



The Effect of Drawing Microbiology Concepts on Short-Term Retention Before and After Interrupted Learning

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Abstract

Introduction: During preclinical education medical students are required to learn numerous concepts that must be retained and added to over time, even when not being actively used or when learning about new unrelated concepts. Previous studies have shown that utilizing drawing as a learning tool leads to improved retention. However, limited studies have been conducted on the use of drawing activities at the medical school level. Therefore, the goal of this study was to utilize mechanism-based drawing aimed at presenting conceptual material, rather than strict memorization of facts before and after interrupted learning.

Methods: Participants were randomly assigned to a drawing or a text group and both groups received text #1 that covered a microbiology concept that they were instructed to read, but only the drawing group received a drawing prompt. The groups were given 15 minutes to read, take notes, or draw. The groups then completed post-test #1. During part two of the study the groups received text #2 with no drawing prompt. Both groups were instructed to read the text and take notes for 15 minutes. The two groups were then instructed to complete post-test #2 which covered topics from text #1 and #2. A t-test or Mann-Whitney U was performed and $p < 0.05$ was considered significant.

Results: The drawing group performed significantly better on post-test #1 compared to the text group. There were no significant differences on overall performance on post-test #2. However, the drawing group performed significantly better on questions related to the material covered in the text #1 on post-test #2.

Conclusions: Results presented here show that students perform significantly better when immediately tested on microbiology text while drawing, even after the introduction of an unrelated concept. A future study will be conducted to investigate the effectiveness of an online drawing workshop that will supplement concepts taught during lecture.

Introduction

- Students must learn and retain copious amounts of material during their pre-clinical education; thus it is important to find effective learning approaches.
- Previous research has found evidence that drawing enhances memory retention.
- Limited studies have looked at the effectiveness of drawing at the medical school level.

Methods

Student study techniques. A total of 82 graduate and medical students were recruited. Each student was given a questionnaire on a 7-point Likert scale. Statements such as "I draw out concepts in order to remember/study" and "I prefer reading text in order to learn new concepts" were used to determine students view of different approaches to studying.

Effectiveness of drawing on immediate performance. Each student was randomly assigned to the drawing group or the text only group. The drawing group received text #1 that covers the adenovirus replication cycle that they were instructed to read and then draw. Each student was given 15 minutes to complete the reading and drawing. The text only group received the same text but without the drawing prompt. The text only group was given 15 minutes to read, take notes, and /or highlight on the text. After the 15 minutes expired both groups were given 10 minutes to complete a 10-question post-test on the topics covered in the text.

Effectiveness of drawing after interrupted learning. The two groups received text #2 covering the topic of quorum sensing with no drawing prompt. Both groups were instructed to read the text, take notes, and/or highlight over the course of 15 minutes. After the 15 minutes the two groups were given 20 minutes to complete a 20-question post-test which covered topics from text #1 and text #2.

Statistical analysis. Student performance on the post-tests were compared between the two groups. A t-test or Mann-Whitney U was performed and $p < 0.05$ was considered significant.

