Promoting the vocabulary development of English learners with hypermedia authoring projects

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Abstract
This study investigated the impact of authoring hypermedia projects on the academic vocabulary development of middle school, ESL students. Vocabulary definitions, in-process verbalizations, observations and semi-structured interviews were the primary means of collecting data and assessing vocabulary growth. The results of this study indicate that hypermedia authoring had a positive impact on students’ understanding of grade level, science concepts as well as on student engagement in and attitudes toward vocabulary building activities. Thus, the procedures implemented in this study provide a model for teachers to follow as they attempt to facilitate their students’ vocabulary and concept development.

Keywords: Vocabulary development, technology, ESL, science education, middle school.

Introduction
According to recent demographic data, over 1.5 million English learners attend public and private schools in California. This number is expected to exceed 2 million by 2015, thus greatly increasing the number of students in need of language and literacy development in English. This situation is similar in many other states where changing immigration patterns have brought native speakers of other languages to schools in growing numbers. In fact, half of all teachers nationally may expect to have an English learner in their classroom at some point in their career. Consequently, the provision of English language and subject matter instruction to English learners is one of the most critical challenges confronting teachers and teacher educators today.

Further exacerbating the situation is the fact that the functions and nature of literacy in today’s society have changed. Literacy is no longer defined simply as the ability to read and write. In addition to being able to communicate in oral and written form, to be considered truly literate one must be able to think critically, reason logically and use technology. As the number and diversity of English learners increase, educators everywhere will need to seek solutions, meet challenges, and embrace changes necessary to ensure quality education for all students. Vocabulary development – particularly academic vocabulary development – is an essential element in any attempt to address these challenges.

A hypermedia environment is an environment that supports linking graphics, sound, and video elements in addition to text elements. The World Wide Web is a hypermedia environment since it supports graphical hyperlinks and links to sound and video files. Hypermedia authoring tools allow students to design their own hypermedia environments incorporating text, images, sound, video, and animation and creating links among these components [1].

Hypermedia and multimedia construction is predicated on the idea of knowledge as design¹, creating opportunities for a constructivist learning environment. ELL students benefit from environments that provide contextualized, authentic learning opportunities and engage students in tasks where they use language to communicate in meaningful ways [2], [3]. When these students are engaged in the authoring of hypermedia projects, they are developing and reinforcing their academic vocabulary as they make connections among text, images, video, sound and animation. This process encourages students to construct meaning and to make connections to their background knowledge. These activities also promote cognitive and metacognitive learning strategies as students decide/choose how to represent information and what associations/links to make between the text and multimedia component.
Researchers in literacy education have articulated the need for all students to become more familiar with learning in hypermedia and web-based environments [4], [5], [6]. Research studies exist which demonstrate that students who learn in multimedia and/or hypertext environments show greater gain in areas of language development than students who learn in more traditional environments [7], [8], [9], [10]. However, only a few studies have examined the impact of student construction of these hypermedia environments on their language acquisition [11], [12]. Thus, an examination of the research on instructional strategies that positively impact the vocabulary development of ELL students, as well as the research on the impact of hypermedia authoring on student learning, provides a strong rationale for investigating the impact of hypermedia authoring on L2 vocabulary acquisition.

Research Questions

In this study we investigated the impact of authoring hypermedia projects on the academic vocabulary development of seventh grade, ESL students. The specific research questions we addressed were:

- What impact does the authoring of hypermedia projects have on students’ academic vocabulary development?
- What are student perceptions of hypermedia authoring projects and vocabulary learning?

Methodology

Subjects and Setting: The research design included both qualitative and quantitative methodologies and was chosen to allow for an in-depth investigation of students’ vocabulary development. 14 students participated in this research study. These students were in a middle level, ESL classroom in a northern California urban middle school. The students in this classroom were children for whom Spanish, Russian, Farsi or Hindi is their first language. Other factors such as number of years in the U.S. and levels of L1 proficiency and literacy were determined to provide a context for the study (see table 1).

