A Proposal for the Utilization of Vocabulary and Comprehension Interventions to Increase Student Literacy

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Introduction

Throughout their school careers, students will be required to learn from a myriad of different formats. One of the most important ways students will acquire knowledge is through direct exposure to information in written texts. Individuals who lack the proper skills to learn from what they read will face countless challenges and significant disadvantages as they progress through school. A prime example of this can be seen during one unit of study that I will later describe in greater detail. The unit contains difficult vocabulary and text passages that are packed with important information. Therefore, students who are unable to gain information through reading will not master the rigorous content expectations and skills that are required of them. Direct actions must be taken on my part to repair reading deficiencies in order to provide my students with opportunities for success that they deserve. In this paper, I will describe in detail the instructional unit my students will experience, the reading challenges they will face, and the strategies I will use to help them overcome those difficulties

Description of the Instructional Unit

For this project, I choose a high school chemistry unit on hydrocarbons and carbon chemistry. The overall theme of the unit is humans' relationship with petroleum. This theme is broken down into the following sections: A) general hydrocarbon information, B) hydrocarbons as energy sources, and C) hydrocarbons as sources for creating materials. Within these sections, there are several concepts and skills that students will be expected to master. In section A students will describe the composition and uses of petroleum, understand how electron configuration relates to covalent bonding, describe a class of molecules called alkanes, and predict and analyze trends in hydrocarbons. Next, in section B, students will indentify types of energy, understand energy conversion and the law of conservation of energy, use heat of

combustion to analyze the usefulness of certain fuels, and evaluate the plausibility of a variety of alternative fuels. Finally, in section C, the students will explore polymers and polymerization, relate polymer structure to function, compare saturated and unsaturated hydrocarbons, and analyze the significance of alcohols, organic acids, and esters, and their functional groups.

The lessons and activities for the unit will incorporate a number of different instructional strategies. Some lessons will be teacher centered while others will be more student focused. Since discussion is an essential feature of science classes, this tactic will be used frequently in a variety of formats. During the activities themselves, I will extensively use small group and whole class talk formats for the purpose of socializing intelligence and to make formative assessments of student progress. Listed below is a brief description of the sequence of activities for the unit. Following each activity in this sequence there will be analysis and discussion questions that will serve as formative assessments of understanding.

Section A: First the students will be given the pre-assessment for the unit in which they will be asked the following question: "Is petroleum more valuable to humans as a fuel source or as a source for materials?" The students must answer the question in a specific format we will have practiced many times called Claim-Evidence-Reasoning. Using this format, students answer a question or make an assertion, use concrete evidence to support it, and explain how and why the evidence is relevant and sufficient. In the next activity, the students will distill a mixture of two liquids and identify trends in the boiling points. This serves to provide background knowledge for the next activity in which students will read about the fractional distillation of petroleum. Following this, the students will analyze trends in hydrocarbon boiling points. In this activity, they will interpret data of various hydrocarbons, including their molecular formulas and boiling points, to recognize a pattern between those variables. In the next activity, students will read

about, then model, covalent bonds. To understand why the trends in hydrocarbon boiling points exist, the students will relate the number of covalently bonded carbon atoms in a molecule to the boiling point. Next, the students will model, predict, and draw isomers of different hydrocarbons. They will then explore the relationship between the extent of branching and the boiling points of the isomers. I will also give a summative multiple choice quiz at the end of the sequence.

> Content related vocabulary words for this section: Hydrocarbon, distillation, fractional distillation, intermolecular forces, carbon chain, electron shells, valence electron, covalent bond, alkane, straight-chain alkane, branched-chain alkane, and structural isomer.
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> Michigan High School Content Expectations covered in this section: Separate mixtures based on the differences in physical properties of the individual components (P4.p2C), given the formula for a simple hydrocarbon, draw and name the isomers (P4.2e), predict if the bonding between two atoms of different elements will be primarily ionic or covalent (C5.5A), draw Lewis structures for simple compounds (C5.5c), draw structural formulas for up to ten carbon chains of simple hydrocarbons (C5.8A), and draw isomers for simple hydrocarbons (C5.8B).

