Engaging Vocabulary Learners with Technology & Non-Technology Strategies

Calyssa A. Rose
Centerville City Schools

Hannah H. Chai
Wright State University
United States

Abstract

Vocabulary instruction is critical. As such, it is important that content area instruction provide rich and engaging vocabulary activities that support content learning. This teacher-research study examined the effectiveness of three technology-based activities (TBAs) and three nontechnology-based activities (NTBAs) in supporting science vocabulary learning. The study found that enjoyment of TBAs led to stronger motivation and engagement leading to stronger vocabulary knowledge, and that purposeful and explicit vocabulary instruction is needed in supporting student's content learning.

Introduction

There is a strong correlation between readers' vocabulary knowledge and their reading comprehension (DeVries, 2015). The National Reading Panel (NRP, 2000) noted that comprehension cannot be gained without vocabulary knowledge, i.e., students need to be able to understand and use complex words. The importance of vocabulary learning extends beyond the ELA classroom into all content areas, i.e., math, science, and social studies, however content area teachers generally place more emphasis on content knowledge rather than vocabulary instruction ((Chai & Welz, 2018; Harper, 2018). Vocabulary instruction is critical. As such, it benefits content area teachers to bring vocabulary instruction to the forefront of their instruction. By providing rich and engaging vocabulary instruction, teachers can create a positive word-learning environment that supports content learning.

Being purposeful in selecting meaningful and engaging vocabulary activities can support students' learning (DeVries, 2015). To explore the impact of creative vocabulary activities on content area learning, we implemented a teacher research study in a 5th-grade science classroom. The goal of the study was to explore the effects of technology-based vocabulary activities (TBAs) vs. nontechnology-based vocabulary activities (NTBAs) on student engagement, motivation, and learning of science vocabulary words.

The Importance of Content-Specific Vocabulary Instruction

Vocabulary is critical in building a solid foundation for learning because it provides a pathway to comprehension (Peeples et al., 2019). Vocabulary provides access to information by providing a foundational knowledge of words for that specific content (Graham et al., 2014). In the executive summary, the National Reading Panel (NRP, 2000) stated that comprehension and mastery may not be achieved without foundational understanding of vocabulary and word knowledge. While content area teachers may use challenging and complex texts, explicit vocabulary instruction is often treated as an afterthought (Harper, 2018). Research has shown that growth in vocabulary can support active engagement with complex texts and subject matter (Graves, 2008; Harper, 2018; Kuhn et al., 2015; Peeples et al., 2019). This means that students who have a stronger grasp of vocabulary will be better prepared to comprehend the content because they understand the words used in that content. According to Harper (2018), there is not one *best* way for teaching vocabulary. Instead, students should be exposed to multiple, repeated activities to encourage retention of word knowledge. Creating a classroom of *word detectives* (Goodwin & Perkins, 2015) and *vocabularians* (Chai & Welz, 2018) should be a goal for content teachers. As such, engaging vocabulary strategies are needed so that students can make sense of complex topics and learn content area topics on a deeper level (DeVries, 2015).

Engagement with Technology-Based Vocabulary Activities

One way to encourage and engage students with vocabulary learning may be the use of explicit hands-on vocabulary instruction through technology-based activities (Harper 2018). Technology tools and resources such as Flocabulary, Quizlet, podcasts, PowerPoint presentations, and other learning apps may provide support in meeting vocabulary goals (Weiss et al., 2016). Wolsey (2015) found that students in a 5th-grade science class were more motivated to complete vocabulary activities when they interacted with technology. The study noted that students were more invested in learning the science content because they were able to use technology to learn the science words while simultaneously becoming more independent. The use of digital tools and activities can facilitate deeper learning and meaning-making within content area instruction.

Conclusion

Vocabulary instruction is critical to students' success in content areas because it directly impacts comprehension and learning of that content (DeVries, 2015). If students are expected to learn and understand complex topics and texts, explicit vocabulary instruction and hands-on strategies are needed (Bintz, 2011). As such, the purpose of this study was to examine the impact of TBAs vs. NTBAs on students' science vocabulary learning.

Methods

Context and Participants

This study took place in a 5th grade class in City School District (pseudonym), a public school located in the Midwest. The state department of education (2020) showed that the elementary school served almost 300 students in grades 2 through 5. The demographic data showed that approximately 52% were female and 48% were male; approximately 82% identified as White, 5% Black, 4% Multiracial, 2% Hispanic, and <1% as Asian/Pacific Islander. The study was conducted in a 5th grade science classroom. Of the 20+ students in the class, 18 students (13 boys and 5 girls) consented to participate in this teacher-research study. The participants consisted of four students identified as gifted and three students on IEPs. Additionally, eight students read below grade level and three received Title I services.

