

7-2010

Effects of Visual Analogies on Learner Outcomes: Bridging from the Known to the Unknown

Susan Spezzini

University of Alabama at Birmingham, spezzini@uab.edu

Recommended Citation

Spezzini, Susan (2010) "Effects of Visual Analogies on Learner Outcomes: Bridging from the Known to the Unknown," *International Journal for the Scholarship of Teaching and Learning*: Vol. 4: No. 2, Article 11.

Available at: <https://doi.org/10.20429/ijstl.2010.040211>

Effects of Visual Analogies on Learner Outcomes: Bridging from the Known to the Unknown

Abstract

This study examined the effects of visual analogies on learner outcomes in Phonology for ESL Teachers, a challenging course within a master's degree program at a prominent university in the southeastern United States. To reduce student anxiety, facilitate Saturday classes, and bridge from the known to the unknown, concrete images (train cars) were used to represent abstract ideas. Data were analyzed from course evaluations and exams of 70 students in two non-analogy courses (2004, 2005) and 114 students in three analogy-based courses (2007, 2008, 2009) and from an electronic survey completed by 64 former students (September 2009). Course evaluations improved, exam scores increased significantly, and participants reported significant increases in their use of visual analogies when teaching. Additional qualitative and quantitative data also suggested that the use of visual analogies positively influenced satisfaction, learning, and impact on teacher pedagogy. This study offers implications for instruction, assessment, and research.

Keywords

Visual analogies, Learner outcomes, Higher education, Teacher preparation, Phonology, English as a second language

Effects of Visual Analogies on Learner Outcomes: Bridging from the Known to the Unknown

Susan Spezzini

University of Alabama at Birmingham
Birmingham, Alabama, USA
spezzini@uab.edu

Abstract

This study examined the effects of visual analogies on learner outcomes in *Phonology for ESL Teachers*, a challenging course within a master's degree program at a prominent university in the southeastern United States. To reduce student anxiety, facilitate Saturday classes, and bridge from the known to the unknown, concrete images (train cars) were used to represent abstract ideas. Data were analyzed from course evaluations and exams of 70 students in two non-analogy courses (2004, 2005) and 114 students in three analogy-based courses (2007, 2008, 2009) and from an electronic survey completed by 64 former students (September 2009). Course evaluations improved, exam scores increased significantly, and participants reported significant increases in their use of visual analogies when teaching. Additional qualitative and quantitative data also suggested that the use of visual analogies positively influenced satisfaction, learning, and impact on teacher pedagogy. This study offers implications for instruction, assessment, and research.

Keywords: visual analogies, learner outcomes, higher education, teacher preparation, phonology, English as a second language

Introduction

"HUH? Is this course going to be hair raising or what?"
"EEEEEEEEEEK! I have never had a class like this before."
"I hope I am not in over my head. It scared me half to death."
"My first reaction was that I had died and been sent to torment."
"I was so lost. I felt like a foreigner in a world where I didn't belong."
"My brain strained to the point it couldn't take in any more information."
(Students pursuing master's degree in education)

These are comments of students after their first *Phonology for ESL Teachers* class session. As this all-day session progressed, the students' anxiety had risen steadily and learning became compromised. By 4:45 p.m., most students were totally overwhelmed. As they despondently filed out, I asked for feedback. Their email responses confirmed my suspicion: I had to change what I was doing. Although I had taught a similar course 15 times, it was in a different context. Not only was this a new course in a new degree program, but I was new to the institution and to the region.

This scenario took place in January 2004. Although I made some changes, immediately and in each succeeding semester, students consistently identified phonology as their most difficult course. A breakthrough for me came in December 2006 at a faculty development seminar. We were asked to select our most difficult concept and to brainstorm an

association between this concept and a common object (Brightman, 2006). I selected phonology and, after some careful thought, associated it with a train. In January 2007, I greeted my new class with a multi-faceted train analogy. The students visibly relaxed; it was as if they were listening to a story. This train analogy served to scaffold complex content by bridging from the known (train cars) to the unknown (phonological concepts). The train also provided a thread that wove throughout the semester.

