ACTION RESEARCH

USING WORDLES TO TEACH FOREIGN LANGUAGE WRITING

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This paper introduces readers to Wordle, a data visualization tool, and describes how word clouds, or wordles generated by Wordle, were used in an action research project designed to facilitate the teaching of foreign language (FL) writing within a dual coding theoretical framework. Over the course of one semester, students in a third-semester university FL Spanish course submitted drafts of their compositions electronically to create wordles (word clouds). The wordles were then used as visual tools to discuss students' writing development, writing strategies, and lexical acquisition. Word frequency counts along with wordles also contributed to student-centered discussions about writing. The paper concludes with a discussion of ways in which instructors can incorporate wordles into their FL classrooms to facilitate the teaching of L2 writing, as well as use them as tools to promote vocabulary development and communicative task-based teaching and learning.

USING WORDLES TO TEACH FOREIGN LANGUAGE WRITING

Data visualization tools have recently generated increased interest in multiple disciplines due to their ability to present and summarize data in ways that appeal to different types of learners. One type of data visualization, word clouds, assists in accentuating the main points of text-based information. In a matter of a few seconds, a word cloud highlights the main ideas by presenting words used in a text in the shape of a cloud, with the biggest words being those that were most frequently employed in the text. While numerous ideas exist for the potential of word clouds, there is relatively little research on whether and how they can facilitate the teaching and learning of vocabulary. No study exists to date that explores their potential in the FL classroom. In examining one type of data visualization tool for word clouds, Wordle, the present paper aims to fill this gap by carrying out an action research project during which "wordles" were incorporated into a Spanish foreign language (FL) classroom. The project had two goals: to facilitate the teaching of writing in class and to improve students' writing in the FL.

The first part of the paper that reports on this project contains a brief discussion of data visualization as a learning tool by specifically examining word clouds and how they have been used in previous research. The second part describes an action research project conducted by the authors using Wordle. The final section discusses the outcome of the project and provides suggestions for incorporating word clouds into the FL classroom. Throughout the paper, the term *wordle* is used to refer to a word cloud in general, while the capitalized term *Wordle* refers to the specific application tool created by Jonathan Feinberg (2009).

Data Visualization

Data visualization refers to the use of tools for representing data in the form of charts, maps, tag clouds, animation, or any graphical means that make content easier to understand (Barret, 2010). It serves as a way to communicate information clearly and effectively through visual representation, sometimes even via animated multimedia (see Friendly, 2008, for an excellent review of the history of data visualization through the centuries). Over the past few years, the use of data visualizations has increased rapidly in academia and in other contexts. These tools can help facilitate the understanding of complex events or phenomena because they present data in a multimodal way, incorporating visual, phonological, textual, and even animated input. For example, data visualization was used to report on the 2010 midterm elections in the United States (see CNN© video at http://www.youtube.com/watch?v=xnPjjAfcIgI).

Wordle

It is only recently that data visualization has become more accessible to the general public. Using widely available Web 2.0 tools, users can now easily create data visualizations without needing to know the technology used to create word cloud output. Creating data visualizations is now as easy as pasting information into a browser's window and choosing an output style, thanks to the many Websites that provide these tools for free to the public.

Word clouds are one of the most popular forms of data visualization. A word cloud, also called text cloud or tag cloud, is a visual representation of word frequency. The size of each word in a cloud depends on how many times it appears throughout the text. As the frequency of the word increases, the size of the word in the cloud becomes larger as well. The importance of a word is thus visualized in the cloud according to its font size. A number of free word cloud tools are available, such as Tagxedo, Tagul, Wordsift, and Tag Crowd. One of the most popular word cloud generators is Wordle, created by IBM developer Jonathan Feinberg. Feinberg also built Word-Cloud Generator (WCG), the tool found in the widely-known interactive data visualization site called Many Eyes (http://www-958.ibm.com/software/data/cognos/manyeyes/).

Defined by Feinberg as a "toy," Wordle is used by many for its simplicity and its visually appealing results. Users simply need to copy text from any source and paste it into Wordle, which performs statistical analyses of the text and organizes it by word frequency. Users can then change the font, shape and color scheme of the resulting image, remove any unwanted words, and view the total word frequency counts in a separate chart. Figure 1 below shows a word cloud created by the authors using Wordle.

Figure 1. Example word cloud from Wordle.net (created by the authors).