Section B: The opining activity for this section is meant to engage the students in energy transformations. I will show the students a spinning soda can steam engine and ask them to identify the origin of the energy that made the can move. The students will also produce a diagram of the energy flow. They will then read about different kinds of energy, energy conversion, and the law of conservation of energy. We will have a class discussion of the topics, and relate them to the demonstration. The next activity will be a lab in which the students will

be introduced to the concept of heat of combustion. The students will burn a candle to determine the heat of combustion of paraffin, and compare it to heats of combustion of other hydrocarbons. They will then decide which fuels are most appropriate under different circumstances. In the final activity for this section, the students will perform a research project where they will examine alternative fuels and judge which is most promising as the primary energy source for humans in the future. This project can be viewed at https://sites.google.com/site/syrek2010/. Once again a summative assessment will take the form of a multiple choice quiz.

Content related vocabulary words for this section: Potential energy, kinetic energy, chemical energy, thermal energy, endothermic, exothermic, law of conservation of energy, combustion, and heat of combustion.

Michigan High School Content Expectations covered in this section: Explain that the amount of energy necessary to heat a substance will be the same as the amount of energy released when the substance is cooled to the original temperature (P3.p1 A), draw enthalpy diagrams for exothermic and endothermic reactions (C3.1b), calculate the amount of heat produced for a given mass of reactant from a balanced chemical equation (C3.1d), explain why it is necessary for a molecule to absorb energy in order to break a chemical bond (C3.3c), use the terms endothermic and exothermic correctly to describe chemical reactions in the laboratory (C3.4A), explain why chemical reactions will either release or absorb energy (C3.4B), write chemical equations including the heat term as a part of equation or using ΔH notation (C3.4c), explain why some endothermic reactions are spontaneous at room temperature (C3.4f), compare the energy required to raise the temperature of one gram of aluminum and one gram of water the same number of degrees

(C5.4A), and compare the melting point of covalent compounds based on the strength of intermolecular forces (C5.4e).

Section C: As an engagement and pre-assessment activity for this section, I will pose the following question to the students: "What properties of petroleum allow us to make so much stuff out of it?" The students will work in teams of two to answer this question, and once again the claim-evidence-reasoning format will be used. Following this, the students will read about monomers, polymers, double covalent bonds, and addition polymers, and will discuss the question, "What are polymers, and how have they made life today different from 100 years ago?" In the next activity, the students will use models to predict how double covalent bonds are formed. Groups will discuss and share with others the methods they used and reasoning behind their choices. In a class discussion, we will come to a consensus on what a double covalent bond is and what it looks like. I will then show the students different polymers, like a plastic shopping bag and a PVC pipe, and give the structural formulas for the monomers used to make each polymer. The students will model the construction of each polymer and discuss the similarities and differences. They will also identify and discuss the key factor in forming these polymers: the double covalent bonds. In the next activity, students will explore how the processes of branching and cross-linking of polymers affect their properties by examining polymers that are made of the same substance, but that have different characteristics. They will then read about branching and cross-linking and draw pictures to model what they look like. The next activity will be a lab where students will explore condensation reactions by forming methyl salicylate, an ester, out of methanol and salicylic acid, an alcohol and organic acid respectively. They will then read about and discuss this type of reaction and the builder molecules used in it. Finally, as a summative assessment, the students will revisit the pre-assessment question, and

answer it using the knowledge gained in this section. The summative assessment for the unit will be very similar as the students will again address the unit pre-assessment question. This assessment can be viewed at https://sites.google.com/site/syrekunit3/.