Materials

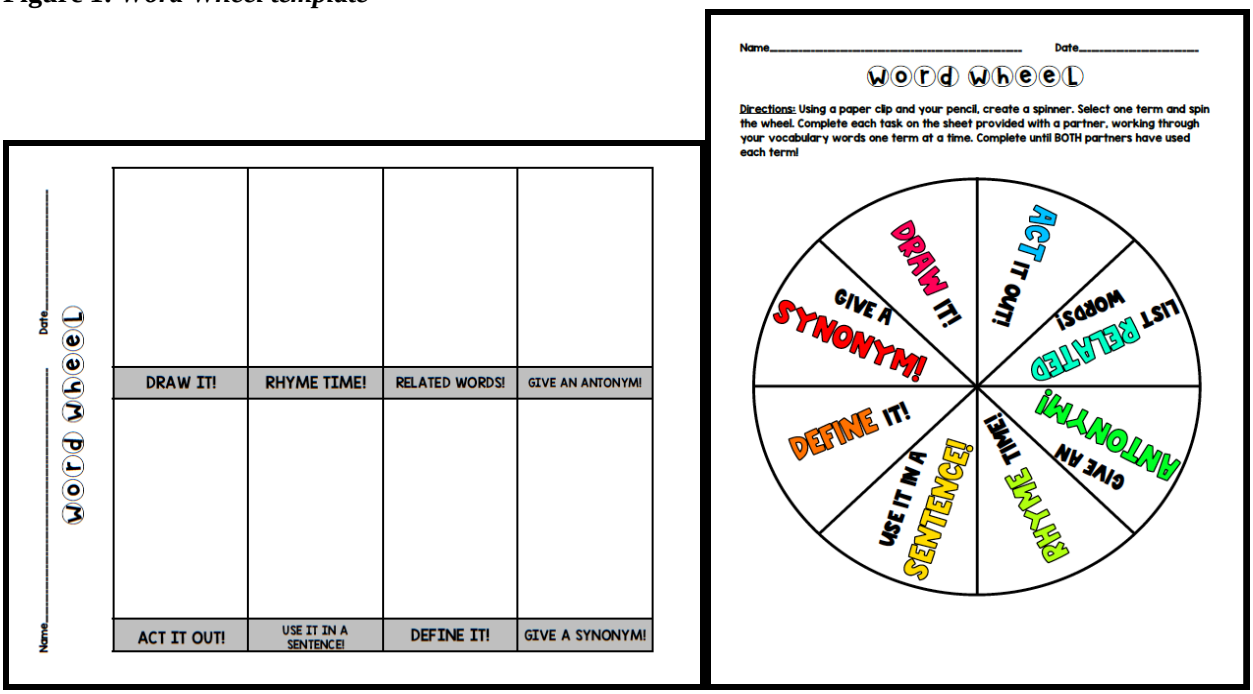
A variety of data tools were used to gather data about the students' vocabulary knowledge, engagement, and enjoyment in using TBAs and NTBAs within a science classroom. These data tools included: weekly vocabulary pre- and post-assessments, surveys, instantaneous sampling, and semi-structured interviews.

Vocabulary Activities

A variety of vocabulary TBA and NTBA were used during this seven-week study to help students learn science words on a deeper level. Each activity was chosen so students would be able to practice the science vocabulary through visual, auditory, tactile, and/or kinesthetic means. The activities were chosen with a goal of supporting learning outcomes and increasing student engagement. The strategies utilized in this study included the following six activities: Vocabulary Sketches, Word Graffiti, Vocabulary Frames, Canva Infographic, List, Group Label, and Vocabulary Storyboards. Each are labeled as TBA or NTBA.