Table 1: Student Demographics

<table>
<thead>
<tr>
<th>ID</th>
<th>L1 prof. (1-5)</th>
<th>L2 prof. (1-5)</th>
<th>Ac Rating</th>
<th>Years in US</th>
<th>Language at Home</th>
<th>ESL Next Year</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Farsi</td>
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<td>2</td>
<td>3</td>
<td>Spanish</td>
<td>2</td>
</tr>
<tr>
<td>JL</td>
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<td>2/3</td>
<td>4</td>
<td>3</td>
<td>Spanish</td>
<td>2</td>
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<td>2</td>
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<td>12</td>
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<td>2</td>
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<tr>
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<td>5</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>Russian</td>
<td>3</td>
</tr>
<tr>
<td>IT</td>
<td>4</td>
<td>2/3</td>
<td>5</td>
<td>4</td>
<td>Russian</td>
<td>3</td>
</tr>
<tr>
<td>IK</td>
<td>4</td>
<td>2</td>
<td>3.5</td>
<td>1</td>
<td>Russian</td>
<td>2</td>
</tr>
<tr>
<td>AB</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>5</td>
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<tr>
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<td>4</td>
<td>2</td>
<td>5</td>
<td>½</td>
<td>Hindi</td>
<td>4</td>
</tr>
<tr>
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<td>4</td>
<td>2</td>
<td>Farsi</td>
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<tr>
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</tr>
<tr>
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<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>Spanish</td>
<td>2</td>
</tr>
</tbody>
</table>

Project Description: The instructional activities occurred in three phases. The introductory activities in phase I were designed to help students understand how they associate words with the concepts they represent through images, text and sound. Activities in phases II and III required them to apply this concept to their learning of a set of unfamiliar words.

Associating familiar words with their underlying concepts (phase I): The purposes of the first introductory activity were to help students take a metacognitive stance about learning vocabulary, to have students begin to think about multiple ways of representing the meaning of words, and to introduce students to the process of creating slides using Powerpoint. The whole class was asked to consider the word computer and brainstorm ways to explain this word to someone who speaks another language and does not understand the word in English. As students offered suggestions for explaining the word, the instructor typed text and inserted images and sounds into Powerpoint that was projected on a screen so students could see the process. Students suggested multiple ways of explaining the word, e.g., showing the object, showing a photograph, drawing a picture, using the language of the person to whom they are speaking.

The purposes of the second activity were to continue having students take a metacognitive stance about their learning and to begin to have students think about levels of difficulty in vocabulary. Familiar words were used in this activity to allow students to discuss the different levels of difficulty in words and to think about how to represent the meaning of words through the use of text and images. The students were asked to look
at four words familiar to them and, using index cards, write and draw pictures explaining these words. Students were then prompted to provide as much information as possible about each word. Finally, the whole class shared and discussed which words were easier to explain and why.

Students were then taught how to create hyperlinks using PowerPoint. The instructor brought a prepared PowerPoint presentation and a laptop for each student group with the same PowerPoint file on each computer. The Powerpoint had two blank slides and a number of pre-created slides with images, text, charts and sound to explain a selection of words. Once again these were all words familiar to the students. This allowed students to focus on the process of hyperlinking and continue to think about how to explain words familiar to them. The instructor led the whole class through the process of writing sentences with three words on a blank slide and then modeled the process of hyperlinking on the overhead as students followed along on their laptops. Next, students created hyperlinks for an additional three words, allowing them to practice the process and receive individual help from the instructor. Finally, students were asked to write their own sentences for three additional words and to hyperlink them to the appropriate pre-created slide.

**Learning the concepts underlying new vocabulary (phase II):** In pairs, students completed a web-based scavenger hunt designed by the researchers. The scavenger hunt was a directed activity in a hypermedia environment. Students went online to the scavenger hunt that required that they read questions and click on links that led them to pages where they could find information to use as the basis for their answers. They recorded their answers on the computer screen. The questions asked ranged in difficulty and were spiraled to help students gain an understanding of the vocabulary words and underlying concepts. The linked pages where students found the answers contained text, images and sounds allowing students to use these different media components to develop an understanding of the unit and target vocabulary. The purpose of this scavenger hunt was twofold. First, it provided instruction for students on the unit and opportunities for them to begin to learn and understand the target vocabulary. Second, it furthered their understanding of a hypermedia environment. After completing the scavenger hunt, students continued to explore web pages provided on the computer and to use books to gather as much information as they could.

