The Impact of Content Reinforcement on Anatomical Knowledge Retention of Cardiovascular and Lymphatic Systems in Nursing Students

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Introduction

- Despite anatomy and physiology being foundational courses in medical, allied-health and nursing programs, there is growing concern that students are not retaining the essential bioscience knowledge in these courses over time (McVicar et al., 2015).
- Numerous studies have highlighted the concerns regarding student's ability to acquire anatomical knowledge in the first year and successfully transfer, retain, and apply it throughout their program (Narnaware and Neumeier, 2020; Narnaware, Y. 2021).
- There have been several vigorous interventional strategies that have been implemented in medicine and allied health disciplines to overcome the gap between first-year theory to senior years of theory and clinical (Manyama et al., 2016).
- However, despite these available interventions, they are lacking in nursing education. We have previously shown that nursing students lose anatomical knowledge by approximately 30.0% over three years (Narnaware, Y. 2022).

Purpose of the Study

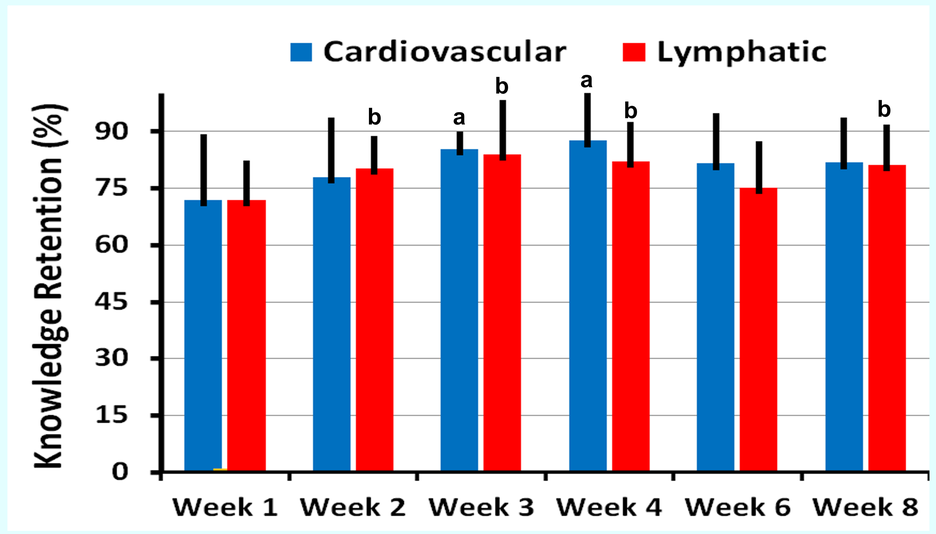
- To improve the acquisition and retention of anatomical knowledge, the present study aims to evaluate an interventional strategy that includes the content reinforcement (repeated knowledge testing) of the cardiovascular and lymphatic systems over eight weeks that will help improve knowledge retention.

Methods

- The present study was conducted in the semester of Fall 2022 with two different classrooms of 80 anatomy students each. Quizzes were created using an online quizzing platform called Kahoot (Kahoot Inc., Oslo, Norway) to assess content reinforcement of the cardiovascular and lymphatic systems over eight weeks.
- The students were encouraged not to prepare for Kahoot quizzes in advance to obtain the most accurate results.
- Between seven and nine multiple-choice questions reflecting first-year anatomical knowledge of these organ systems were incorporated into 6 Kahoots per organ system over eight weeks, and new sets of questions were used for each week's Kahoot quiz.
- Data was statistically analyzed using SPSS II, and means were compared using 2-sample t-tests.
- The scores are described as the mean and standard deviation (SD) and are presented in table 1 and figure 1.
- Statistical significance was set at $P \leq 0.05$ for all tests.

Results

- Compared to week 1, repeating knowledge of the cardiovascular system yielded a slight increase in knowledge retention in week 2 (+8.5%) and a significant increase in week 4 (+22.5%) with a sufficient increase in week 8 (+14.0%).
- Additionally, retention was significantly high at week 3 (+19.7%) and slightly increased at week 6 (+14.1%) compared to week 1 (Table 1 and Fig.1).
- In comparison to the cardiovascular system, repeating anatomical knowledge of the lymphatic system over eight weeks resulted in a significant increase in knowledge retention at week 3 (+16.8%) and week 4 (+14.4%), with week 6 being the least significant increase (+4.6%) compared to week 1.
- Comparably, anatomical knowledge increased sufficiently at week 2 (+11.7%) and week 8 (+13.4%) compared to week 1. (Table 1 and Fig.1).



Impact of content reinforcement on knowledge retention of the cardiovascular and lymphatic systems over eight weeks in nursing students.
a , b compared to week 1; P<0.001, P<0.05.

Table 1. Percent Change in Knowledge Retention of the Cardiovascular and Lymphatic Systems Over Eight Weeks in Nursing Students

Organ System	Percent (%) Change in Knowledge Retention					
	Week 1	Week 2	Week 3	Week 4	Week 6	Week 8
Cardiovascular System	100	108.5	119.7**	122.5**	114.1	114.0
Lymphatic System	100	111.7*	116.8*	114.4*	104.6	113.4*

Data shown as means ± (standard deviation. Percentage change in knowledge retention over eight (8) weeks compared to week 1. *P<0.05, ** P<0.01).

Discussion & Conclusion

- The higher retention in weeks 3 and 4 for the cardiovascular system and weeks 3 and 4 for the lymphatic system may be, in part due, that students were studying these organ systems for upcoming midterm exams.
- The decrease in knowledge retention compared to weeks 3 and 4 for both systems may be attributed to the fact that students focused on the next organ systems and discontinued their review of the cardiovascular and lymphatic systems.
- Despite fluctuations in the knowledge retention of the two organ systems, the study results show that nursing students consistently retained knowledge of the cardiovascular and lymphatic systems over 8 weeks.
- The cardiovascular system had slightly better retention than the lymphatic system after repeated knowledge assessment over the 8-week period.
- No comparable data on content reinforcement of these systems are available in allied health and nursing students.
- The results of this study are consistent with those of medical students (Anderson et al., 2016) and nursing students in the cardiovascular physiology content reinforcement study reported earlier (Narnaware, Y. 2022).
- Therefore, content reinforcement should be used as one of the interventional strategies to improve knowledge retention in nursing students, and further research should be conducted to evaluate effective ways to maintain increased retention over more extended periods.

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References

- Manyama M, Stafford R, Mazyala E, Lukanima A, Magele N, Kidenya BR, Kimwaga E, Mayer RE. 2016. Applying the science of learning to medical education. Medical Education, 44:543–549.
- Narnaware, Y., & Neumeier, M. (2020). Second-year nursing students' retention of gross anatomical knowledge. Anatomical Sciences Education,13, 230-236.
- Narnaware, Y. (2021). Never Heard That Before! Bioscience Knowledge Retention in Undergraduate Nursing Education-Current Topics. Human Anatomy and Physiology Society Educator, HAPS Educator Journal, 25 (2), 77-83.
- Narnaware, Y. (2022). Gross anatomical knowledge loss in fourth-year nursing students. The Federation of American Societies for Experimental Biology Journal (FASEB J), 36 (S1), P.32.
- Young JQ, van Dijk SM, O'Sullivan PS, Custers EJ, Irby DM, Ten Cate O. 2016. Influence of learner knowledge and case complexity on handover accuracy and cognitive load: Results from a simulation study. Medical Education, 50: 969–978.