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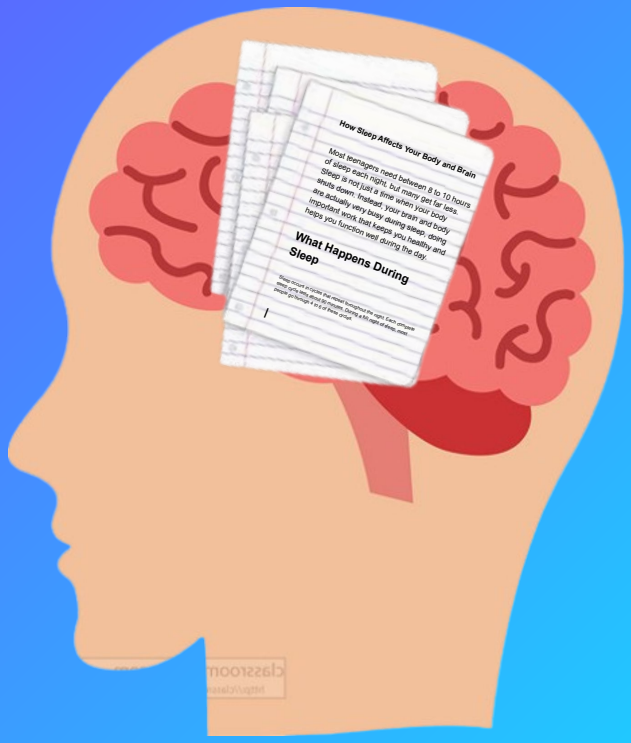


Paper

Background Research

Do students remember information better after reading and answering questions on a screen or on paper with pencil? I chose this topic because I use both paper and digital devices for schoolwork and I wanted to find out which way helps students remember information better. I hope to learn whether reading and answering questions on paper or screens affects short-term memory. The scientific principle behind this experiment is short-term memory recall and spatial memory. Spatial memory helps people remember where things are located, in this case on a page, such as which side a paragraph is on (McDonald, 2022). Reading on paper gives clear visual cues that help memory, while screens can be distracting. Studies show that people understand more from paper. For example, a study in Tokyo found that reading on paper helped students' brains work better, while reading on a phone made it harder to remember information (Showa University School of Medicine, 2022). Other research also shows students remember more from paper than screens (Clinton, 2019; Honma, et al., 2022).

Question and Hypothesis

Question

Do students remember information better after reading and answering questions on a screen or on paper with a pencil?

Hypothesis

If students read an informational text and answer questions on paper with a pencil, compared to reading and answering questions on a screen, then they will remember more information because paper will be less distracting and will activate students' spatial memory which will enhance their short-term memory.

Procedure

1. Divide 32 eighth-grade students into two groups of 16:
    - Group A (paper/pencil)
    - Group B (screen/Chromebook)
2. Group A receives a printed informational text and has 5 minutes to read it. The text is then collected.
3. Group A receives a paper with questions about the informational text and has 5 minutes to answer using pencil and paper. Responses are collected when time is up.
4. Group B receives a Chromebook and opens to a Google Classroom assignment that links to a Google Form. They have 5 minutes to read the same informational text on the form.
5. After 5 minutes, Group B moves to the next section of the Google Form and has 5 minutes to answer the same questions as Group A. They submit their responses when time is up.
6. Neither group may take notes or refer back to the text while answering questions.
7. After both groups finish, responses are collected and scored to compare short-term memory performance.

Variables

Independent variable – The reading medium, either paper/pencil or a screen from a student Chromebook.

Dependent variable – The number of correct answers on the quiz on the information they read.

Controlled variables – The same informational text, the same questions, the same amount of time for reading and answering questions, the same place for the experiment, the same grade level of participants (8th), the same pencil type, and the same screen type (Chromebooks).

