To Highlight or Summarize? The Benefits of Constructive Learning in Geology

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Introduction

One way to improve students' learning is through the use of effective learning techniques that can be quickly and easily adopted by students to achieve their learning goals (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). Unfortunately, the reality is that students are either unaware of how certain learning strategies may be more beneficial than others or simply do not utilize strategies effectively while learning.

Theoretical Framework

To better understand why some learning strategies are more effective than others, this present study draws upon Chi and Wylie's (2014) ICAP framework. This framework identifies four modes of cognitive engagement in learning – passive, active, constructive, and interactive, defined by the overt learning activities that learners participate in and the product of the activities.

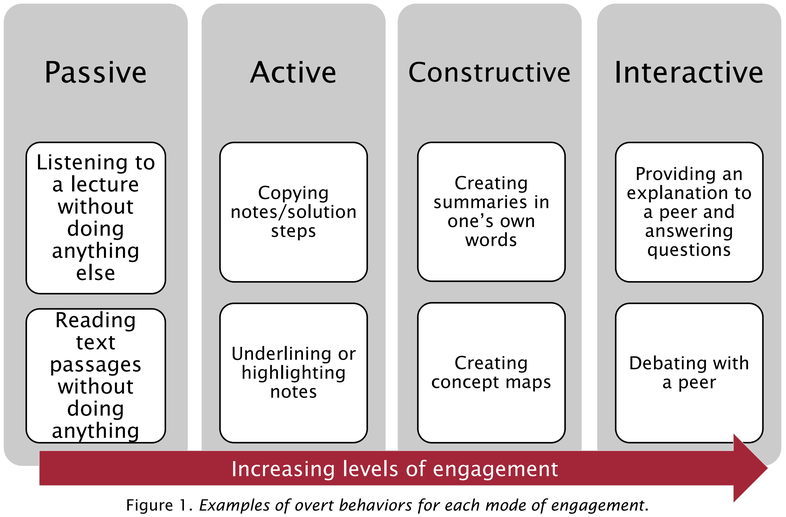


Figure 1. *Examples of overt behaviors for each mode of engagement.*

Chi and Wylie (2014) also hypothesize that as one's mode of engagement increases from passive to interactive while learning, the individual is more likely to achieve a deeper understanding of the material. Essentially, engaging in an interactive mode of learning may help one achieve deeper understanding than engaging in a constructive mode, and so on.

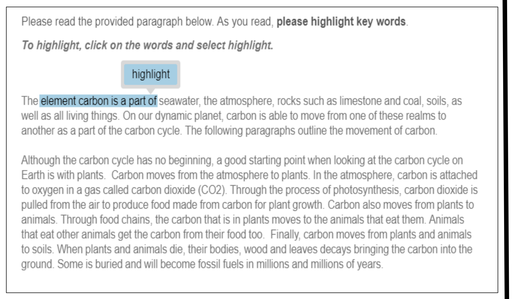
The Present Study

To test Chi and Wylie's hypothesis in an authentic classroom setting, the present study sought to answer the following research question:

What is the effect of highlighting (i.e. active engagement) and summarizing (i.e. constructive engagement) on students' geology knowledge in an authentic classroom environment?

Method

Participants and Research Design
A between-subjects design was used to investigate the effect of highlighting and summarizing on students' learning performance in geology. Seventy-one undergraduate students participated in this study. Assignment to either the highlighting or summarizing condition was done based on the lab session students signed up for.


Please read the provided paragraph below. As you read, **please highlight key words**.

To highlight, click on the words and select highlight.

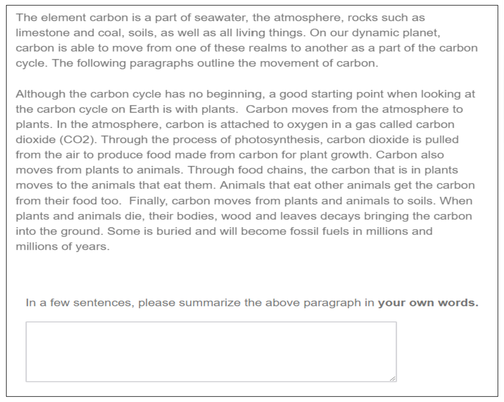
highlight

The element carbon is a part of seawater, the atmosphere, rocks such as limestone and coal, soils, as well as all living things. On our dynamic planet, carbon is able to move from one of these realms to another as a part of the carbon cycle. The following paragraphs outline the movement of carbon.