Content related vocabulary words for this section: Monomer, polymer, addition reaction, branched polymer, cross-linked polymer, saturated hydrocarbon, unsaturated hydrocarbon, functional group, alcohol, ester, organic acid, and condensation polymer. Michigan High School Content Expectations covered in this section: Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions (C1.1B), describe a reason for a given conclusion using evidence from an investigation (C1.1E), distinguish between scientific explanations that are regarded as current scientific consensus and the emerging questions that active researchers investigate (C1.1i), identify and critique arguments about personal or societal issues based on scientific evidence (C1.2B), develop an understanding of a scientific concept by accessing information from multiple sources (C1.2C), and analyze how science and society interact from a historical, political, economic, or social perspective (C1.2K).

Literacy Requirements for the Unit

Since students will experience printed text in a variety of formats during this instructional unit, several skills are necessary to fully benefit from these interactions. The overarching skill students will need to display is to establish a relationship between their existing knowledge, the information presented, and the context of the situation (Garner, n.d.). Several other necessary skills, however, will be dictated by the type of activity in which the students will engage. One

way students will interact with print in this unit is through reading several passages from a textbook. In these instances, students will need to be able to decode words and construct meaning from what they read. This is crucial to the understanding of the text. Students will also interact with other text formats, like web pages, from a number of sources. They must be able to interpret the text, synthesize ideas, and form opinions when completing these tasks.

Another way students will interact with print is through the introduction of many content related vocabulary words. The students must understand what these words mean and apply their understanding in numerous contexts. Also, because several guided activities and laboratory investigations will be experienced in this unit, the students must be competent at understanding and following both written and verbal directions. Lastly, whether it be through formal writing, project creation, or question answering, students will need to communicate their understanding and opinions in writing. The skills necessary for these tasks include recapping and relating information, generating ideas, and problem solving. All of the literacy skills students will need to independently access the unit will be modeled, scaffolded, and practiced.

Literacy Challenges

In my years of experience as a teacher, I have seen students struggle in a variety of ways related to literacy. From what I have observed in my past teaching of this particular unit, the most common difficulties arise because of poor reading ability and include the decoding of difficult vocabulary terms and the comprehension of printed text. The main challenge students face with vocabulary is not that they have trouble reading or sounding out the words, but that they struggle to understand and remember the meanings of them. In the article, *Teaching Meaning Vocabulary*, Stahl and Shiel (1992) highlight two theories that may account for difficulties with vocabulary. The first explanation is that good readers have a more refined ability to derive

meaning from context, while the second is that good readers simply read more than poor readers. It appears that evidence favors the second explanation, but whatever the cause, vocabulary has presented a consistent challenge to my students in the past.

A second challenge faced by many of my students is comprehension of written text. This is especially troubling because as Guthrie et al. (2004) point out, reading comprehension provides the basis for a substantial amount of learning in the high school grades. Research indicates that readers who struggle with comprehension do so because they lack the necessary metacognitive skills, such as self-monitoring, predicting, and reality testing (Wong & Jones, 1982). An important distinction must be made clear that a lack of proper skills does not indicate a deficiency in ability. Ivey (2002) points out that there are many students who struggle with reading, but demonstrate that they are capable of very sophisticated thinking. Therefore, just because a student has difficulty understanding what he reads, I cannot assume that he is unable to understand the content of the text. Research, including a study done by Stahl (2003), indicates that vocabulary knowledge and comprehension are very closely related. Addressing both of these difficulties should provide large gains in understanding for my students.

Interventions

The first intervention I plan to practice is related to vocabulary instruction. I plan to take advantage of the fact that the majority of the words in the English language have meanings that can be deciphered from the meanings of their parts (Cunningham, 1998). A hallmark of good readers has always been to break unfamiliar words into segments and relate familiar word parts to meaning (Anthony & Francis, 2005). This process may not be so natural for struggling readers, and therefore must be explicitly taught. In my vocabulary intervention, I will teach students how to use the morphology of words to understand their meanings. This will be

especially useful for my students, because as Stahl and Shiel (1992) point out, decomposing words into known parts not only makes them more memorable, it also serves as a useful strategy in determining the meanings of unknown words.