Word Clouds in Research

Only a small number of studies (Cidell, 2010; McNaught & Lam, 2010; Pendergast, 2010; Ramsden & Bate, 2008) has conducted research with word clouds, all within the last four years. Pendergast (2010) used "tag clouds" to perform an analysis of the most commonly used terms from documents published by the American Association for Family and Consumer Sciences (AAFCS), creating what she referred to as a "folksonomy" of texts (p. 292-3). She showed that the clouds revealed a visual hierarchy of text, and concluded by suggesting that tag clouds be included on Websites next to the published documents. Pendergast argued that doing so would appeal to multiple generations, including the "millennials," who, according to her, are multiliterate and tend to prefer visual over textual information (p. 297).

Cidell (2010) suggested that "content clouds" may serve as a form of exploratory qualitative data analysis (p. 516). She carried out a study with geographical data from public meeting transcripts and newspaper articles about "green" buildings. Using both visual content clouds and word frequency reports to carry out two case studies, Cidell showed visually how the same environmental issues are understood in different ways across the country. McNaught and Lam (2010) also supported the use of word clouds, arguing that they can be used as supplementary research tools for the triangulation of data (i.e., using multiple methods and data sources to obtain a more reliable picture of the phenomenon being explored). They carried out a study in which transcripts from two student focus groups, Chinese secondary school science students and second year law students, were analyzed. The researchers used Wordle to assess students' blog entries about their educational experiences as well as the use of ebooks. They were able to demonstrate the vast differences among student experiences, as well as to qualitatively corroborate their quantitative findings about students' perception of the value of both the focus groups and ebooks. Finally, Ramsden and Bate (2008) discussed the potential for word clouds to contribute to the field of education. They described how word clouds can be used to examine teacher responses to a survey about podcasting in educational contexts. The authors concluded by suggesting other uses for wordles (e.g., gathering informal feedback during large group instruction), as well as considerations teachers should take into account when creating word clouds, for example, the selection of software, data preparation, and how to interpret a word cloud.

Word Clouds in Education

To our knowledge, there is currently no research on the implementation of word clouds in the classroom. Rather, there are resources and suggestions for teachers on how to use word clouds. For example, Mehta (2007) created a Website that uses word clouds to analyze the speeches of U.S. presidents called *U.S. Presidential Speeches Tag Clouds*. Users can drag a timeline cursor to compare the frequency and trends of word use by all of the presidents. Another example is the Website *www.gapminder.org*, which has a section entirely dedicated to materials for teachers, such as the data visualization graph of wealth and health of nations. Not surprisingly, most literature on ways that teachers might incorporate word clouds is available on the Internet, typically in the form of blogs. One of the most detailed blogs with ideas for teachers is the Website The Clever Sheep, maintained by a Canadian high school teacher Rodd Lucier who proposes a number of educational uses for word clouds (Lucier, 2008).

Dual Coding Hypothesis

The theoretical framework for using wordles in the classroom is based on the dual coding hypothesis (Paivio, 1986). Engaging in class-based discussion about the meaning of words while simultaneously being able to look at them in a wordle, thus presenting learners with visual and auditory input concurrently, may help them to process and to retain vocabulary more effectively. According to Paivio's Dual Coding Theory, as well as to recent empirical findings about the way in which human brains process information (see Sousa, 2006, for a review), both verbal and nonverbal knowledge contribute to lexical representation of words in the mind. In reviewing what brain research tells us about second language learning, Genesee (2000) explains that "as connections are formed among adjacent neurons to form circuits, connections also begin to form with neurons in other regions of the brain that are associated with visual, tactile, and even olfactory information related to the sounds of words" (p. 2). Using multimedia-based input in class such as wordles should facilitate learners' ability to make meaningful connections among written, oral, and visual information, since the dual coding theory postulates that the mind processes and encodes information in multiple ways. There is clearly a need, then, for studies that show whether and if so, how, word clouds can enhance teaching and learning. The present study sought to address this need by carrying out an action research project exploring the potential of word clouds in a FL classroom context.

THE PRESENT STUDY

To investigate the potential of word clouds in a FL classroom, an action research project was designed using Wordle to enhance essay-writing skills in an intermediate-level FL Spanish class. The steps used in the present project were adapted from Mackey and Gass's (2005) explanation of action research, specifically to (a) incorporate "wordles" in the FL classroom to facilitate the teaching of writing in Spanish and (b) improve students' FL writing. To follow is a description of the classroom context and each step taken during the research project.