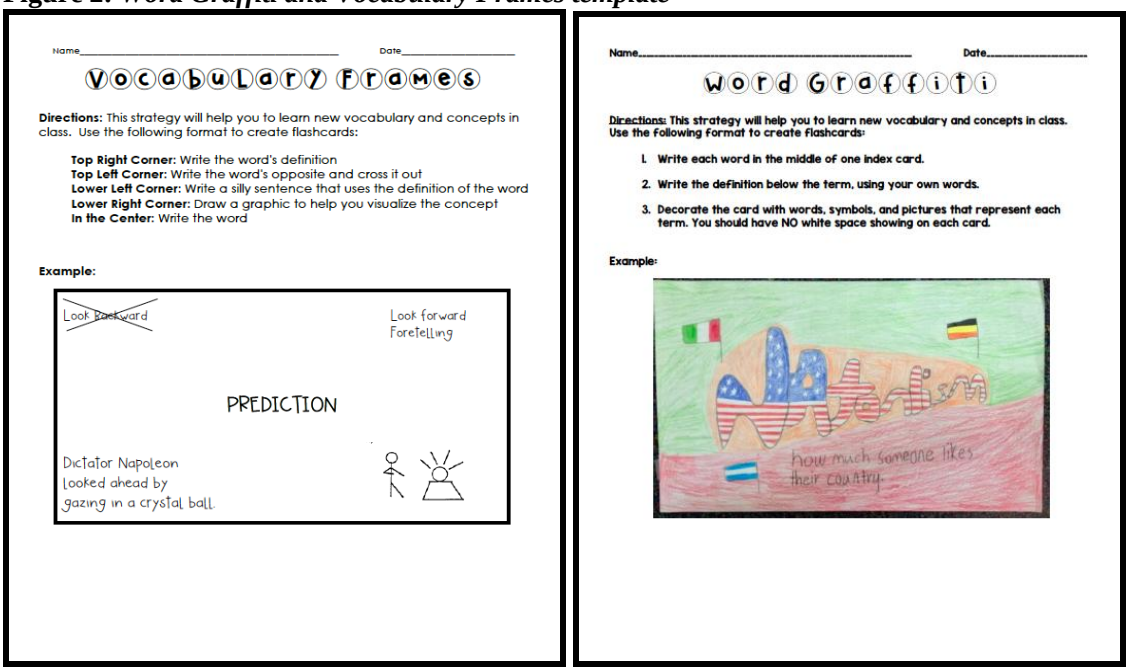
Word Wheel (NTBA). Students used this game-like graphic organizer in partners and took turns "flicking" the spinner. During this activity, the students *performed* the various tasks on the spinner for their science vocabulary words. They were allowed to use their vocabulary list, which contained definitions, with the activity because the tasks required deeper understanding of the words beyond the definition.

Figure 1: ***Word Wheel template***



Word Graffiti (NTBA). This strategy enabled students to define and explore the vocabulary words by creating a visual/pictorial representation, i.e., symbols or pictures they felt best represented and explained the meaning of the word.

Figure 2: ***Word Graffiti and Vocabulary Frames template***



Vocabulary Frames (NTBA). This activity involved students in creating a *frame* for each word. Using an index card, the students wrote each word in the center of the card. In the top right corner, they rewrote the definition in their own words. In the top left corner, they wrote antonyms for each word with an "X" through the antonym signifying that it was the opposite. In the bottom left corner, they wrote a silly sentence using the word. And finally, in the bottom right corner, the students drew a picture or symbol to represent the meaning of the word. This activity allowed students to creatively define and engage with the words.

Canva Infographic (TBA). The students used the Canva application on a Chromebook (https://www.canva.com) to create an infographic poster for their vocabulary words. They were required to use all of the weekly words within the Canva app. Students were able to choose backgrounds, colors, and graphics to represent the words in an organized way.

Vocabulary Sketches (TBA). The students completed a digital graphic organizer on a template on Google Docs. They filled out four categories for each word: word, definition, significance, and visual representation.

Figure 3: ***Vocabulary Sketch template***

Vocabulary Storyboards (TBA). The students were given the opportunity to demonstrate their vocabulary knowledge using Storyboard That (www.storyboardthat.com/storyboard-creator). This computer app provided students with colorful graphics and backgrounds to create digital storyboards for each word.

Weekly Vocabulary Pre- and Post-Assessments

The 5th-graders were given an eight-question vocabulary pre- and post-assessment at the beginning and end of each weekly unit in order to measure their learning before and after engaging in various vocabulary activities. A comparison was made regarding their vocabulary growth using the TBAs versus NTBAs.

Vocabulary Engagement and Motivation Survey

The students were given a short survey at the end of each week to determine their level of engagement and motivation with each vocabulary activity. This Likert-scale survey gauged students' perceptions of each new vocabulary strategy, evaluated their motivation to participate, and determined their overall enjoyment of each vocabulary activity. The survey included statements such as: *The activity motivated me to learn and study my vocabulary words*.

Semi-Structured Group Interviews

Semi-structured interviews were conducted by the teacher-research in a small group setting at the end of each week. The interviews provided students with a space to speak freely about their perceptions of the pros and cons of each vocabulary activity and how they felt about each strategy. Each student group was interviewed twice regarding their feelings towards both TBAs and NTBAs.