During the ensuing 2-year development of *The Fun-Analogy (phonology) Train*, anecdotal evidence suggested that students were experiencing greater satisfaction and success. This train analogy seemed to reduce student anxiety, enhance their attitudes, and improve performance. Such evidence prompted me to study these visual analogies within the scholarship of teaching and learning (Hutchings & Shulman, 1999) with a focus on student satisfaction, student learning, and impact on teacher pedagogy. More specifically, I wanted to examine the effects of *The Fun-Analogy Train* on the learning of phonology and on students' ability to use this knowledge to help English language learners (ELLs) with improving their pronunciation.

I analyzed data from the course exams and course evaluations of 70 students in two courses taught without analogies (2004, 2005) and of 114 students in three courses taught with analogies (2007, 2008, 2009). In September 2009, I surveyed these 184 former students regarding their perceptions of the course. Improvements in test performance indicated a greater understanding of course content. Course evaluations also improved, and participants reported significant increases in their own use of visual analogies when teaching. Additional qualitative and quantitative data suggested that *The Fun-Analogy Train* had positively influenced student satisfaction, learning, and impact on teacher pedagogy. The results from this study provide implications for instruction, assessment, and research.

Overview of Visual Analogies

An analogy compares similarities between two concepts "that are neither completely similar nor completely different" (Orgill & Bodner, 2006, p. 1040). By definition, an analogy has two domains: a base domain and a target domain. The base domain (analog) is usually a familiar object such as a plant, and the target domain is usually an unfamiliar object such as a journal. In this example, the analogy can be represented by the image of a bamboo plant. It can also be a statement: A bamboo plant is like the *International Journal for the Scholarship of Teaching and Learning*. And, it can offer an explanation: This relationship is analogous because both have tensile strength, vitality, effective uses, and rapid growth (<http://academics.georgiasouthern.edu/ijsotl/>).

When analogies are used for instructional purposes, such as those examined in this study, the base domain is a common object that is well-known to students, and the target domain is a new object or concept that is to be learned by students. By associating attributes between the known (old) and the unknown (new), instructional analogies aim to help students gain a better understanding of the target concept. Analogies support instruction by relating "new information to knowledge and experience that students already possess, particularly if the new information is abstract and difficult to grasp" (Hargittai & Hargittai, 2007, p. 357). Adult students, such as in college courses, have reported "recalling analogies as triggers for larger concepts, very useful in exams, and also in other spheres of study" (Davies, Nersessian, & Goel, 2005, p. 145).

Types of Analogies

Instructional analogies can be classified based on relationship, presentation, and level of enrichment (Orgill & Bodner, 2006). With respect to relationship, analogies between known and unknown objects can be either *structural* or *functional*. The analogous relationship is structural when both objects share similar physical structures such as their external features. It is functional when both objects function or behave in similar ways. An instructional analogy can also represent a relationship that is both structural and functional.

Based on their presentation, analogies can be either visual or verbal (Radford, 1989). In visual presentations, instruction is enhanced by using the image of a known object (concrete image) that is analogous to an unknown object (target concept). These non-linguistic presentations have been called *visual analogies* (Krieger, 2005; Lin, Shiau, & Lawrenz, 1996), *pictorial analogies* (Feild & Graves, 1981; Issing, 1990), *graphic analogies* (Bailey, 2003), *Big Picture diagrams* (Brightman, 2006), and *'new-look' representations* (Perkins & Unger, 1994). In verbal presentations, analogous relationships are expressed in writing. These written presentations have been called *verbal analogies* (Radford, 1989) and *text analogies* (Curtis, 1988). An instructional analogy can also be both visual and verbal.