**Reinforcing concepts underlying new vocabulary (phase III):** Students continued to learn about the words as they went through the process of creating a PowerPoint slide representing their understanding of each target word and incorporating text, images, and sound. Working in pairs students planned and decided how to create a slide to explain each of their words using images, text, and scanned diagrams/drawings. Before they continued with the process of creating the slides, they were required to share and explain their plan to the instructors for input and feedback. They were also required to write two or three slides about their chosen topic that included all the target vocabulary. They then went through the report highlighting each target word and creating a hyperlink between the word and the slide they had created to explain the word. Because they used PowerPoint to create these hyperlinks, the process allowed them to view the highlighted word in their report and the slide with their representation of the word simultaneously. Finally, each pair presented their hyperlinked report to the whole class. During the presentation they clicked on each hyperlinked word and explained the slides they had created.

**Data Collection**

**Vocabulary Development:** Three data sources were used to determine vocabulary development. The primary source of data was student index cards gathered both before and after the hypermedia authoring project. Students were given a set of blank index cards and asked to explain on one side what each of the target vocabulary words meant. On the other side, they were told to draw a picture or in some other way visually represent the concept the word represents. They were told that they could use English and/or their L1 and that they should provide as much information about the word as they could. Two secondary sources of data were the student’s final hypermedia products and individual, semi-structured interviews conducted at the end of the project. In these interviews students were asked to talk about the meaning of each word.

**Students Perceptions:** Two data sources were used to ascertain students’ perceptions of the hypermedia authoring project, in-process verbalizations and retrospective semi-structured interviews. During these interviews students were asked their views about hypermedia authoring and how they believed it contributed to their learning of words. In addition, observations and field notes
Data Analysis

Vocabulary Development: Based on an analysis of pilot study data of student responses on index cards, the researchers developed a continuum that represents levels of understanding of the target vocabulary words. The categories represented on the continuum are:

- Student provides a complete explanation of the word.
- Student provides a correct but incomplete explanation of the word.
- Student provides an example or characteristic of the word.
- Student provides incorrect information about the word.
- Student provides no information about the word.

This continuum was used to analyze the pre and post index cards for this study. The index cards for each student were placed along the continuum, and the frequency of words in each category was recorded. Students’ final hypermedia reports were assessed for whether or not the words were used in a meaningful way. Student interview responses related to the meaning of the target words were analyzed to ascertain the students’ conceptual understanding of the words. The data from the interviews was then compared to information students had provided on the index cards.

Student Perceptions: In-process verbalizations recorded throughout the project, and retrospective interview responses were transcribed and coded for emerging themes using the constant comparison method (Miles & Huberman, 1994). Observational data was analyzed and used for triangulation, to expand on preliminary data findings, and to provide a rich context for the study.

Results

Vocabulary Development: Analysis of the index cards shows that students’ understanding of the words increased over the course of the project. On the pre-test 100% of the words were in either the Incorrect or the No Information categories. After completion of the hypermedia project 69% of the words were in the Correct but Incomplete or Complete categories (see table 2).

<table>
<thead>
<tr>
<th>A/B C D/E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Test</td>
</tr>
<tr>
<td>Post Test</td>
</tr>
</tbody>
</table>

Table Key: A= No information; B= Incorrect; C= Example or characteristic; D= Correct but incomplete; E= Correct

Another level of analysis showed that improvement varied across words. For example 100% of the index cards for the words ‘vertebrate’ and ‘invertebrate’ were placed in the Complete category. However, only 40% of the index cards for the word ‘endangered’ were placed in the Complete category (see table 3).

<table>
<thead>
<tr>
<th>A B C D E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertebrate</td>
</tr>
<tr>
<td>Invertebrate</td>
</tr>
<tr>
<td>Warm-Blooded</td>
</tr>
<tr>
<td>Cold-blooded</td>
</tr>
<tr>
<td>Endangered</td>
</tr>
<tr>
<td>Characteristic</td>
</tr>
</tbody>
</table>

Table Key: A= No information; B= Incorrect; C= Example or characteristic; D= Correct but incomplete; E= Correct

Analysis of the final hypermedia reports shows that students used the majority of the words in meaningful ways. Examining each of the slides that students created as part of their final report reveals the range of complexity across the words. For
example most students found a very simple way to represent the meaning of the word vertebrate on their slides, using text and images. Most groups included an explanation of the word, and a picture of a vertebrate with an arrow from the backbone to the word ‘backbone’. However for many students the meaning of the word endangered was more difficult to represent using text and images. Comparing the analysis of the index cards to the final products we found that when students had used their own words and used images to represent the concept the word represents, their index cards placed further along the continuum on the post test.