Figure 1

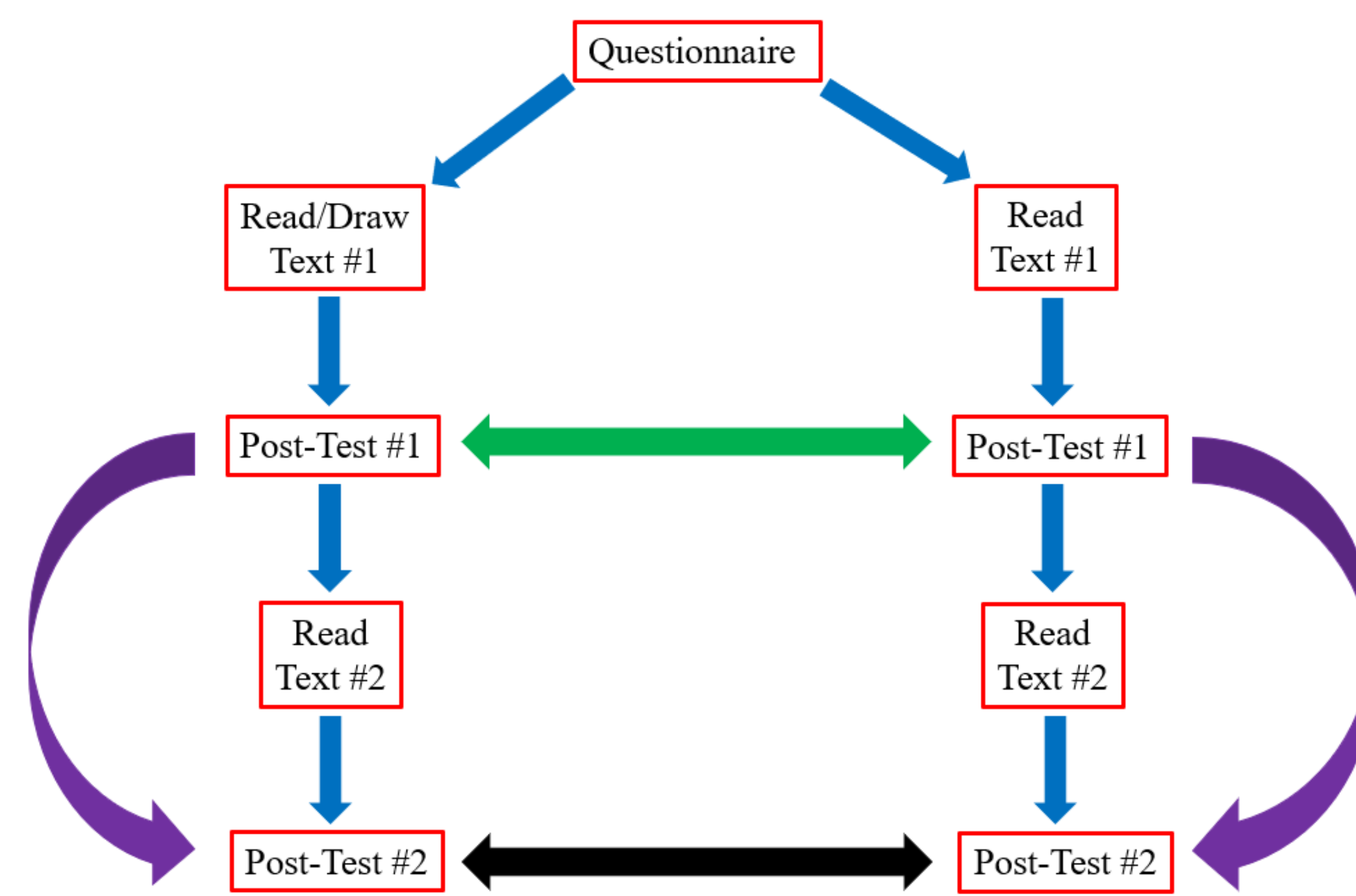


Figure 1. Study design. At the start of the session students were instructed to complete a questionnaire. After completing the questionnaire students were randomly assigned to the two groups and placed in different rooms. They were then instructed to read or draw the concepts from text #1 followed by the 10-question post-test #1. Then both groups were instructed to read text #2 immediately followed by the 20-point post-test #2. Student performance on the two post-tests were analyzed and compared.