Classroom Context

Wordles were incorporated into an Intermediate-level Spanish FL class at a private research university. In a class of 18 students, which met for 50 minutes three times a week, students were assigned communicative tasks to perform with their peers in order to practice newly learned vocabulary and grammar. Students were also regularly assessed in speaking, reading, listening and writing.

For the writing component, students wrote four compositions throughout the semester, each with two drafts. Some days of instruction were designated for in-class writing workshops that served as an opportunity for discussing the writing process and writing strategies, and also for receiving instructor and peer feedback. The writing workshops were conducted as a class and were typically divided into two parts. During the first half of the workshop (25 minutes), the instructor discussed with students how to write in different genres such as narration, argumentation, and presentation in Spanish. Spanish transition words, such as paragraph markers, were presented, as well as writing techniques and formats that students could employ in their essays. The instructor also dedicated time to review common intermediate-level errors in writing. During the second half of the workshop (25 minutes), students worked in pairs to develop and discuss their essay topics, work on outlines, and ask questions. The writing workshops were conducted in Spanish.

All four composition topics covered cultural themes introduced in the course. Students were expected to be able to: present information formally with an introduction, supporting paragraphs, and a conclusion; use accurate grammar; and incorporate the instructor's feedback into their writing. These expectations were clearly communicated to the students.

Action Research Stage 1: Identification of the Problem and Hypothesis

The instructor observed two main issues in students' writing, which served as the foci of the current project: (1) continuous repetition of errors in students' essays, and (2) students' reliance on high frequency words, without trying to incorporate new ones into their writing. In other words, students rarely employed new vocabulary, relying instead on the same words. Below are some examples from student compositions.

> *Pienso que estereotipos no están basados en la realidad por muchos razones. Primero, un estereotipo que pienso que no es cierto es el estereotipo que atletas son brutos y no son inteligentes. Un otro estereotipo es que personas gordas son gordas porque no hacen ejercicio; este también es falso por muchas razones. Muchas personas piensan que ...*
>
> "I think that stereotypes are not based on reality for many reasons. First, a stereotype that I think is not certain is the stereotype that athletes are dumb and are not intelligent. One other stereotype is that fat people are fat because they do not do exercise; this is also false for many reasons. Many people think that …"

Note that the verb *pensar* "to think" is used three times; the adjective *mucho* "many" three times, and the *un otro* "one other" is used instead of otro "another," a common error. Despite class discussions about the use of new lexical items, students often relied on words with which they were most comfortable. The instructor therefore wanted to develop a more student-centered way to promote more lexical creativity

and grammatical accuracy. In consultation with the instructional technology staff, the instructor decided to use wordles as a teaching tool during the writing workshops. Because wordles are used for visualizing the text and could be based on the students' own compositions, the instructor hypothesized that their use could have a positive effect on student writing.

Action Research Stage 2: Data Collection

Data collection for this action research project came from three sources. First, at each draft stage, the instructor used Wordle to create one whole-class-based wordle as well as a word frequency count from all of the students' compositions. Second, after each writing workshop, the instructor wrote a teaching reflection about the class discussion and how students responded to the wordles. Lastly, at the end of the semester, the instructor asked students about their own perceptions of the use of Wordle for the writing process.

For the second composition, students were asked to submit their first draft to the instructor electronically. Using Wordle, the instructor then created a single wordle based on all the students' compositions. During the next class meeting and writing workshop, the instructor showed the resulting wordle to the class.

Figure 2. Students' first wordle for draft one of composition two.