To determine which students to include in the intervention group I will use prior performance, observations, and a vocabulary pre-assessment. For this task, the students will be given a worksheet with all of the vocabulary words for the unit. They will self-score their own understanding of each word on a scale from 1 (completely unfamiliar) to 4 (complete understanding). If a student assigns himself a score of 3 or 4 for a given word, he will be required to define the word and use it in a sentence in order to prove his understanding. After students score each word, they will tally their results and calculate an average score. This average will be a strong determinant for which students will receive the intervention.

I am in the fortunate position of co-teaching my chemistry classes with a special education teacher. We routinely utilize practices such as parallel teaching, so our students are very accustomed to having the class broken up into separate groups. This will be very important in maintaining the ambiguity of struggling readers when they are given the vocabulary intervention. Also, in a further effort not to single out an entire group, I will include good readers in the intervention group. Even though the strategy will be intended for struggling readers, anyone who receives it will benefit because many high school students do not know the meanings of even common word parts (Stahl and Shiel, 1992).

For my vocabulary intervention, I will use word decomposition to teach students how to segment words and use their parts to decipher the meaning. A vocabulary maze will be given as both a pre-assessment and post-assessment following the sequence to determine the overall effectiveness of the intervention (See figure 1). Following the initial attempt at the vocabulary

maze, I will write ‘exothermic’ on the board and ask students to write down what they think the word means. Most, if not all, students will be perplexed by the word. I will then explain that words perceived as difficult can be made easy by understanding their parts. To demonstrate this, I will model the process of breaking the word into its parts: exo, therm, and ic, describing that these parts make up the prefix, root, and suffix of the word. I will then give the students a handout, partially adapted from a list provided by Stahl and Shiel (1992), with common prefixes, suffixes, and roots. The reasoning behind this is that Stahl (2003) makes the claim that a small list of affixes can have a significant impact on overall word learning. The list will contain mostly word parts that are specific to vocabulary words from the unit. Figure 2 displays this handout.

Figure 1. Section A Vocabulary Maze

Petroleum is a mixture of various electrons / hydrocarbons / fractional distillations, that can be separated from one another through the process of fractional distillation / structural isomer / straight-chain alkane. This can be done because hydrocarbons have a backbone that is composed of a covalent bond / carbon chain / structural isomer. The longer this sequence, the stronger the electrons / branched-chain alkane / intermolecular forces, and the higher the boiling point.

Hydrocarbons are held together by covalent bonds / fractional distillation / electron shells. This is where the alkanes / valence electrons / electron shells of atoms are shared to create full straight-chain alkane / branched-chain alkane / electron shells.

One class of hydrocarbons is the alkanes / electron shells / valence electron, which contain only single covalent bonds. They can come in two different forms. In a straight-chain alkane / branched-chain alkane / hydrocarbon, no carbon atom is bonded to more than two other carbons. On the contrary, in a covalent bond / valence electron / branched-chain alkane, a carbon atom could be bonded to as many as four other carbons. Sometimes these two forms can exist for the same hydrocarbon. For example, octane has several electron shells / structural isomers / covalent bonds, or molecules with the same

molecular formula, but different structural formulas.

Figure 2. Word Part Handout

prefix	meaning		root	meaning		suffix	meaning
a or an	not or non		act	to do		able or ible	capable
anti	against		combust	to burn		al	relating to
co	together or with		condense	come together		ane	single bonds
dis	apart or away		conserve	to keep		ar	belonging to
endo	coming in, inside or within		dict	tell		ed	adjective or past tense of root
exo	leaving, outside or out		fraction	part		er	that which
hydro	water or hydrogen		function	performance or execution		ic	like or relating to
inter	between or among		mer	part		ing	act of
iso	same or equal		meter	measure		ion	result or state of
kino	movement		min	small		ity	state of
mis	wrong		mit	send		ive	causing
mono	one		molecule	particle of a compound		ly	like
non	not		port	carry		ness	state of
over	excess		struct	build or form		ous	full of or having
poly	many		therm	heat		s or es	plural
pre	before		valence	importance		y	tend to
re	again or back						
sub	below						
un	not						