Figure 2

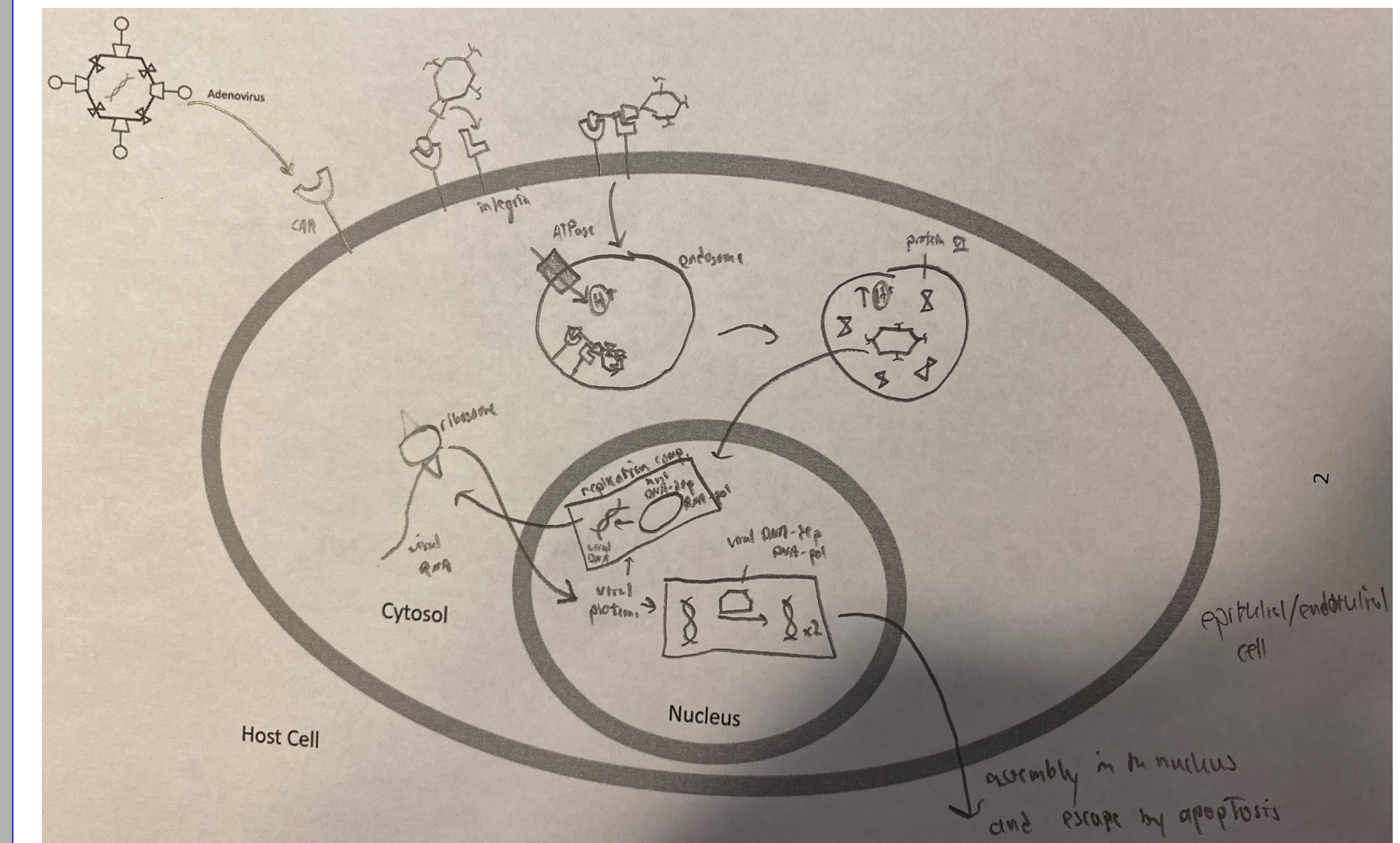


Figure 2. Adenovirus replication cycle student drawing. The students in the drawing group were instructed to read text #1 about the adenovirus replication cycle. These students were also prompted to draw out the process from the text with the guidance of a figure legend.

Figure 3

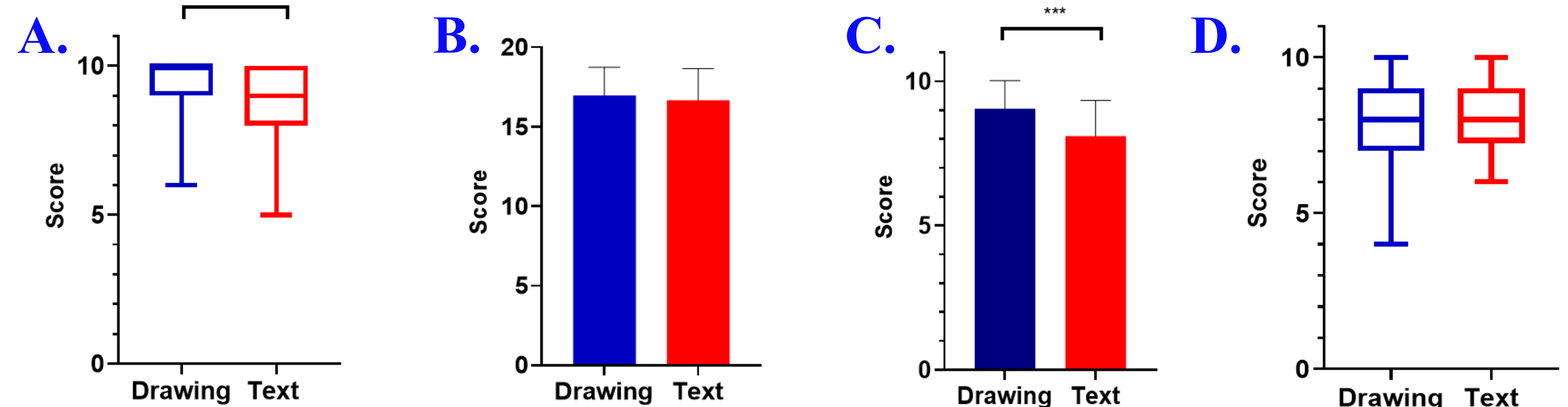


Figure 3. Drawing and text only groups performance on post-test #1 and post-test #2. A. The immediate effect of drawing or reading on adenovirus concepts. Students in the drawing group performed significantly better than the text only group. B. Overall results from post-test #2, which tests on adenovirus and quorum sensing concepts. There were no significant differences between the two groups. C. The effect of interrupted learning on adenovirus concepts. The drawing group performed significantly better than the text only group after the introduction of new material. D. Student performance on quorum sensing topics. There were no significant differences between the groups on questions based on quorum sensing topics. For A and D data are median correct \pm SEM and a Mann-Whitney U was performed. For B and C data are mean correct \pm SEM and a t-test was performed.