Regarding level of enrichment, verbal analogies can be simple, enriched, or extended (Orgill & Bodner, 2006). *Simple analogies* are limited to one sentence with three parts: analog ("a train"), connector ("is like"), and target ("phonology") (Radford, 1989). Because simple analogies are undeveloped and unelaborated, they are similar to assertions and "do not provide the instructional scaffolding that many learners need, particularly in the initial stages of learning a concept" (Glynn, 2008, p. 116). In contrast, *enriched analogies* aid comprehension by providing a purpose for using a specific analogy and/or an explanation of its analogous relationship and of the parts within that relationship (Orgill & Bodner, 2006). These enriched analogies become *extended analogies* when "used multiple times throughout a text" (p. 1049) and/or throughout the lecture or series of lectures.

Enriched or extended verbal analogies can become *elaborate analogies* when the analog features are systematically mapped onto the target features and accompanied by an image (Paris & Glynn, 2004). Two different approaches have been taken for creating elaborate analogies. Some analogy-creators first develop an enriched verbal analogy and then add an image—the visual analogy (Paris & Glynn, 2004; Radford, 1989). Other analogy-creators first use an image as a visual analogy and then add text, which, over time, may evolve from a simple verbal analogy into an enriched analogy (Spezzini, 2009). Although Krieger (2005, 2008) uses enriched and/or elaborate analogies, he continues referring to them as visual analogies. This could be the result of first having used visual images and then added text. Or, it could be based on the prominent role of images in promoting long-term recall (Brightman, 2006; Marzano et al., 2001). In this study, I also refer to image-based analogies as visual analogies, regardless of their level of verbal enrichment.

Impact on Learning Outcomes

A growing literature base reinforces the effectiveness of visual analogies in aiding student learning (Halpern, Hansen, & Riefer, 1990; Krieger, 2008). Complexities are addressed effectively by comparing new concepts to learners' common sense knowledge. Through such direct comparisons, visual and graphic analogies provide a short cut to learning and help learners retain complex ideas (Bailey, 2003). As an important human problem solving strategy, such analogies are "especially effective with mature adult learners because they come to learning with a large accumulation of previous experience" (p. 133).

Benefits of using visual analogies in secondary and college classrooms have been widely reported. Feild and Graves (1981) found pictorial analogies to help college students overcome writing blocks. Siqueira, Remiao, and Azevedo (1988) found visual analogies to be most useful in lieu of non-existent visual aids. Issing (1990) reported that learning improved significantly when pictorial analogies were designed properly, used with text, and matched with high structural similarity between the familiar base domain and the target domain. Lin, Shiau, and Lawrenz (1996) reported that the use of visual analogies produced greatest gains among low achievers.

In a meta-analysis of effective K-12 teaching studies, visual analogies were examined within a larger instructional strategy entitled “identifying similarities and differences” (Marzano, Pickering, & Pollock, 2001). With a 45 percentile gain and a 1.61 effect size (p. 7), this strategy was found most effective for promoting student achievement, especially for long-term learning. Results showed that “representing similarities and differences in graphic or symbolic form enhances students’ understanding of and ability to use knowledge” (p. 16).

The *Big Picture Diagram* is a special type of visual analogy that greatly enhances learning outcomes among college students (Brightman, 2006). The *Big Picture* provides students with a familiar concrete image for understanding a new idea and, thus, guides them to active learning that is both meaningful and integrated (Brightman, 2007). By selecting and using concrete images as a *Big Picture*, instructors can communicate in everyday language, and, by doing so, explain complex concepts in accessible ways. Such visual analogies also help students engage in critical thinking, increase retention of knowledge for long-term learning, and effectively bridge the gap between known and unknown.

