Long-term retention of material taught and examined in chiropractic curricula: its relevance to education and clinical practice

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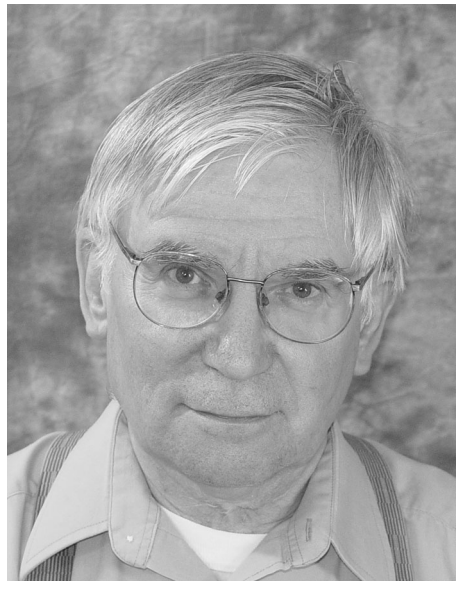

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Introduction

Although studies[1–4] have been published analyzing knowledge retention in other fields of study, a literature search failed to yield any published research on this topic in the field of chiropractic education. Due to the large volume of material presented in curricula at chiropractic colleges, there is concern that the information taught is not sufficiently retained in future years of study or in clinical practice. Testing this assertion would require a quantitative assessment of information retention after certain retention intervals. To our knowledge, the degree to which material is retained throughout subsequent years of study has not recently been directly assessed at the Canadian Memorial Chiropractic College (CMCC).

Studies[4–13] have investigated and defined several variables which affect long-term knowledge retention, including differences in teaching style and examination format. As teaching institutions have a vested interest in incorporating the most effective methods in their curricula, we anticipate that the comments made in this article could potentially assist educational planners at chiropractic colleges to assess and address the degree of student learning.

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Discussion

For the purposes of this discussion, a "retention interval" is defined as the time that elapses between a test of original learning and a retention test. "Knowledge retention" is defined as the proportion of knowledge retained by an individual after a specific retention interval. Previous research [1] has proposed three main principles pertaining to knowledge retention in general.

Firstly, knowledge retention generally falls to 75–89% of its original level after a relatively short period of time. Sisson et al.[2] suggest that if a score of 70% is deemed a passing grade which indicates minimal "competence" in the material being tested, 45–60% of students become "unqualified" after three months. Secondly, retention rates decrease over time as a function of the length of the retention interval in a relatively linear manner. The results of several studies[1,3,4] demonstrate this in various fields (e.g., medicine, other university programs), finding retention rates of 85% after four months, 80% after 11 months, and 75% after 24 months. To our knowledge, at present no comparable statistics have been reported in the literature for chiropractic students. Thirdly, although students who perform best on the original examination also tend to score better on subsequent retention examinations, there is generally no difference in differential retention rates between good and relatively inferior performers. This suggests that all performers, regardless of their individual levels of achievement on the original examination, have similar knowledge retention rates.

Previous research has already investigated and defined several variables which affect long-term knowledge retention in various fields of study. According to Semb and Ellis,[1] these include the type and content of the task to be learned, the amount of original learning, the instructional strategies used, the examination strategies used, the length of the retention interval, and subject individuality. From these, several contentions have been made in the literature regarding the relative effectiveness of various instructional and examination strategies.

Instructional Strategies

a) Class Format

Three studies comparing the effect different class formats have on retention rates demonstrate conflicting results. Silverberg et al.[5] examined differences between lecture-based and small group-based teaching methods in a continuing medical education course. Their results demonstrated that, although both groups had a significant decline on a three-month follow-up exam, the group who attended lecture classes performed better than the group who attended small group classes. In another study, Kolars et al.[6] separated second-year gastrointestinal medical students into two groups: one group which attended "teacher-centred" lecture-based classes, and another which attended "student-centred" small group-based classes. They concluded that small group-based classes lead to greater learning and retention compared to lecture-based classes. Finally, a study by Harrison[7] testing medical students compared knowledge retention after a one year interval between groups assigned to attend either lectures or self-study classes. On both the original final examination and the retention examination, there were no statistically significant differences between the two groups' performance.

b) Note-Taking

A study by Hadwin et al.[8] examined the effects "working memory" (i.e., the ability to focus on more than one task at a time) has on knowledge retention. In this study, first-year university students were subdivided into two groups: one group which were deemed to have a "low" working memory, and another which were deemed to have a "high" working memory. Both groups were again subdivided into groups which either took their own notes in class or simply listened to the lecture and received a set of notes provided by the instructor. The groups' performances demonstrated that whilst there was no difference between the two instructional methods in students with a "low" working memory, the group of students with a "high" working memory who listened (without taking notes) to the lecture performed significantly better than those who took their own notes. This study not only provides insight into the individuality of students and how individual memory and learning styles can potentially affect performance, but also suggests that in courses where courseware is utilized, those students with "high" working memories stand to benefit greatly.

c) Studying Style

Two studies comparing the effect different studying styles have on retention rates demonstrate interesting re-

sults. Hultgren and Crewe[9] separated their subjects into groups who either "crammed" for their examinations (i.e., only studied immediately prior to the examinations) or reviewed the course material periodically throughout the term. Whilst the results demonstrated that the students who "crammed" scored better on the final examination than those who reviewed periodically, knowledge retention was not examined. Onion and Slade[10] separated their subjects into groups who either studied using "superficial processing" or "deep processing". The results demonstrated that the students in the "deep processing" group performed better on the retention examination than those in the "superficial processing" group. This suggests that the type of information processing used whilst studying is important when learning new material if one is to retain the knowledge.