Procedures

The study took place over a seven-week period. Throughout the course of the study, the students completed the vocabulary activities during station rotations in their science class. Each station lasted approximately 25 minutes. Each week, the students were introduced to eight new vocabulary words and utilized those words with TBAs and NTBAs. This framework for vocabulary inclusion enabled the students to see the vocabulary instruction not as an *add on*, but rather as a part of the science content reading activities. During the final week, the students were able to choose their favorite activity during their vocabulary instruction time.

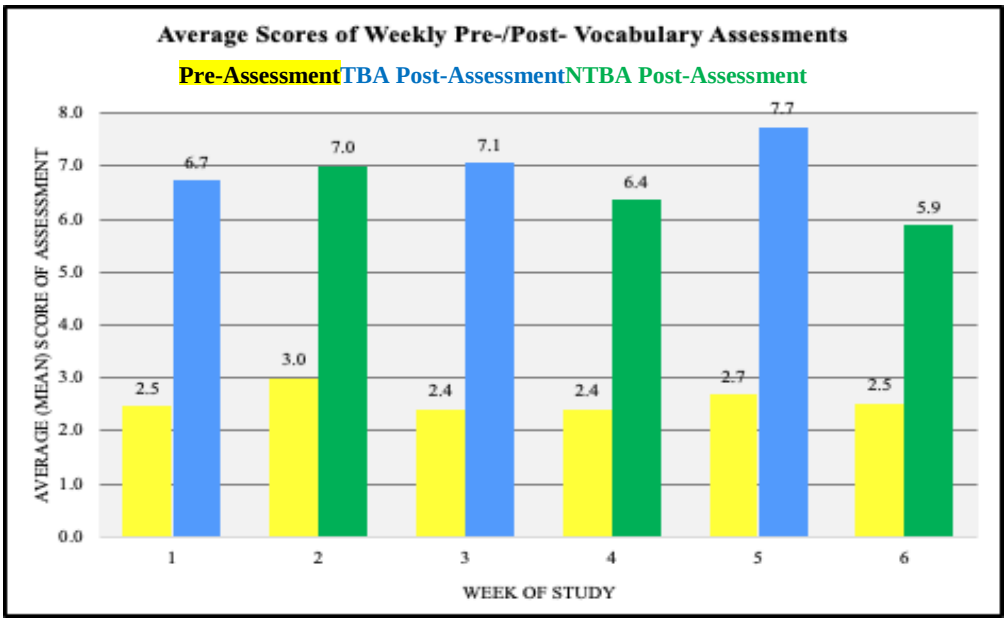
Results

The seven-week study provided valuable insights regarding students' vocabulary learning and engagement with the TBAs and NTBAs. The results from the weekly vocabulary pre- and post-assessments, a vocabulary interest post-survey, and semi-structured interviews are organized and shared in this results section.

Vocabulary Pre-/Post-Assessment Data

Students completed a weekly pre- and post-assessment on the science vocabulary words. This assessment showed the impact of the TBAs vs. NTBAs on students' vocabulary learning.

Figure 4. ***Vocabulary Pre- and Post- Assessment Results***



Students participated in TBAs during Weeks 1, 3, and 5 of the study, and participated in NTBAs during Weeks 2, 4, and 6. The pre-assessment scores(yellow) assessed student's prior knowledge and were similar across the six weeks. The post-assessment data showed significant differences between the TBAs (blue) and NTBAs (green). Table 1 below shows which activities were utilized, as well as the pre-/post-assessment averages.