Materials

Participants

- 32 Eighth-grade students (split into two groups of 16)

Testing Supplies

- Group A: Paper & Pencil Group
  - 16 Printed informational texts and questions
  - 16 Pencils
- Group B: Screen Group
  - 16 Student Chromebooks
  - 16 Google Forms containing informational text and questions

General Equipment

- Internet access
- Timer
- Answer key
- Quiet classroom testing environment

How Sleep Affects Your Body and Brain

Most teenagers need between 8 to 10 hours of sleep each night, but many get far less. Sleep is not just a time when your body shuts down. Instead, your brain and body are actually very busy during sleep, doing important work that keeps you healthy and helps you function well during the day.

What Happens During Sleep

Sleep occurs in cycles that repeat throughout the night. Each complete sleep cycle lasts about 90 minutes. During a full night of sleep, most people go through 4 to 6 of these cycles.

There are two main types of sleep: REM sleep and non-REM sleep. REM stands for Rapid Eye Movement. During REM sleep, your eyes move quickly back and forth under your closed eyelids, even though you're asleep. This is when most dreaming occurs. REM sleep is important for memory and learning. Your brain processes and stores information from the day during this stage.

Non-REM sleep has three stages. Stage 1 is very light sleep that lasts only a few minutes when you first fall asleep. Stage 2 is slightly deeper sleep, and your heart rate slows down while your body temperature drops. Stage 3 is the deepest sleep, also called slow-wave sleep. This is the most restorative stage, when your body repairs tissues, builds muscle, and strengthens your immune system.

Why Sleep Matters for Learning

Sleep plays a crucial role in how well you learn and remember information. When you study for a test, your brain doesn't just store that information immediately. The process of moving information from short-term memory to long-term memory happens mainly during sleep, especially during REM sleep and deep sleep.

Research shows that students who get a full night's sleep before a test perform better than students who stay up late cramming. In one study, students who slept 8 hours remembered 35 percent more information than students who only slept 4 hours. Getting enough sleep after learning something new is just as important as the time you spend studying.

Sleep also helps with problem-solving and creativity. Have you ever gone to bed stuck on a homework problem, then woken up knowing the answer? This happens because your brain continues working on problems while you sleep, making new connections between ideas.

Sample: Page 1 of the informational text given to both groups

Instructions: Choose the best answer for each question based on the text you just read.

1. How many complete sleep cycles do most people go through during a full night of sleep?
   - A) 2 to 3 cycles
   - B) 3 to 4 cycles
   - C) 4 to 6 cycles
   - D) 6 to 8 cycles

2. Which stage of non-REM sleep is described as lasting only a few minutes when you first fall asleep?
   - A) Stage 1
   - B) Stage 2
   - C) Stage 3
   - D) REM sleep