Analysis of student interviews showed that students learned more about words than is reflected on their index cards. For example one student wrote “it describes things” on the index card for the word Characteristics. However when this student was asked in the interview to talk about the word Characteristic, he replied ‘Characteristics describe the animal or a person. Like a bird have feathers, wings beaks like…stuff like that. People have eyes, hair, skin.”

The students told researchers that it was easier to talk about the words than to write about the words.

‘It is harder to write it down and it is easier to talk about it and tell you’.

Therefore, the data in Table 1, which only reflect student responses on index cards, is a conservative indicator of student learning.

Student Perceptions: Analysis of student comments during the hypermedia authoring project showed that students were excited, engaged and on task during the project. The student interviews conducted at the conclusion of the hypermedia authoring project revealed perceptions held by the students about their own learning during the project. Many of the students commented on the impact of the process of creating the slides on their ability to remember the meaning of the word. In other words, the picture created on the slide became a picture in the student’s mind.

“I think about what we wrote, what we put on the slides, and if I put the picture in my head, then I can remember…”

Some of the students commented on the process of creating the hyperlinks from the words in the report, and revealed that they believed this process helped further their understanding of the words. Additionally, students felt that they are more likely to use their own words to represent the meaning of the target words when they are creating slides than during traditional instruction, which results in better student learning.

“On slides you think about using your own words (more than when reading and taking notes from a book). I did that and it worked. People listened more (when I gave my report). Like my drawing was my own way to explain cold-blooded and it wasn’t confusing to other kids”

“In this laptop we had to put pictures, describe things, use arrows, scan pictures, something like that….it is better to remember the words that way. Also making hyperlinks is also better to remember the words that way. …Cause you look at the words again and you look at slides again and it is interesting and you remember.”

Another finding from the interviews revealed that students had a better understanding of the words when they created the slide than when another student in their group created the slide. Since the students worked in groups, individual students were not always directly involved in the creation of each slide.

“I remember better words I did with M than it was to remember words O and A did.” (O and A were other members of her group.)

The students revealed sophisticated perceptions related to the use of hypermedia environments compared to traditional textbooks. Many students commented that access to and availability of information via hypermedia environment was greater and more useful than that in textbooks and other “traditional” instructional materials. They also commented on that fact that they could choose the direction they wanted to take and that they could access the information they needed more efficiently using the hypermedia environment.

“In books there are so many words to read and it is hard to find what you want. It is easier on the computer to find what you need to know. You can go your own way sometimes.”

“(Learning from the computer is better) Because it has pictures and more information about things. Like I went to the thing and I was just asking about cold-blooded and it gave me information about it right there. And I knew everything. And everything, like everything is right there and you can find everything. Yeah it has pictures and describing stuff and hyperlinks
to stuff. And when you find what you need you can like put it into your slide. Everything is there”

Conclusions
The lack of a control group was an obvious limitation of this study. However, previous experience at this school with students from similar backgrounds made it evident that more traditional, text-driven vocabulary activities had not been succeeding. Even students who had scored high on teacher-created and/or end-of-chapter vocabulary tests did not develop a true understanding of the concepts they were studying. In addition students were more engaged and enthusiastic during the hypermedia project than during traditional instructional activities.

Hypermedia environments can be tailored to meet the needs of English Language Learners, by incorporating an appropriate amount of text for the language level of the students and adding images and sounds. These environments also provide students with learning choices and allow them to navigate at their own pace. The use of this type of hypermedia environment in our project helped students stay engaged, on task and lessened their frustration level during the learning process. Engagement in the process of hypermedia authoring promotes vocabulary development as students connect new words to their prior knowledge and choose their own words and images to represent the underlying concepts. Thus, the procedures used in this study represent a potential instructional model for teachers in similar settings. Hypermedia authoring as described above can improve both students’ understanding of target vocabulary and their attitudes toward vocabulary instruction.

References