Once I have distributed the handouts, I will have the students look up the word parts in the table, and discuss in small groups what the word means. In a whole group discussion we will come to the consensus that exothermic means ‘relating to heat leaving.’ I will then light a candle and

allow students to place their hands above the flame. Instructing them that the burning of the candle is a chemical reaction, I will ask the students if the reaction is exothermic. Again we will hold a group discussion until we agree that burning a candle is an exothermic reaction because heat is leaving. Although I may not be able to immediately provide a context for each vocabulary word, eventually through the course of the unit, situations will arise that give the words their relevance. Following this activity, I will segment each of the appropriate vocabulary words from section A, and have the students work in pairs to look up and decode their meanings. We will once again discuss the meanings as a whole group to confirm the definitions.

As Stahl and Shiel (1992) point out, when learning word parts, the entire emphasis should not be on learning specific terms. Therefore I will have the students engage in an activity where they will use the given word parts, as well as ones they knew previously, to create both real and nonsensical words. This will assure that the students are learning not only the intended terms, but also how the word parts function together to affect word meaning (Stahl and Shiel, 1992). If the students can master this skill, it will carry relevance for them far outside of this class.

The final part of the intervention for this section will be to revisit the vocabulary maze. Students who can show that they are proficient will move on to a new activity. Those who are not, will receive extra support and practice until they become competent. The students in the intervention group will now complete the other activities for section A with the rest of the class.

Once we have completed the full sequence of learning activities for the first section, I will reconvene the intervention group for the section B vocabulary. The sequence of events for this section's vocabulary terms will be the same as that for section A, but will use a different set of words. In an effort to scaffold the word decomposition process and pass more responsibility onto the students, I will no longer segment the words for them. Support will still exist through

partner work and whole group discussion though. Once we reach section C, I will remove the support of partner work, and the students must perform the word decomposition individually. At all stages of this process, students who do not demonstrate proficiency will be given extra support and practice until they meet the desired expectations.

The second intervention strategy I will use relates to comprehension. For this intervention, I will make use of self questioning and monitoring. As a pre-assessment, and to determine which students need the intervention, I will have them read a passage from the textbook, individually answer analysis questions, and complete a survey on their comprehension (See figure 3). The survey will include original questions developed by me, as well as some adapted from the Textbook Reading/Study Strategies Inventory (n.d.) from Module 7 of TE 822. Anyone with an average comprehension score below 3 will be included in the intervention group.

Figure 3. Comprehension Survey

On a scale of 1 (lowest) to 5 (highest), rate the following criteria:

_____ 1. How well did you understand this material?
_____ 2. How well did you monitor your understanding? (In other words, did you know when you didn't understand something?)
_____ 3. How easy was it for you to identify main ideas of paragraphs?
_____ 4. How well could you relate new information to what you already know?
_____ 5. How easy was it for you to ask yourself questions about the text?
_____ 6. How easy was it for you to identify the reason for reading this passage?
_____ 7. How easy was it for you to answer the analysis questions?

Add up your scores and find the average (total score divided by 7)

Average Comprehension Score = _____

For the intervention itself, I will use a combination of strategies including a read-aloud described by Ivey (2002), as well as Ehren's (2005) strategies for self questioning and monitoring. Beginning with the first textbook passage from section A, I will read the text aloud, and pause to model my own mental processes. By removing the burden of reading, I will allow my students to focus their mental energy on the strategy being introduced (Ivey, 2002). When I pause, I will ask and answer these specific questions: "For what reason am I studying this passage? What is the main idea of this passage? What assessment questions might be asked about the main idea? What are the answers to these questions? Do I understand what the author is saying? On what part do I need clarification?" I will tell the students that they will be expected to ask themselves these questions on the next passage.