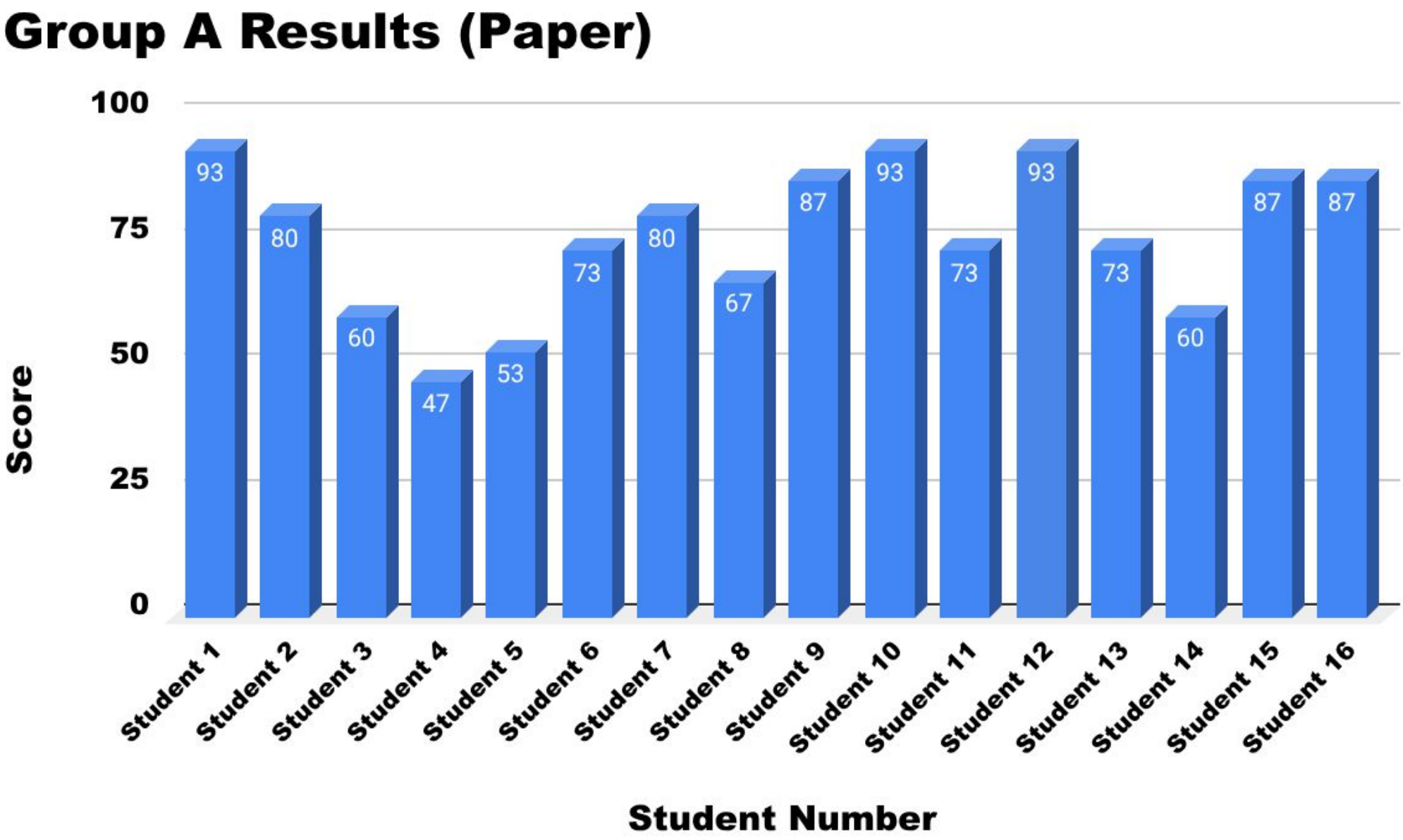
3. During Stage 2 of non-REM sleep, what two things happen to your body?
   - A) Heart rate increases and body temperature rises
   - B) Heart rate slows down and body temperature drops
   - C) Breathing speeds up and muscles tense
   - D) Eyes move rapidly and dreaming begins

4. In the study about sleep and memory, students who slept 8 hours performed better than those who slept how many hours?
   - A) 3 hours
   - B) 4 hours
   - C) 5 hours
   - D) 6 hours

