How much do they remember? Anatomical knowledge retention in nursing education- A four-year longitudinal study

Raj Narnaware[1] and Sushma Manwatkar[2]

1. Department of Nursing Foundation & Science, Faculty of Nursing, MacEwan University, Edmonton, Alberta, CANADA T5J 4S2
2. VSPM College of Nursing, Katol, Maharashtra State-441302, INDIA

Introduction

- The human anatomy is regarded as a cornerstone of health care disciplines and is a pre-requisite for subsequent years of medical, allied health and nursing theory courses and clinical (Young et al., 2016). Numerous studies have expressed concern over students' ability to acquire anatomical knowledge in the first year and successfully transfer, retain, and apply it throughout their program (Doomernik et al., 2017; Narnaware and Neumeier, 2020).
- Most of the knowledge transfer, loss and/or retention studies have been carried out in medical and allied health disciplines, and this has been assessed only in second-year nursing students (Narnaware & Neumeier, 2020).
- This study seeks to determine the overall and system specific anatomy knowledge retention by nursing students over a Bachelor of Science in Nursing (BScN) program at MacEwan University.

Methods

- This study was conducted from the Fall 2018 - 2022 semesters with classes of 33-80 students. Quizzes were created using an online quizzing platform called Kahoot (Kahoot Inc., Oslo, Norway) to assess knowledge retention. The quizzes were not used for marks, and students were encouraged not to study for them in advance.
- Approximately nine to eleven multiple-choice questions reflecting first-year anatomy knowledge from eleven major organ systems were developed into eleven Kahoots.
- Quizzes were given each year over the course of a 13- weeks semester, with quizzes being done once per week in weeks 2-12.
- The pooled data from the first-year anatomy course and the second-, third- and fourth-years were subjected to statistical evaluation using SPSS II (IBM Corp; Armonk, NY) to determine overall knowledge loss over a four year assessment period. Means were compared using 2-sample 't' tests. Significant differences were considered at $P<0.05$.

Results

- The mean score for all organ systems in year one was 83.04 ± 7.95 (SD), which was significantly ($P<0.001$) decreased to 54.36 ± 12.5 (SD) by the second-year, 51.57 ± 12.9 (SD)($P<0.001$) by the third year and 53.13 ± 9.4 (SD) ($P<0.001$) by the fourth year (Figure 1).
- This means the overall percent (%) knowledge loss in the second year was 33.5%, 31.8% in the third and 29.6% in the fourth year (Figure 2).
- Knowledge retention was highest for the gastrointestinal system (89.7%). The lowest retention for the head and lymphatic system was a 57.4% loss. Most systems maintained similar levels of retention over time.
- The loss was lowest (17.3% - 20.0% approx.) for special senses for the second and third year and highest (37.0%) for the fourth year. An opposite was reported for the vascular system (30-40% approx.). Whereas the loss was highest for the second (30.7%) and third (40.3%) years and lowest in the fourth (26.6%) year for musculoskeletal (Table 1).

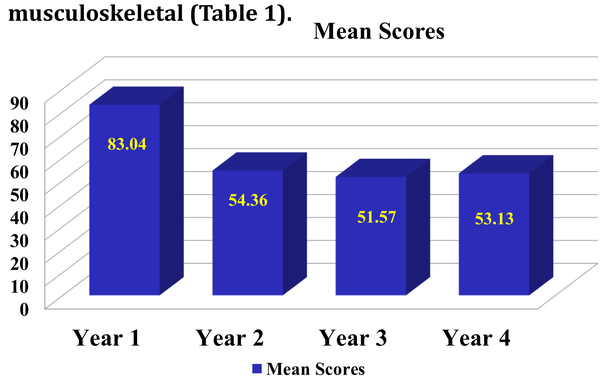

Figure 1. Retention by Organ System

Anatomical Knowledge Retention by System Over Time				
Organ System	Year 1	Year 2	Year 3	Year 4
	Mean Score ± SD	% Knowledge Loss		
Integumentary System	90.6 ± 6.8	19.9%	23.9%	28.2%
Head & Neck Lymphatic	91.4 ± 11.7	57.4%	57.6%	55.7%
Special Senses	88.4 ± 6.9	20.6%	17.3%	37.0%
Gastrointestinal	63.6 ± 6.9	10.3%	12.6%	12.0%
Respiratory System	72.9 ± 5.8	11.0%	14.0%	13.9%
Vascular System	83.5 ± 5.4	46.1%	49.0%	27.6%
Nervous System	83.9 ± 8.1	25.1%	25.1%	25.1%
Cranial Nerves	88.2 ± 4.4	41.2%	42.6%	44.1%
Musculo-skeletal System	88.0 ± 7.0	30.7%	40.3%	26.6%
Lymphatic System	82.6 ± 2.8	35.7%	37.6%	37.6%
Genitourinary System	80.4 ± 16.4	16.4%	21.2%	21.2%

Results continue..

Figure 1. The Summary of Overall Retention

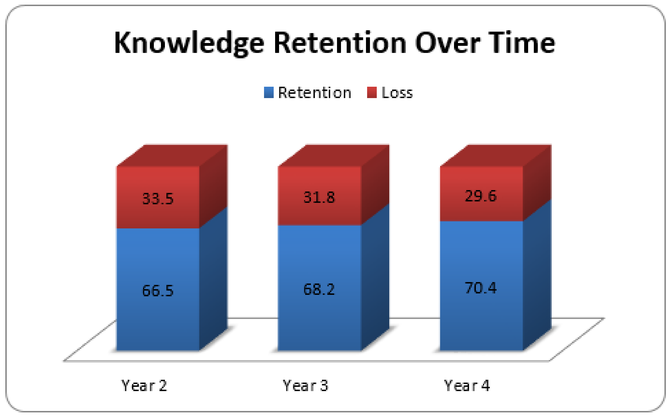

Table 1. Fluctuating Knowledge Loss

Organ System	Year 2	Year 3	Year 4
Special senses	20.6%	17.3%	37%
Vascular	46.1%	49%	27.6%
Musculoskeletal	30.7%	40.3%	26.6%

Discussion

- The present study demonstrates that anatomical knowledge retention was organ and time-specific.
- Interestingly, this study does not follow the expected decline in knowledge retention to negative forgetting curve described by Ebbinghaus (1913) or loss of knowledge by 30% in the first year or 50% after two or more years (Custers, 2010; Kooloos et al., 2020).
- The differences in knowledge retention over a time and organ system may be influenced by a course - related factor such as class time and teaching hours.
- It may be also influenced by the institutional factors like course management, method of delivery, instructors ' self- efficacy and teaching style and teaching experience.
- Whereas, student factors like attendance, course organization, individual learning style, application and self-efficacy (Bashar et al., 2023).

Conclusion

- The present study has identified significant differences in knowledge retention in specific systems over three-year intervals among BScN nursing students.
- Identifying knowledge gaps where anatomical knowledge is lost and gained is valuable to instructors to target these specific areas with more effective and focused interventional strategies.
- This will help prepare practitioners and educators, and future studies can be conducted using this baseline data to evaluate the effectiveness of new classroom techniques as they can be implemented.
- While the results of the present study are specific to the BScN program, it can be replicated in any institution to gather program-specific data to inform curriculum design or changes.

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