Table 1. ***Vocabulary Methods Assessment Data***

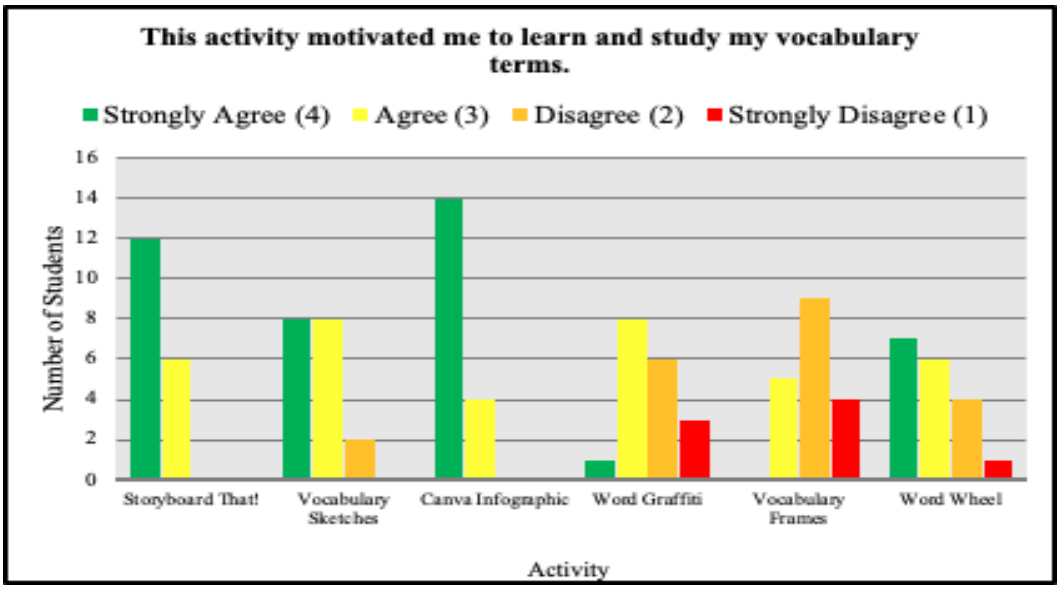
Week of Study	Activity Utilized	Activity Category	Pre-Assessment Average Score	Post-Assessment Average Score	Increase %
1	StoryBoard That!	TBA	31%	84%	+53%
3	Vocabulary Sketches	TBA	30%	89%	+59%
5	Canva Infographic	TBA	34%	96%	+62%
2	Word Graffiti	NTBA	38%	88%	+50%
4	Vocabulary Frames	NTBA	30%	80%	+50%
6	Word Wheel	NTBA	31%	74%	+43%

While both TBAs and NTBAs yielded positive growth in vocabulary learning, the data showed that engaging in TBAs produced a greater understanding of the words as opposed to the NTBAs. The average increase in scores after TBAs were implemented was 58%, whereas the average increase for NTBAs was 47.6%. Students consistently increased their post-assessment scores each week while utilizing TBAs, achieving 84%, 89%, and 96% successively.

Vocabulary Engagement and Motivation Survey

The Vocabulary Engagement and Motivation Survey was utilized to compare the students' feelings about each activity throughout the study. Figure 5 shows the results from Statement 1: *The activity motivated me to learn and study my vocabulary words.*

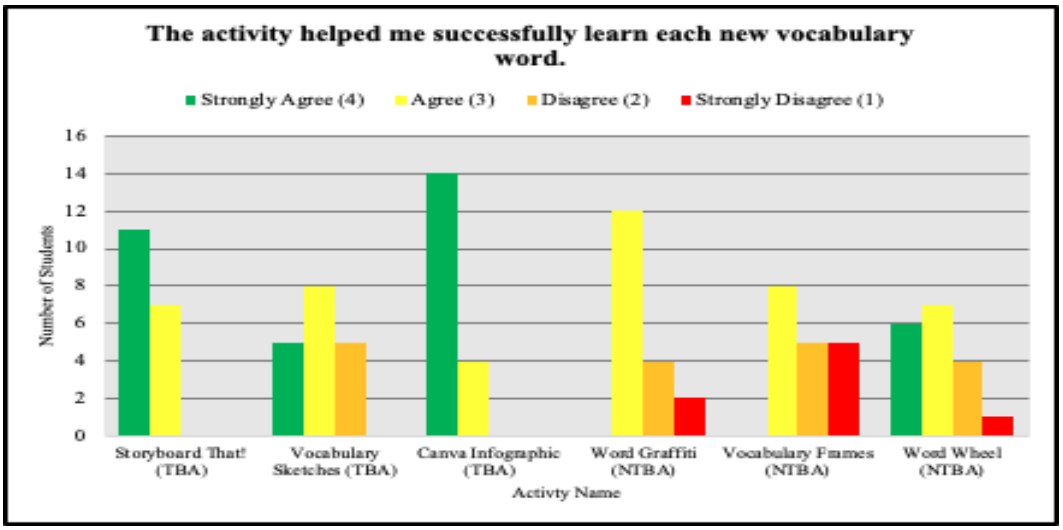
Figure 5. ***Vocabulary Motivation and Engagement Survey: Motivating Me to Learn***



The students' responses showed an overall strong motivation to participate in vocabulary TBAs (Storyboard That!, Vocabulary sketches, and Canva Infographic). The two activities that received the highest feedback were Canva and Storyboard That!. Both of these TBAs had all positive feedback (*agreed-strongly agreed*) and no negative responses. Conversely, the data showed that the least motivating activities were NTBAs: Word Graffiti and Vocabulary Frames. More than half of the respondents indicated they either *disagreed* or *strongly disagreed* about feeling motivated by either of these NTBAs.