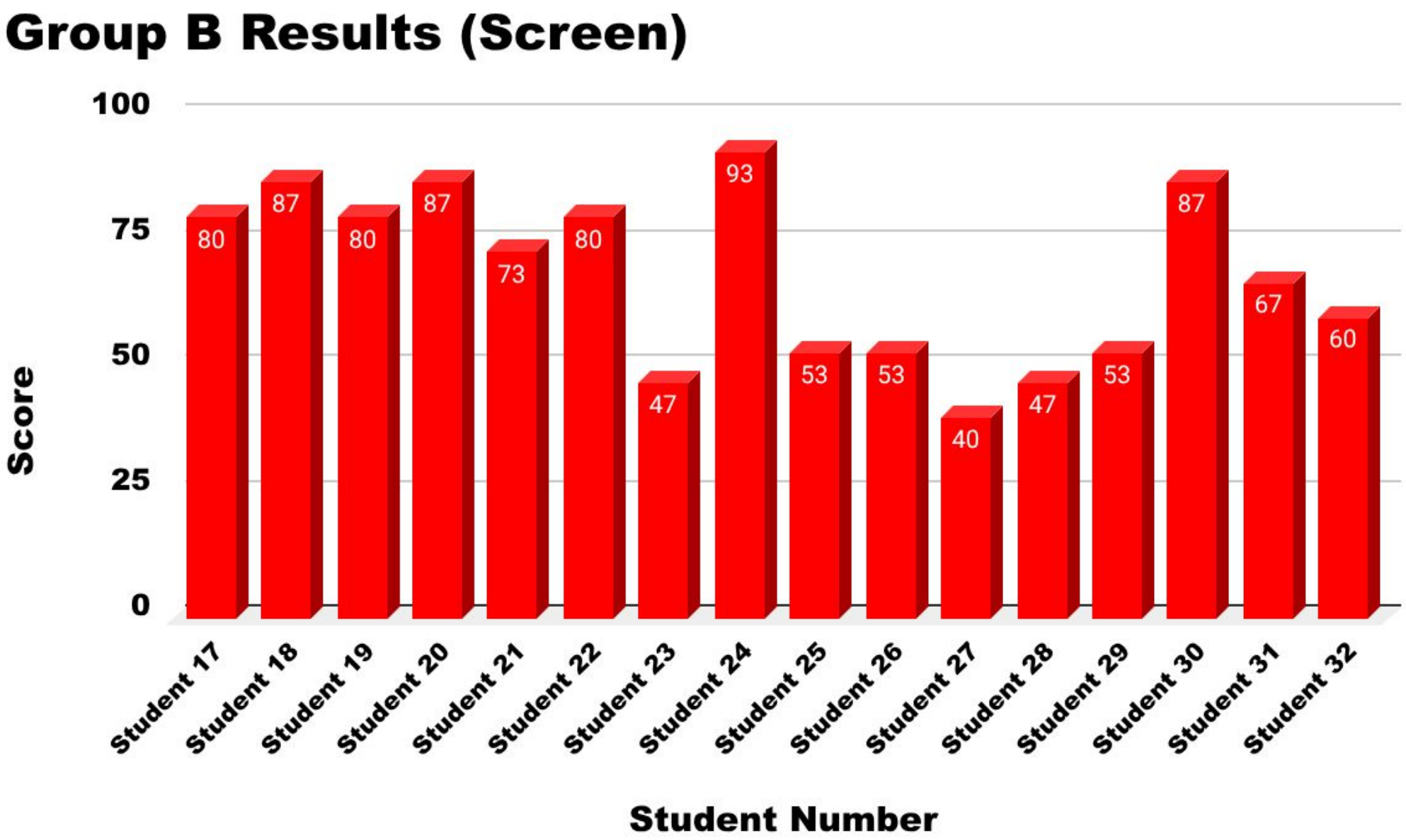
5. According to the text, what is one reason teenagers need more sleep than adults?
   - A) They are more active during the day
   - B) Their brains process information more slowly
   - C) Growth hormone is released during deep sleep
   - D) They spend more time in REM sleep