When the group comes back together for section B, I will have the aforementioned questions printed on handouts for the students. I will distribute them, and have the students read the passage together in pairs. Pairing students to have them work together and discuss their use of the strategy is an integral part of this intervention because as Guthrie et al. (2002) point out, comprehension strategies are more effective and lead to better understanding when students are afforded opportunities to share questions and information being gained. In the partner activity, the students will read one paragraph at a time and switch roles at the end of each paragraph. Before they switch, the listener will ask the reader the questions from the handout. If the reader has difficulty answering any of the questions, the listener will do his best to assist with answers. This will lead to a discussion of the tactics used to find the answers. If both students struggle, I will read the paragraph aloud and model my own mental process for answering the questions. As with the vocabulary intervention, I will carefully reduce the amount of support given to the students, so that over time, more of the responsibility for using the questioning strategy falls on

them. When we reach the third textbook passage in the sequence, the first reading for section C, I will once again pair students and give them the handout containing the questions. Just as before, the students will take turns reading the paragraphs, but this time, the non-reader will act as an observer. The reader in the pair will be responsible for asking himself the questions on the handout. The observer's role will be to note if the reader is asking himself the proper questions, and assist in answering if necessary.

The next time the intervention is employed, which will be the second passage for section C, the students will still be able to use the handout with self-monitoring questions, but this time I will have the students read and question themselves individually. After reading, I will use analysis questions and the questions from the pre-assessment to judge how effectively the students are using the strategies. For students who score below level four, I will ask them to pose two questions from Ehren's (2005) monitoring strategy to themselves to identify the cause. These are: "Did I not attend sufficiently to what I was reading? Or was there something in the text that confused me?" This will help those students better monitor their comprehension and begin to repair the problem.

For the final reading in the sequence of activities for the lesson, I will remove all supports. By now the students should have internalized the self-questioning and monitoring strategies. They will be asked to read the passage individually with no questions provided for them. I will once again assess their progress using analysis questions along with the comprehension survey. If there are any students who still have difficulties, I will replace the necessary supports and allow for more practice until they are proficient at using the strategies independently.

Beyond the Interventions

The vast array of abilities, skills, background knowledge, and learning styles of my students will make it quite probable that these interventions will not be effective for all of the targeted individuals. For those that are not affected by training in word decomposition, it is possible that approaches like SCAR or "look inside-look out" will be more effective (Stahl and Shiel, 1992). Also, a deficiency in word decomposition is not the only factor that accounts for readers who struggle with vocabulary. If post-assessment data indicates that some students still have trouble understanding vocabulary terms after receiving different kinds of treatment, I may have to change my intervention strategy. Further investigation may determine that some students lack basic phonemic awareness. In this case, I could intervene with a series of lessons related to phonological decoding.

Likewise, deficiencies in comprehension can stem from many different causes. Post-assessments may show that even after intervention, some students have not made any progress. This could possibly be the result of a lack of engagement and motivation on the part of the students (Guthrie et al., 2004). To increase motivation and therefore comprehension, an intervention using Concept-Oriented Reading Instruction may be the best approach.

Conclusion

Unfortunately, not all deficiencies can be addressed by a single intervention. However, my plan attends to two of the most pressing needs faced by my students. Most importantly, it will have an impact not only inside my classroom, but in other classes and the world outside of school as well. Students will continue to confront new and difficult words throughout their lives. If they continue to use the strategy of breaking the words into parts and using the prefixes, roots, and suffixes to decipher the meanings, their vocabulary will continue to grow. Even if students

encounter an unfamiliar word part during this process, they are only a reference book away from unlocking the full understanding of the word.

The comprehension strategy will continue to have enduring use for my students as well. The beauty of it is that its application is not limited to textbooks. The strategy can be used when reading all kinds of printed text. Since reading is a key to overall learning, if my students can better comprehend what they read, they will be much more successful as lifelong learners. By teaching the strategies described in this paper, I can transform poor readers into proficient ones. Not only will this enable them to be more successful in school, but it will grant my students many more opportunities for a better life.

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