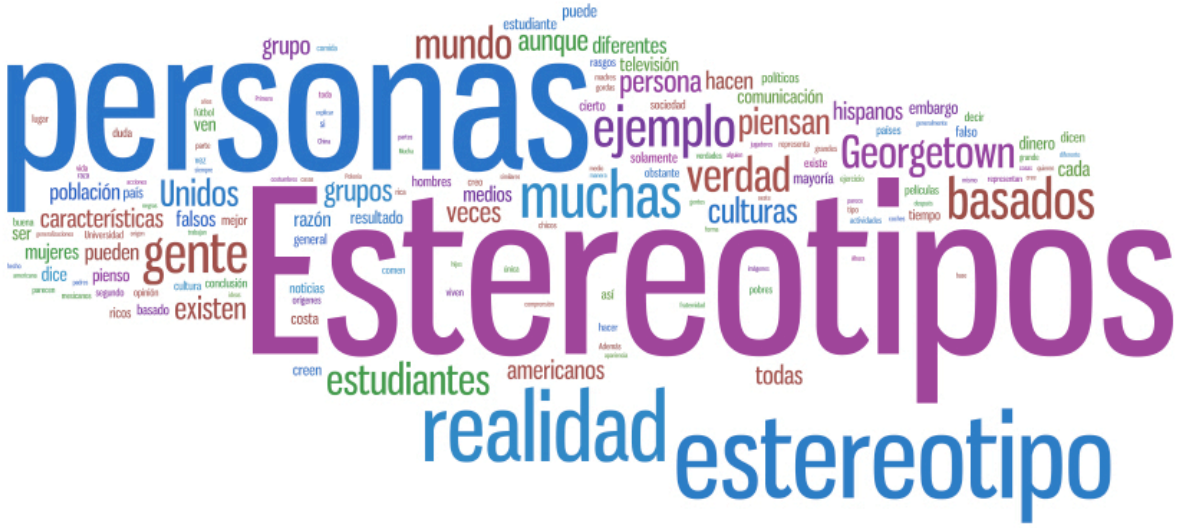
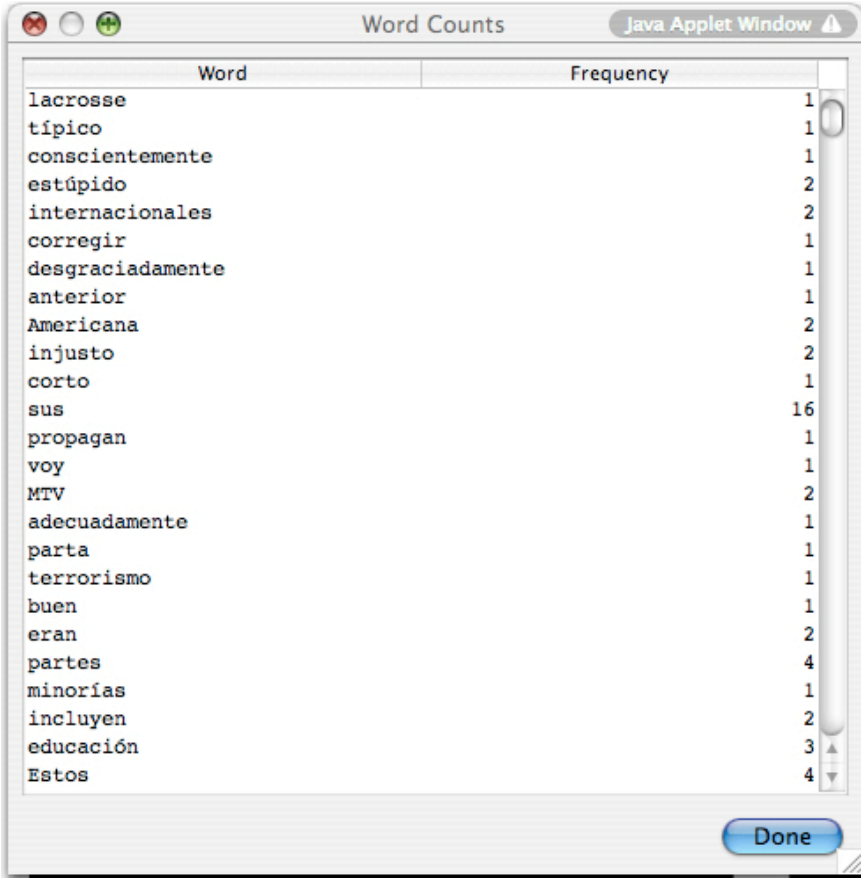


Figure 3. Students' wordle for the second draft of composition two.

As can be seen in the wordle in Figure 2, the largest words were those most frequently used in the students' writing. Using the wordle, the students and the instructor engaged in a dialogue about vocabulary items they had used, the different tenses, and even themes that their peers had written about. The class discussion during the workshop was therefore focused entirely on the students' own use of words. By examining the wordle in Figure 2 as a visual representation of the students' own writing, the instructor addressed issues in writing in a way that was based primarily on the students' written production instead of the teacher's feedback. Together, the class then came up with the goal of having students use five new vocabulary words in their second composition draft. For the next writing workshop, students again sent their second draft electronically to the instructor. Figure 3 shows the wordle from the second draft of the second composition.