Visual analogies have been studied extensively for teaching science, from elementary through college (Bean, Searles, Singer, & Cowen, 1990; Bulgren, Deshler, Schumaker, & Lenz, 2000; Dagher, 1995; Thiele, Venville, & Treagust, 1995). One research focus has examined science analogies on the computer (Perkins & Unger, 1994). By guiding students to construct explanations and justifications, ‘new-look’ representations (i.e., suggestive visual analogies) clarified the structure and reduced the cognitive load. Another research focus examined analogies in science textbooks, which contained many more analogies than social studies textbooks (Curtis, 1988). Recommendations were to select base domain objects that are well-known to students (Radford, 1989) and to clearly identify analogies as analogies, explain the analogous relationship more thoroughly, weave analogies throughout the text, and explain any limitations within these analogies (Orgill & Bodner, 2006).

Several of these criteria were incorporated within a set of visual analogy guidebooks for the teaching of human anatomy and physiology (Krieger, 2005, 2008). These visual analogies have been effective at reducing anxiety and at helping students focus on learning. They also make “learning more fun, relevant, and meaningful” (Krieger, 2008, p. 2). In a study of 62 college students, 77% responded that these visual analogies had helped them learn (<http://www.paulkrieger.com/SurveyResults.htm>).

Yet, some studies have shown that analogies do not necessarily enhance learner outcomes (Radford, 1989). Moreover, “if used ineffectively, they can hinder learning by causing misconceptions” (Glynn, 2008, p. 118). Negative outcomes seem related to undeveloped analogies, and positive outcomes seem related to elaborate analogies. Hence, implementing elaborate analogies is the purpose of the Teaching-With-Analogies Model (Glynn, 2007). In this model, teachers introduce a new concept (target domain), remind students about the known concept (base domain), identify relevant features in both concepts, connect or map out the similar features from the base domain to the target domain, indicate where the

analogy breaks down (i.e., differences), and draw conclusions. This model has enhanced students' learning and increased their interest in science.

Some studies have also examined analogy-based instruction for pre-service and in-service teachers. Texts with elaborate analogies were seen as instrumental in increasing science knowledge and improving attitudes among pre-service teachers preparing to teach grades 4-8 (Paris & Glynn, 2004). Computer-based treatment, which included pictorial analogies, influenced changes in the instructional techniques and materials of a beginning chemistry teacher (Lin & Chiu, 2000). These studies show that the use of analogies in teacher education can have a two-way effect. As shown in the first study, analogy-based instruction can enhance an individual's knowledge and attitudes. As shown in the second study, analogy-based instruction can positively influence an individual's pedagogical practice.

Numerous studies were found validating well-constructed analogies, visual and elaborate, as an effective instructional strategy among K-12 and college students for learning new knowledge and improving attitudes, especially in science. However, few studies examined how analogies affect teachers, pre-service and in-service, both for their own learning and for using analogies in their own classrooms. The current study is an attempt to fill this gap in the professional literature.

Method

To examine the effects of visual analogies on the teaching and learning of phonology, I conducted a cross-sectional, mixed-methods study. This study was guided by the following research questions:

- (1) As indicated by exams and course evaluations, how did visual analogies affect learning outcomes?
- (2) As self-reported by students, how did visual analogies affect their knowledge of phonology, ability to teach pronunciation, motivation to learn, anxiety about course content, and attitude towards the course?
- (3) To what extent did visual analogies influence the students' use of visual analogies in their own teaching?

Context of Study

This study was conducted at a prominent research university in the southeastern United States. Situated in the School of Education (SOE), it examined effects of visual analogies on learning outcomes in *Phonology for ESL Teachers*. To accommodate student needs, I taught Phonology on Saturdays (8:00 a.m. to 5:00 p.m.) in the spring of 2004, 2005, 2007, 2008, and 2009 and on Tuesdays (5:30 to 8:00 p.m.) in spring 2006 and in the fall of 2005, 2008, and 2009. The Saturday format entailed 5 class sessions (2 in January, 2 in February, and 1 in April), and the Tuesday format entailed 15 class sessions (weekly).