Sample: Page 1 of the quiz on the informational text given to both groups

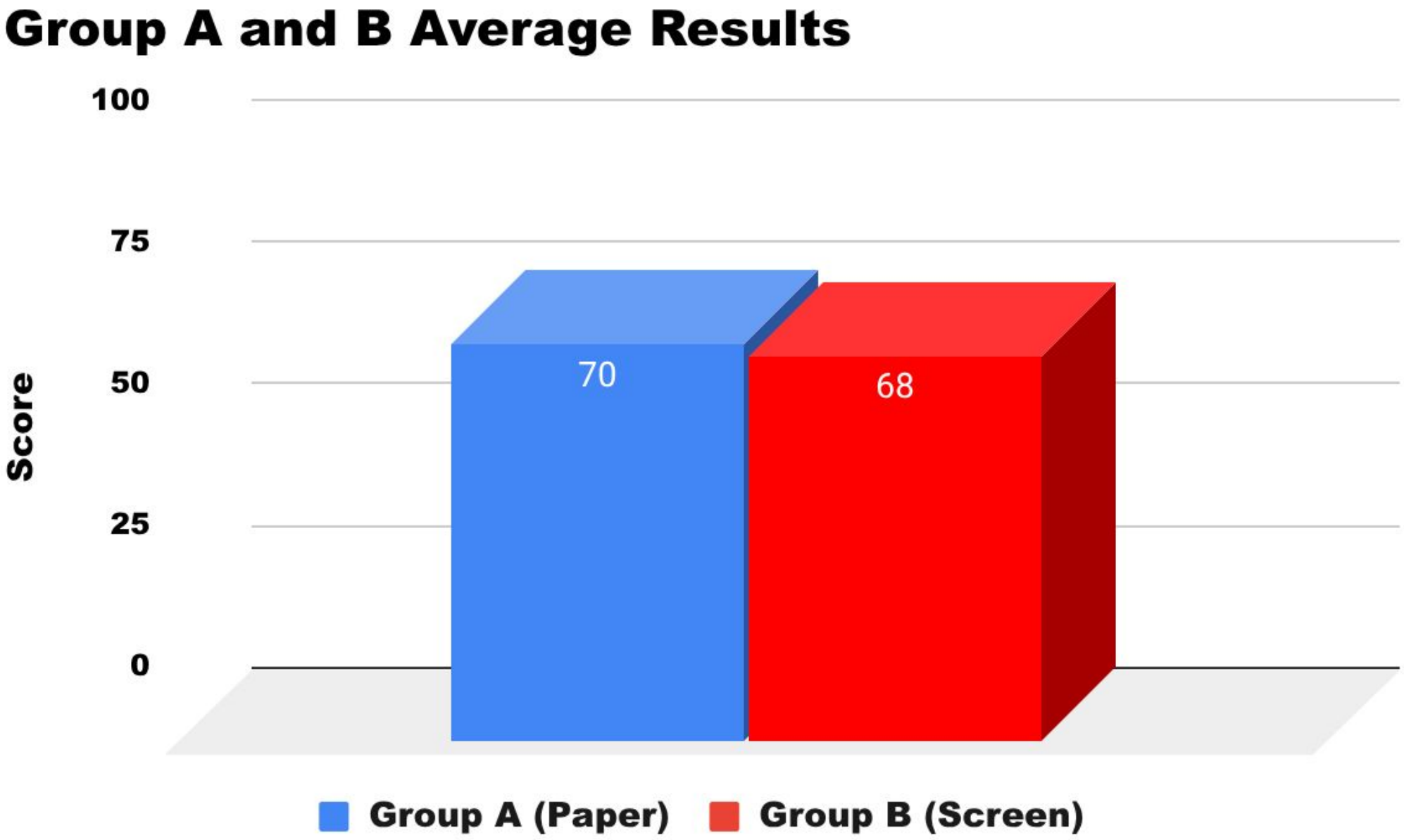
Data from Group A (Paper test)



Data from Group B (Screen test)



Comparison Between Group A and B Average Results



Results

According to my experiment, Group A's average results (this is the group that read and tested on paper) were higher than Group B's results (this is the group that read and tested on screens) by 2%. This proves my hypothesis that students will do better if they read and test on paper compared to reading and testing on a screen because Group A's scores were higher than Group B's. Overall, both averages were very similar, which means that students in both groups did well. The difference with Group A (the paper group) was that there were more frequent high scores than Group B (the screen group).

Conclusion

My hypothesis was that Group A (the group that read and tested with paper and pencil) would do better than Group B (the group that tested on screens). My results do support my hypothesis because Group A's average results were higher than Group B's average results. Both of the groups' tests went smoothly with no major problems.

Implications and Ideas for Future Research

If I could do this experiment again, I would test with a larger group of people and maybe run it twice to get more accurate results. I also might make the reading longer and the test longer, so that it tests the student's memory more. Also, I wonder if the informational text content chosen affects results. I chose an informational text on the importance of sleep. I wonder if I had chosen a different topic, if that would have affected results.

The topic of testing and reading on paper versus screens is important for people to know because many teachers and schools are switching to doing more on screens and I wanted to see if this can affect how students learn, read, and remember information. My project proved that students have more trouble remembering information when it is read on a screen than when they read on paper. These results can help educators to find what will help their students retain information better. Schools might reconsider if going to screens is detrimental to learning.

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