This wordle showed that more words were used in the second draft than in the first one. To provide additional evidence, the instructor used the "show word counts" tool on the Wordle Website to create a corpus count of every word used in all 18 student compositions (Figure 4). While the total number of word types that students as a class used in their first draft was 1,134, the second draft word count was 1, 258. Furthermore, in addition to showing the total number of word types used by the students, the instructor showed them the frequency of each word. For example, in the first draft, the high frequency word *mucho* "many" was used 48 times across students' compositions. In the second draft, it was used only 21 times, meaning that students were using different adjectives in their writing. Both tools also showed students how many tenses they had produced, the different uses of adjectives, and how they showed grammatical agreement. The word frequency list also allowed the class to discuss topics in orthography: in scrolling down the word count list, a student pointed out that *observaciones* "observations" was listed twice. A closer examination revealed that across all 18 compositions, there were two uses of *observaciones* and two uses of *observaciónes* with an accent mark on the penultimate syllable. Students then inquired about which was correct, noticing their equal frequency. The instructor invited students to brainstorm about syllabification rules in groups. As a class, the students concluded that the single form *observación* has an accent, but maybe the plural form does not need one. This allowed the instructor to briefly discuss accentuation in a way that was based on the students' own writing. To conclude workshop 2, students established further goals for their next composition: a continued incorporation of new vocabulary words as well as the use of tenses besides only the present and past. One student also reminded the class to think about accent marks when an extra syllable is added to the word. Goals, therefore, were student-generated for the next composition and writing workshop.

In the third composition, students' writing continued to improve in the areas of grammatical complexity, accuracy, and use of new vocabulary, as indicated by an improvement in the average composition grade calculated with a rubric in these three areas, among others. Anecdotally, students reported to the instructor that they enjoyed the Wordle tool and looked forward to seeing the class wordle getting bigger with each successive draft. By the third composition, the whole-class wordle contained 1,476 word types. Some students used new vocabulary that had specifically come up during the class discussions of their writing. There was also a notable decrease in the use of commonly used words, such as *mucho* "many," *pienso que* "I think that," and *personas* "persons". The wordle helped to discourage use of common words, because students knew that they would show up in the class wordles. The end goal of seeing the wordle grow promoted the incorporation of new lexical items in their FL writing.



Word	Frequency
lacrosse	1
típico	1
conscientemente	1
estúpido	2
internacionales	2
corregir	1
desgraciadamente	1
anterior	1
Americana	2
injusto	2
corto	1
sus	16
propagan	1
voy	1
MTV	2
adecuadamente	1
parta	1
terrorismo	1
buen	1
eran	2
partes	4
minorías	1
incluyen	2
educación	3
Estos	4

Figure 4. Excerpt from word frequency count (produced by the same Wordle tool).

One incident that took place during a conversation about the students' third composition was particularly revealing. The name *Bob* was present in the second wordle (composition 3, draft 2). During the following writing workshop, the instructor asked students to identify any words they did not recognize in the wordle, and then invited the authors who had used those words to define them in class. A student raised his hand and asked "*¿Quién es Bob*?" ("Who is Bob?"). After much laughter from the class, the student who had written about Bob explained that Bob was his uncle who had dressed up as a clown one year for his birthday. Notably, this excerpt had an error in it: the student's first draft contained the erroneous form *vestió*, "dressed," which the instructor corrected to *se vistió* (irregular spelling and reflexive form). The student, while telling the class about Bob, produced the correct form (*se vistió*) and went on to explain that this irregular verb had been corrected in his first composition, but that he had remembered the correct form. The humorous conversation about Bob turned into a form-focused incident during which the student himself drew attention to a linguistic form in front of the whole class. Thus, a student's observation resulted in another student's consideration of grammatical accuracy, while sharing a meaningful story. This moment in class illustrated how opportunities to talk about the writing process, grammar, and feedback, namely, the instructor's corrections of students' compositions, were facilitated by the use of wordles.

By the fourth composition, the wordle for students' compositions had grown by another 50 words, as can be seen in Figure 5. Not only were students using more vocabulary in their writing, they also were employing and trying out new grammatical tenses, as demonstrated by both the wordle and corpus word frequency count.

Figure 5. Students' wordle for final composition.

For example, the first wordle and word frequency count showed that students employed only the present and past tense; however, by the fourth composition, they were using the present, past, future, perfect tenses, and even the present subjunctive. Though the addition of these tenses and moods was a function of new grammar learned during the semester, the wordles helped to show how much students had learned and how much they could express in writing by the end of the semester. It is important to point out that the very mechanisms of their writing served as the focal points of their own class discussions about the writing process.