The students also shared their opinions about how helpful the activities were for learning new vocabulary words. Statement 3: *The activity helped me to successfully learn each new vocabulary word* showed the students' perceptions of each TBA and NTBA.

Figure 6. ***Vocabulary Motivation and Engagement Survey: Helping Me to Learn***



The data showed that in addition to being most motivating, students felt that Canva and Storyboard That! were most effective in helping them learn new vocabulary words. Both of these TBAs received 100% positive opinions (*agree - strongly agree*). On the other hand, Vocabulary Frames received the most negative feedback, with 10 out of 18 students responding that they *disagreed - strongly disagreed* that the NTBA helped them learn new vocabulary words.

The Vocabulary Motivation and Engagement Survey not only assessed whether students felt motivated/unmotivated by the activities or if they felt the strategies were helpful/not helpful. It also allowed them to share their opinions about wanting or not wanting to use the activity again for future vocabulary learning in the science classroom. Table 2 identifies the students' feelings regarding Statement 4: *I would like to use the activity again.*

Table 2. ***Vocabulary Motivation and Engagement Survey: Use the Activity Again***

Statement 4: I would like to use the activity again.						
	TBA			**NTBA**		
Activity Name	**Storyboard That!**	**Vocabulary Sketches**	**Canva Infographic**	**Word Graffiti**	**Vocabulary Frames**	**Word Wheel**
Response	**Number of Students**					
4 Strongly Agree	6	8	15	0	0	5
3 Agree	12	8	3	10	4	12
2 Disagree	0	2	0	7	8	0
1 Strongly Disagree	0	0	0	1	6	1

All 18 students responded they would like to use two of the activities again: Canva and Storyboard That!. This was consistent with the participants' responses to the previous statements (see Figures 5 and 6), for which all 18 students indicated feeling motivated and successful when using both of these TBAs. Additionally, the data show a correlation between students' feelings about each activity and their desire to participate in the activity again. Overall, TBAs were positive while NTBAs yielded more negative feelings and feedback.

Semi-Structured Group Interviews

Semi-structured group interviews were conducted at the end of each week regarding students' feelings toward the vocabulary activity for that week. Overall, the students expressed excitement and motivation to learn when using TBAs. Table 3 shows excerpts from the group interviews.

Table 3.*Excerpts from Semi-Structured Interviews About Student Motivation with TBAs*

Activity	**Statement**
Storyboard That!	• "Well, I liked that we got to use the computer. Sometimes we do a lot of writing and drawing but this week we got to use the computer more which made it more fun." (Danny) • "I liked using the computer too… Yeah. I think the computer was more fun. I was more excited to work on it because it was on the Chromebooks." (Collin) • "I liked trying a new app. Sometimes we do a lot of the same vocabulary activities, and I liked that this new one let us get on the computer. Plus, it was fun to find pictures and captions to use for the activity." (Samantha)
Canva Infographic	• "I liked designing the poster for our vocab words. It was really fun because it was a new app I didn't use before and it had a lot of options." (Spencer) • "We were all excited to work on our posters and show them to each other during our stations." (Lacey) • "I even worked on (my Canva poster) at home because I like doing it!" (Nicole) • "Me too and I like never work on stuff at home!" (Chase)
Vocabulary Sketches	• "I liked how organized the words were. I was able to print a copy of my sketches to help me study at home, and it was organized because of doing it on the computer. I think the table helped me learn the words better too." (Jenna) • "The [Vocabulary Sketch Activity] was my favorite. I think it was the easiest one to complete. Plus it was on the computer, which I like better than writing stuff. It makes it feel more fun." (AJ)

The feedback from students about each TBA was positive, and they attributed multiple reasons for why they enjoyed each activity. Regarding Canva, Spencer stated: "I liked designing the poster for our vocab words. It was really fun because it was a new app I didn't use before and it had a lot of options." This student discussed the features of the app that made completing the activity enjoyable. Nicole expressed her excitement by stating, "I even worked on (my Canva poster) at home because I like doing it!" This student was motivated to complete the activity and wanted to work on it in her free time outside of the classroom. Many students discussed their overall enjoyment of using TBAs over NTBAs during vocabulary instruction. They felt the TBAs were better organized and user-friendly. One student shared her feelings regarding Vocabulary Sketches, "I liked how organized the words were. I was able to print a copy of my sketches to help me study at home, and it was organized because of doing it on the computer. I think the table helped me learn the words better too." Another student affirmed, "the [Vocabulary Sketch Activity] was my favorite. I think it was the easiest one to complete. Plus, it was on the computer which I like better than writing stuff. It makes it feel more fun." When students were able to utilize TBAs, they reported increased enjoyment and motivation during vocabulary instruction. The students also discussed their motivation and success with each TBA and NTBA.

