak, S.K. & Bliss, J.P. (2000). The effectiveness of human anatomy instruction as a function of media style. Proceedings of the Human Factors and Ergonomics Society Annual Meeting 2:94.

Plack, M.M. (2000). Computer-assisted instruction versus traditional instruction in teaching human gross anatomyJournal of Physical Therapy Education; Spring 2000; 14, 1; ProQuest

Tan, S., Hu, A., Wilson, T.H., Ladak, H., Haase, P., & Fung, K. (2012). Role of a computer -generated three-dimensional laryngeal model in anatomy teaching for advanced learners. The Journal of Laryngology & Otology (2012), 126, 395–401. MAIN

Udaya Kumar, P. & Seema, M. (2013). Teaching methodology of anatomy: Towards a modern outlook. IJCRR.

Valdecasas, A.G., Correas, A.M., Guerrero, C.R. & Juez, J. (2009). Understanding complex systems: lessons from Auzoux's and von Hagens's anatomical models; J. Biosci. 34 835–843] DOI 10.1007/s12038-009-0097-0