Action Research Stage 3: Qualitative Evaluation of the Effects of Wordle

At the end of the semester, the instructor asked students to share their thoughts about the use of Wordle and whether or not they thought it was an effective tool to learn about writing in Spanish. Students were asked to write their opinions anonymously. 100% of the students thought that the use of Wordle was worthwhile and that it was a valuable tool to help them improve their writing. Many credited the wordles with making the writing workshops much more enjoyable and interesting than traditional ones. Students also made reference to the visual component of wordles. Below are some student comments:

> "I really like the wordles. They were fun and different. They also were interesting in that they showed me what everyone else was writing about. I got to know my classmates a little better."
>
> "The wordles definitely helped me in my writing. I especially liked that [the instructor] actually showed us how many more words we were writing with, how our grammar was improving … for me, having something visual just helps me more."
>
> "Using wordles for me was better because it made the writing workshop days more interesting. I normally hate writing workshop days! The visual of what everyone was writing about made it more interesting."
>
> "… What I liked was that it was a way of making art from our class' compositions. It made me more interested in writing, and I can honestly say I learned some words by studying the wordles."

These student comments corroborated perceptions expressed in the teaching reflection journal kept by the instructor. After the first writing workshop, the instructor reflected on how she felt and how students seemed to respond:

> *Today I felt like I really was able to get them interested in writing in Spanish! They seemed to come alive when I showed them the wordle and explained that it was made up of every one of their compositions. For the first time I felt like I wasn't up there in front of the class lecturing about*

> *writing. Writing workshops are sometimes difficult for me in that sense, because it's hard to make the very topic of writing be student-centered and communicative. They seemed so interested and so much more willing to talk about their compositions, and I was able to use the wordle to get them to initiate the discussion. This definitely started by talking about the vocabulary they used, asking which words they recognized and which they didn't. I think the word frequency count will help too—I'm going to try that next time and see how they react to it. The best part of today though, was the fact that the students came up with goals to improve the next round of compositions. This made me ecstatic, because I wasn't telling them what to do—they thought of the ideas themselves.*

By the end of the semester, the instructor wrote the following as a conclusion to the action research project:

> *… I feel like I have finally found something to really enhance my teaching about writing. The wordles were an excellent way to help me teach more effectively this semester, because I felt that I was connecting with my students better. As I've taught this class before, I definitely feel that wordles assisted in obtaining better writing on behalf of the students too. They were fun, were visual, and were created from the students' work … they helped me to motivate my students about writing.*

The instructor's impression of the use of wordles to assist in teaching about FL writing was very similar to that of the students: effective, novel, and enjoyable. Not only did the class discussions and workshop days become more student-centered, students also improved in their writing by incorporating new vocabulary into their essays, using grammar more accurately, and incorporating more content in their writing. Both the instructor and students had positive perceptions of wordles, confirming the instructor's hypothesis that wordles could be an effective tool for improving student writing.

DISCUSSION

This action research project was designed to address problems in students' FL writing as identified by the instructor, as well as to improve instruction in writing workshops. The incorporation of wordles into the classroom as an instructional tool resulted in the students using more varied vocabulary, more verb tenses, and more accurate grammar in their writing. In addition, feedback on students' perceptions of wordle as a tool to help them improve their writing was very positive. From the instructor's perspective, wordles enhanced the teaching of writing workshops and made them more effective and student-centered.

Other Uses of Word Clouds in the FL Classroom

The action research project described above demonstrated how word clouds can be used to facilitate the teaching of FL writing. However, they can certainly be employed as well for other languages, purposes, and for different types of tasks in FL instruction. For example, the Wordle application also supports Cyrillic, Devanagari, Hebrew, Arabic, and Greek scripts, and therefore can be used for many other foreign languages. To conclude, we would like to propose further suggestions for FL instructors such as:

Vocabulary Development

Instructors can create wordles from a text and have students learn and be tested on new words. For example, instructors can create a word cloud from a news article and use it to start an in-class conversation about current events. Students can use the word cloud visual to ask questions about words they might not know and/or as a means of input when discussing current events.

Pre-communicative Task Phase

Instructors can use word clouds during the pre-task phase of communicative tasks for which students are required to use new vocabulary. Students can be given a few minutes to study the word cloud and ask questions; they can then continue to refer to it as a visual means of vocabulary assistance while engaging in conversational interaction.