Participants

Study participants were all 184 students enrolled in *Phonology for ESL Teachers* with Saturday classes. Of these study participants, 70 took phonology without visual analogies (45 in 2004 and 25 in 2005) and 114 took it with visual analogies (41 in 2007, 49 in 2008, and 24 in 2009). Of these 184 participants, 134 were in-service teachers who were pursuing additional licensure (either with or without a master's degree), and 50 were pre-service

teachers who were entering the field of education at the graduate level. The demographics of these 184 participants are provided in Table 1. The columns provide the data according to courses taken without analogies (2004 and 2005) and with analogies (2007, 2008, and 2009). The rows provide data based on five demographic categories: gender, race/ethnicity, age, languages, and program. The blue single underlining indicates the lowest diversity among the students in these courses. The red double underlining indicates the highest diversity among these students.

Table 1. Demographics: Lowest diversity with blue underlining and highest with red double underlining

Phonology for ESL Teachers (Saturdays)	N = 184	Without Analogies				With Analogies					
		2004		2005		2007		2008		2009	
		N = 45	N = 25	N = 41	N = 49	N = 24	f	%	f	%	
Gender		f	%	f	%	f	%	f	%	f	%
Female	170 (92%)	44	<u>98%</u>	24	96%	34	<u>83%</u>	46	94%	22	92%
Male	14 (8%)	1	<u>2%</u>	1	4%	7	<u>17%</u>	3	6%	2	8%
Race/Ethnicity											
Caucasian	142 (77%)	40	<u>89%</u>	22	88%	34	83%	26	<u>53%</u>	20	84%
Afro-American	19 (10%)	0	<u>0%</u>	1	4%	1	2%	15	<u>31%</u>	2	8%
Latino/Hispanic	13 (7%)	4	9%	1	4%	3	7%	4	8%	1	4%
Native American	2 (1%)	1	2%	0	0%	0	0%	1	2%	0	0%
Asian American	4 (2%)	0	0%	1	4%	0	0%	2	4%	1	4%
Other	4 (2%)	0	0%	0	0%	3	7%	1	2%	0	0%
Age											
23-29	59 (32%)	15	33%	5	<u>20%</u>	14	34%	14	29%	11	<u>46%</u>
30-39	61 (33%)	13	29%	10	40%	12	29%	20	41%	6	25%
40-49	40 (22%)	13	29%	4	16%	10	24%	9	18%	4	17%
50+	24 (13%)	4	<u>9%</u>	6	<u>24%</u>	5	12%	6	12%	3	12%
Languages*											
Monolingual	96 (52%)	31	<u>69%</u>	17	68%	13	<u>32%</u>	25	51%	10	42%
Bilingual (2 languages)	72 (39%)	14	<u>31%</u>	8	32%	18	<u>44%</u>	21	43%	11	46%
Multilingual (3+ lang.)	16 (9%)	0	<u>0%</u>	0	0%	10	<u>24%</u>	3	6%	3	12%
Native Lang.: English	164 (89%)	41	91%	23	92%	34	<u>81%</u>	44	90%	22	92%
Native Lang.: Other**	21 (11%)	4	9%	2	8%	8	<u>19%</u>	5	10%	2	8%
Program											
Traditional MA (K-12)	118 (64%)	41	<u>91%</u>	22	88%	19	<u>46%</u>	25	51%	11	46%
Alternative MA (K-12)	40 (22%)	4	9%	2	8%	17	<u>42%</u>	9	18%	8	33%
Licensure-only (K-12)	16 (9%)	0	0%	1	4%	1	<u>2%</u>	11	22%	3	13%
Non-licensure MA: adults	10 (5%)	0	0%	0	0%	4	<u>10%</u>	4	8%	2	8%

* Self-reported by study participants.

**Native Languages: 11 Spanish, 4 Arabic, 2 Japanese, 1 Chinese, 1 French, 1 Russian, and 1 Turkish

As shown in Table 1, demographics varied from year to year. Blue single underlining shows how 2004 students were least diverse in four areas: gender, race/ethnicity, languages, and program. The red double underlining illustrates how 2007 students were most diverse in three areas: gender, languages, and program. The red double underlining also shows how the 2005 students were most diverse for age, and 2008 students for race/ethnicity.