Examination Strategies

a) Repeating Taught Material and Increasing the Number of Testing Trials During the Learning Process

Fisher et al.[4] examined the effects that the repetition of taught material and increasing the number of testing trials during the learning process have on the amount of information retained. In this study, university students were separated into two groups: one group which were given two midterms during the year, and another which were given frequent quizzes. Performance on both "rote" and "meaningful" questions was compared between the two groups via a final examination at the end of the year, as well as via a retention examination given after a two year interval. On the final examination, the "quiz" group performed better than the "midterm" group on both the "rote" and "meaningful" questions. On the retention examination, the "quiz" group performed better on the "meaningful" questions, although there was no difference between the two groups on the "rote" questions.

b) Question Type

Three studies[4,11,12] comparing the effect that "information recognition" (i.e., multiple-choice) and "information recall" (i.e., open-ended) question types have on retention rates reveal conflicting results. Halpin and Halpin[11] separated college graduates into three groups: one group which wrote a MCQ examination, a second group which wrote a short-answer examination consisting of factual and conceptual questions, and a third group did not write an examination. All three groups were given both examinations following a one-month retention interval, and the results demonstrated that there was no difference between the groups on either of the retention tests. Semb et al.[12] demonstrated that, although performance on both "recognition" and "recall" questions decreased over time in their sample, the retention rates were higher for the "recognition" questions. Finally, the results of the previously discussed study by Fisher et al.[4] demonstrated that the students in their sample performed better on "meaningful" (i.e., information recall) questions than on "rote" (i.e., information recognition) questions on the retention examination.

c) Examination Feedback

Kulhavy and Anderson[13] examined the effect that examination feedback delay has on the amount of information retained. In this study, high-school juniors and seniors were separated into two groups: one group which received feedback immediately following the original examination, and another group which received feedback on the subsequent day. Performance on a retention examination was compared between the two groups after a one week retention interval. The results demonstrated that students who received feedback on the subsequent day scored better than the group who received immediate feedback. The authors hypothesized that this was due either to increased student attention to the feedback or a lack of interference (i.e., learners forget their incorrect response when given a delay before receiving feedback).

Recommendations for future study

As outlined in the Introduction, to our knowledge there are no published articles investigating knowledge retention in chiropractic education. Whilst other health care programs are similar to chiropractic programs in terms of the courses taught and overall content in their curricula, there are substantial differences between these fields of study. Hence, it would be prudent to pursue further research in this area at chiropractic institutions to stimulate the development of the most effective teaching and examination methods in this field.

Several authors have indicated a number of inherent weaknesses and limitations in the study of learning and knowledge retention. These include: the multifactorial nature of this topic area;[1] the difficulties in controlling

for the quality and/or quantity of individual studying methods;[9,10] and the difficulties in controlling for individual differences in working memory ability.[8] Any studies into this area of interest would necessarily need to take these issues into account.

We attempted to perform a study investigating this topic during our fourth year at CMCC. However, we were unable to acquire a large enough sample size to generate any meaningful results. Ergo, we propose some further issues which should be considered by researchers attempting to perform studies in this area.

First, with regards to the sampling of subjects, generating a sufficient sample size is paramount and ideally random sampling of the populations of students should be used. Second, although a cross-sectional design would be easier to implement, a longitudinal design following populations of students over longer periods of time would be preferable in order to generate direct inferences with regards to retention rate changes over time. Third, courses that are inherently similar in terms of the material taught (i.e., academic, skill set development over time), but which utilize different teaching or testing methods, should be used to investigate the relative effects that these individual factors may have on knowledge retention.

Two further issues of concern which have also received little attention in the literature are whether individual test scores reflect a meaningful measure of learning within the context of a chiropractic education and the degree of the long-term knowledge retention over years or decades. As there is such an emphasis put on marks and grades at chiropractic institutions (as indeed there is in all education these days), the aforementioned issue is an important one to consider. With regards to the issue of long-term knowledge retention, we found no studies in our literature search addressing a retention interval of greater than two years. One could argue that because chiropractors practice for decades, concepts and conditions are reinforced through repetition. However, retention of knowledge regarding the recognition of rare and/or life-threatening conditions or complications is especially important in clinical practice and would best be evaluated through future study using longer retention intervals. In addition, studies using chiropractors in the field would provide interesting insight into whether the amount and detail of information taught and examined in chiropractic institutions is necessary for competent clinical practice.

Conclusion

There is very little information in the literature with regards to knowledge retention of material taught and examined at chiropractic institutions and the impact that individual factors have in this important area. Although research in other fields of study indicates certain instructional and examination strategies which seem to increase knowledge retention over time, research should be performed to confirm these findings and investigate whether they apply in the field of chiropractic education as well. These trends suggest that educators at chiropractic institutions should:

1) Provide students with thorough course notes before lectures.
2) Maintain the number of classroom hours (both for individual courses and for the overall curriculum) at such a level which allows students to periodically review the material and maximizes "deep information processing".
3) Revisit and explore material taught in the first year of a program in subsequent years to reinforce this information.
4) Increase the number of testing trials during the learning process.
5) Use non-MCQ format questions in examinations.
6) Provide specific and detailed feedback to students soon after an examination.

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