Pre-reading Activity

Students can engage in discussions using key words produced in a word cloud and make predictions about the content before reading the actual text.

Brainstorming

Students can use word clouds to generate ideas for new writing topics and/or themes.

Reflection

Students can use Wordle as a reflective tool for writing projects. For example, a wordle can be created for each essay that a class writes; wordles could be displayed as art forms illustrating the different genres and topics the class wrote about.

Assessment

Instructors can create word clouds from students' individual essays and use them for self-assessment purposes. Similar to the present study, the resulting word clouds as well as word frequency counts can show students' individual progress towards improving their vocabulary. The source of text could derive from blog posts as opposed to essays; this could be especially relevant for online classes.

Define Main Ideas

Students can use Wordle to make a word cloud out of a speech or newspaper article in the target language to discover and highlight the main ideas.

CONCLUSION, LIMITATIONS, AND SUGGESTIONS FOR FURTHER RESEARCH

In this action research project, wordles helped the instructor to foster more student-centered discussion of writing in class. In addition, they helped students to improve their writing. This study also aimed to contribute to the body of literature on emerging technology, in this case, wordles as data visualization tools.

A limitation of this study is its possible lack of generalizability. Findings in action research projects are typically relevant to the specific class under investigation, its students, and its own unique characteristics. While the use of wordles was successful in the current project, it may yield different results in other classrooms, contexts, and even languages. In addition, any instructor who wants to use Wordle must have a Java-enabled Web browser. If the in-class computer does not have java applets, the instructor may need to take a screen shot of the wordle before class. Finally, the algorithm used by Wordle automatically eliminates "common words" unless the instructor turns off this option. It is possible that "common words" are treated differently across languages.

While this study is classroom-specific, our goal is to share the results of the project with other FL instructors so that they too can consider the implementation of word clouds as well as other forms of data visualization tools in their classrooms. Further empirical studies, action research projects, and even classroom tasks are needed so that we learn more about how data visualization tools afford opportunities for teaching and learning in a variety of contexts and languages.

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REFERENCES

Barret, T. (2010). *Forty-five interesting ways* to use Wordle in the classroom* [Slideshare slides]. Retrieved from http://www.slideshare.net/boazchoi/fortyfive-interesting-ways-to-use-wordle-in-the-classroom

Cidell, J. (2010). Content clouds as exploratory qualitative data analysis. *AREA, 42,* 514–23.

Educause (2009). *7 things you should know about…Data Visualization II*. Retrieved from http://net.educause.edu/ir/library/pdf/ELI7052.pdf

Feinberg, J. (2009). Wordle. Retrieved from http://www.wordle.net/

Friendly, M. (2008). A brief history of data visualization. In C.-H. Chen, W. K. Härdle, & A. Unwin (Eds.), *Handbook of computational statistics: Data visualization* (pp. 15–56). New York: Springer.

Genesee, F. (2000). Brain research: Implications for second language learning. *Eric Digest*, EDO-FL-00012, 1–2. Retrieved from http://www.cal.org/resources/digest/0012brain.html

Lucier, R. (2008). Top 20 uses for Wordle. Retrieved from http://thecleversheep.blogspot.com/2008/10/top-20-uses-for-wordle.html

Mackey, A., & Gass, S. M. (2005). *Second language research: Methodology and design.* Mahwah, NJ: Lawrence Erlbaum Associates.

Mehta, C. (2007). US Presidential Speeches Tag Cloud. Retrieved from http://chir.ag/projects/preztags/

McNaught, C., & Lam, P. (2010). Using Wordle as a supplementary research tool. *The Qualitative Report, 15*(3), 630–643. Retrieved from http://www.nova.edu/ssss/QR/

Paivio, A. (1986). *Mental representation: A dual-coding approach.* New York: Cambridge University Press.

Pendergast, D. (2010). Connecting with Millennials: Using tag clouds to build a folksonomy from key home economics documents. *Family & Consumer Sciences Research Journal, 38,* 289–302.

Ramsden, A., & Bate, A. (2008). *Using word clouds in teaching and learning.* Retrieved from http://opus.bath.ac.uk/474/1/using%2520word%2520clouds%2520in%2520teaching%2520and%2520learning.pdf

Sousa, D. A. (2006). *How the brain learns.* Thousand Oaks, CA: Sage Publications.