Although the carbon cycle has no beginning, a good starting point when looking at the carbon cycle on Earth is with plants. Carbon moves from the atmosphere to plants. In the atmosphere, carbon is attached to oxygen in a gas called carbon dioxide (CO2). Through the process of photosynthesis, carbon dioxide is pulled from the air to produce food made from carbon for plant growth. Carbon also moves from plants to animals. Through food chains, the carbon that is in plants moves to the animals that eat them. Animals that eat other animals get the carbon from their food too. Finally, carbon moves from plants and animals to soils. When plants and animals die, their bodies, wood and leaves decays bringing the carbon into the ground. Some is buried and will become fossil fuels in millions and millions of years.

Figure 2a. *Example of highlighting condition.*

Learning Materials
The learning material for the present study consisted of six paragraphs on the Carbon Cycle, presented individually. Students in the highlighting condition were prompted to highlight key words while students in the summarizing condition had to provide a summary after each paragraph.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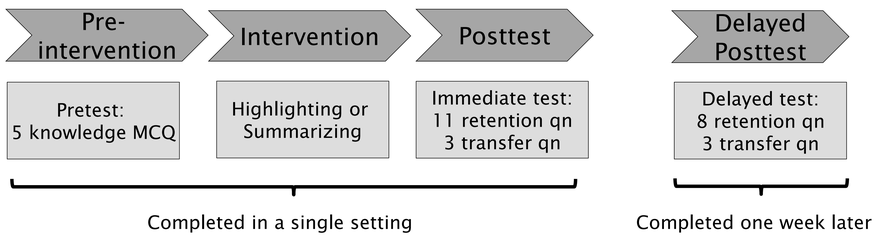
In a few sentences, please summarize the above paragraph in **your own words.**

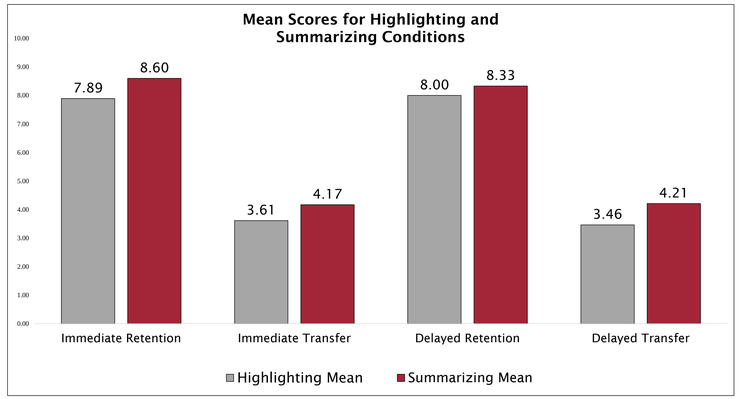
Figure 2b. *Example of summarizing condition..*

Measures
- Pretest – 5 knowledge MCQs
- Immediate Posttest – 11 retention & 3 transfer questions
- Delayed Posttest – 8 retention & 3 transfer questions

Procedure



Results



A one-way ANOVA was conducted with condition as the independent variable and the learning outcomes, immediate retention, immediate transfer, delayed retention and delayed transfer as the dependent variables. Results from the analysis indicated significant differences between the conditions for immediate retention, $F(1, 69) = 4.77$, $p = .03$, and delayed transfer, $F(1, 66) = 4.98$, $p = .03$. Specifically, students in the summarizing condition outperformed students in the highlighting condition ($d = 0.52$ and $d = 0.54$ respectively).

Scholarly Significance

The findings from this study have significant contributions.

- They provide empirical support for the ICAP framework, indicating that a constructive mode of engagement is more beneficial than an active mode of engagement.
- The above point is important because both highlighting and summarizing are common strategies that students either already use or can be easily adopted.
- This study was conducted in an ecologically valid learning environment, thus making the findings even more impactful for educators and students who are interested in identifying strategies to improve learning.

Future Directions

Moving forward, we have planned a study to investigate the effectiveness of constructive and interactive learning strategies in an authentic classroom environment. This follow-up study is important because findings from the current study and future study can provide additional empirical support for the ICAP framework. Additionally, we hope that these studies will shed light on the importance of utilizing learning strategies that increase students' engagement as they learn in the classroom.