Table 4.*Excerpts from Semi-Structured Interviews- Student Success in Vocabulary*

Activity	Type	Statement
Storyboard That!	**TBA**	● "I learned the definitions fast because I had to use them and learn about them all week." (Danny) ● "I spent a lot of time making my storyboard, which means I spent a lot of time picking pictures to go with the definitions. I learned the definitions fast because I had to use them and learn about them all week." (Savannah)
Vocabulary Sketches	**TBA**	● "It was an easy activity to do but it really helped me study at home and at school. I liked finding all the pictures to go with the words and liked that it was a way for me to organize everything." (AJ)
Canva Infographic	**TBA**	● "We spent a lot of time looking at all the words and pictures and stuff. Using pictures helps me remember things better. Plus, I looked at it every day during stations." (Chase) ● "Using all the pictures definitely helps. I was excited to work on my poster, so I think that helped me learn them better too!" (Spencer)
Vocabulary Frames	**NTBA**	● "I think it did [help], but it wasn't the most fun way to learn [the vocabulary words]. We use other more fun things sometimes that are better. You know how you sometimes ask us to use different perspectives to look at words? Well, I think it helped me figure that out. But I still had to practice learning the meanings so I could remember them better." (Jacob)
Word Graffiti	**NTBA**	● "Yeah definitely. I remember all the words' meanings because I can think of the pictures I drew in my head." (Chase) ● "I could easily remember all the words when we took the quiz yesterday. I think it helped me to think of the drawings I made. It made it easy to remember all the definitions." (Spencer)
Word Wheel	**NTBA**	● "I think since we had to act them out, use them in a sentence, and write the definitions a lot this week, it was really helpful. And we had to learn synonyms and antonyms, which always helps me remember the words better." (Jenna) ● "Yeah, I think using all the words this week helped a lot." (Russell)

The students reflected on their successes with TBAs and NTBAs and the data showed that students overall felt successful while using both types of activities. When sharing their thoughts about TBAs, AJ stated, "It [Vocabulary Sketches] was an easy activity to do but it really helped me study at home and at school. I liked finding all the pictures to go with the words and liked that it was a way for me to organize everything." Chase reported his experience using Canva, "We spent a lot of time looking at all the words and pictures and stuff.
Using pictures helps me remember things better. Plus, I looked at it every day during stations." Overall, the students gave positive feedback about the TBAs helping them learn the science vocabulary throughout the course of the study.

In addition to positive feedback about TBAs, the students reported that the NTBAs also supported their success in learning the vocabulary words, however, they were not as motivating. Jacob stated, "I think [the Vocabulary Frames] did [help me learn the words], but it wasn't the most fun way to learn them. We use other more fun things sometimes that are better. You know how you sometimes ask us to use different perspectives to look at words? Well, I think it helped me figure that out. But I still had to practice learning the meanings so I could remember them better." The student acknowledged the NTBA benefitted them, but that it was not as *fun*. Jenna shared, "I

think since we had to act [the words] out, use them in a sentence, and write the definitions a lot this week, it [Word Wheel activity] was really helpful. And we had to learn synonyms and antonyms, which always helps me remember the words better." Overall, the students reported that both TBAs and NTBAs were helpful in supporting their learning of the new science vocabulary words; however, they perceived TBAs to be more engaging and fun and their vocabulary assessment results affirmed this positive impact.

Discussion

This study sought to examine the effectiveness of explicit vocabulary instruction (TBA sand NTBAs) on students' science vocabulary learning. Two themes that emerged from the data were that enjoyment with TBAs led to stronger motivation for students in learning science vocabulary, and students' engagement with TBAs supported stronger vocabulary knowledge.