Figure 4

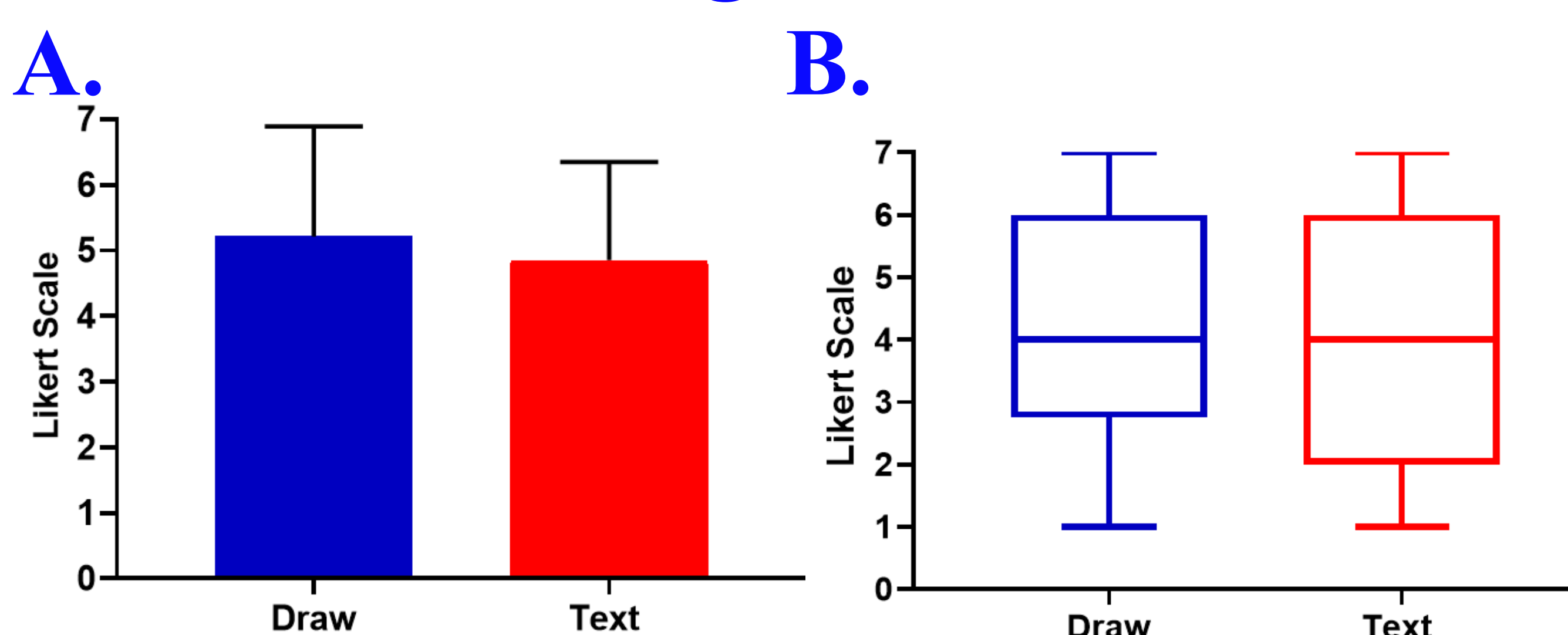


Figure 4. Student study techniques questionnaire. At the start of the session, students were instructed to complete a questionnaire. A. Student 7-point Likert scale responses to "I draw out concepts in order to remember/study". There was no significant difference between the two groups on utilizing drawing as a study tool. Data are mean \pm SEM and a t-test was performed. B. Student 7-point Likert scale responses to "I prefer reading text in order to learn new concepts". There were no significant differences between the groups on utilizing reading as a study tool. Data are median \pm SEM and a Mann-Whitney U was performed.

Summary

- Immediately after drawing the adenovirus replication cycle, the drawing group performed significantly better.
- After learning a new topic (interrupted learning), the drawing group still performed significantly better on concepts drawn previously.
- There were no significant differences between the groups on overall performance on post-test or on quorum sensing questions.
- There were no significant differences between the two groups on their views for reading or drawing as a study tools.
- Drawing can be used to supplement material covered in lecture to help reinforce important and difficult concepts.

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