Enjoyment Leads to Stronger Motivation

Motivation plays an important role in students' vocabulary learning (Chai & Welz, 2018; Harper, 2018). The Vocabulary Engagement and Motivation Survey revealed that students were more motivated to learn new words when they enjoyed the activities. This factor of *enjoyment* is one that is often not considered when planning instruction. Many teachers focus on learning objectives and standards, but enjoyment is not often considered as a part of lesson planning. The students indicated through the surveys that they felt highly motivated with TBAs because they enjoyed the activities. Canva Infographic and Storyboard That! were two TBAs in which 100% of the students enjoyed vocabulary learning (see Figure 6). All the students felt that these TBAs not only enabled them to learn vocabulary, but they were also highly motivated because the activities were *fun*. Motivation for the TBAs was spurred by this sense of enjoyment which was also evident from the student's interviews. Spencer stated, "I liked designing the poster for our vocab words [via Canva]. It was really fun because it was a new app I didn't use before and it had a lot of options." Lacey affirmed, "We were all excited to work on our posters and show them to each other during our stations!" Spencer stated, "I was excited to work on my poster, so I think that helped me learn them better too!" Students overwhelmingly agreed that TBAs were exciting, as well as motivating, which was as an important component in being engaged with the science vocabulary learning. While students benefitted from both TBAs and NTBAs, the data clearly showed that NTBAs were less motivating because they were not as *fun* (see Table 4). Jacob stated, "I think it [Vocabulary Frames] did [help me learn], but it wasn't the most fun way to learn them. We use other more fun things sometimes that are better". Overall, Vocabulary Frames, as well as the other NTBAs, were not as fun and were less motivating for the students. As such, integrating technology via the TBAs increased motivation in learning new science vocabulary because the students enjoyed the activities (Weiss et al., 2016). Guthrie and Wigfield (2000) noted that motivation is a critical factor in supporting learning, and our research demonstrates the additional component of *enjoyment* as an important building block to support motivation.

Students' engagement with TBAs enabled stronger vocabulary knowledge

Students not only enjoyed using TBAs, TBAs enabled stronger understanding and retention of the science vocabulary. While all the participants gained vocabulary knowledge in working with both TBAs and NTBAs, the stronger motivation led to greater student learning. The study found that students were motivated by TBAs, particularly Storyboard That! App and Canva Infographic (see Figure 6). The weekly pre-/post-assessment data showed that students reached a higher level of achievement when technology was integrated into instruction. In fact, the students scored an average of 7.2 out of 8, or 90%, on their vocabulary post-assessment after engaging with TBAs compared to 6.4 out of 8, or 80%, on their vocabulary post-assessments using NTBAs (see Figure 4). The data showed that each of the TBAs yielded a greater increase in student scores from pre- to post-assessment vocabulary knowledge. Students expressed the success they felt in using TBAs (see Table 3 and 4): "I spent a lot of time making my storyboard, which means I spent a lot of time picking pictures to go with the definitions. I learned the definitions fast because I had to use them and learn about them all week.", "Using pictures helps me remember things better. Plus, I looked at it every day during stations.", and "I loved Canva. I want to use it more in class because it helped me learn the words the best since I had to match all the words to pictures." These statements showed that students were not only completing the vocabulary TBAs, but they were also invested in their vocabulary learning. The study found that when students were more engaged with the vocabulary activity, it resulted in a greater level of success on the weekly post-assessment.

Guthrie and Wigfield (2000) noted that engaged students are mentally active, therefore, they may overcome traditional barriers to learning and demonstrate higher levels of achievement. As such, this study found that TBAs enabled students to be more engaged, resulting in stronger vocabulary learning.

Conclusion

We begin this conclusion by sharing what we view as limitations of this study. The students in this study attended a school that was 1:1 technology, and so the vocabulary activities could be accessed via their Chromebooks. While this study generated valuable insights regarding TBAs and NTBAs that motivated and engaged vocabulary learners, access to technology (TBAs) is an important limitation to recognize. This point leads us to recognize the technology gap that exists across schools and districts (Morrell, 2021).

While the students in this study clearly preferred and benefitted from TBAs, without a device, access to the internet, and knowledge of how to utilize TBAs, students may not reap the benefits that technology can provide. Secondly, while this study focused on the integration of vocabulary instruction in a science classroom, explicit vocabulary instruction may not always be an instructional focus in content area classrooms. With this being said, we advocate that teacher snot only consider utilizing TBAs, but strive to provide explicit and purposeful vocabulary instruction as a way to enhance and support content area learning. The study found that when TBAs were incorporated into vocabulary instruction, the students' overall motivation and attitude toward the content vocabulary increased. As such, increasing students' motivation by tapping into their enjoyment may create more engaged learners (Graham et al., 2014). Vocabulary building is both a relevant and necessary skill for students of all ages because there is a strong link between vocabulary and comprehension of material (Harper, 2018). Motivating students to learn and study vocabulary not only increases content vocabulary knowledge, but it may also lead to greater levels of engagement and deeper understanding of the content. By providing adequate time, attention, and purposeful vocabulary instruction, teachers can better support student engagement, motivation, and successful learning of content learning.

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