Instructional Intervention: Visual Analogies

In January 2007, I sketched eight train cars and introduced these visual analogies one-by-one during the first 8-hour class for that semester. After orally explaining a given train car and its corresponding phonological concept, I posted the train car on the side wall. By the end of the day, the phonology train stretched across the classroom. In response to student feedback (e.g., "This is a fun idea, but I think it needs more focus and development to be

useful”), I started the second class by distributing a list of the train cars and their analogous phonological concepts (Coal car :: Vowel sounds) followed by a brief explanation (Both provide energy). Figure 1 provides analogies between freight cars and consonant sounds.

Figure 1. Analogies between freight cars and consonant sounds

Freight Cars :: Consonant Sounds	Similarities
Box Car :: Stop Consonants	Both totally obstruct the air flow.
Cattle Car :: Fricative Consonants	Both partially obstruct the air flow and are noisy.
Circus Car :: Affricate Consonants	Both consist of two parts.
Grain Car :: Nasal Consonants	Both have funny shapes and a downwards opening.
Tanker :: Liquid Consonants	Both are associated with liquids.
Flatbed :: Semi-Consonants	Both contain only half a structure.

This one-sentence explanation of the main similarity between a train car and phonological concept enhanced the effect of the corresponding visual analogy and, by doing so, an enriched analogy was created (Orgill & Bodner, 2006). Students reacted so positively to these analogies that the phonology train became part of each class session. Displayed along the wall, the hand-sketched train cars provided visual support to students throughout the semester, even during exams.

In January 2008, I converted the train car analogies from their original hand-sketched images to computer-drawn images. I also developed a PowerPoint presentation called *The Fun-Analogy Train: An Introduction to Phonology* (Spezzini, 2009). In these slides, the segmental features (i.e., vowels and consonants) were represented as train cars, and the suprasegmental features (i.e., intonation aspects) were represented as smoke that permeated the entire train (i.e., utterance). This phonology train is displayed in Figure 2.

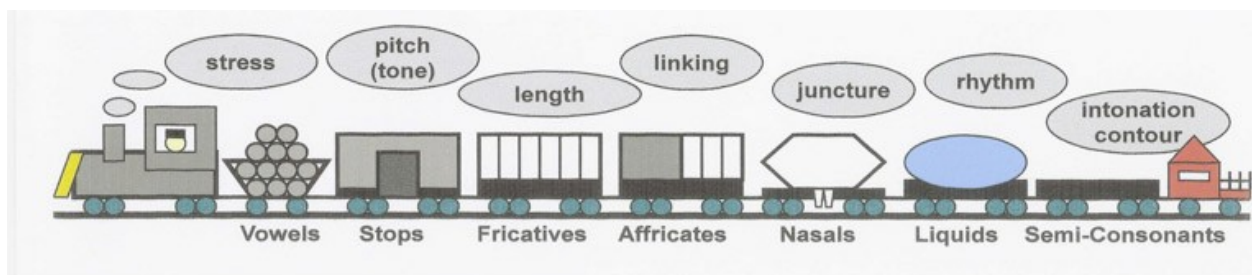


Figure 2. *The Fun-Analogy (phonology) Train*

Using the coal car analogy as an example, Figure 3 compares an original hand-sketched image to its computer-drawn image. As reported in earlier studies, computer-based representations can support the effectiveness of visual analogies (Lin & Chiu, 2000; Perkins & Unger, 1994). Figure 3 also illustrates the layout design used in formatting these slides. The upper left corner represents the base domain and provides the name of the concrete object (e.g., coal car). The upper right corner represents the target domain and provides the name of the abstract concept (e.g., vowel system). Each train slide also has a visual analogy, which is positioned directly below the name of the phonological concept, and a verbal analogy, which is at the bottom of the slide. In the visual analogy, each train car “transports” phonetic symbols from the International Phonetic Alphabet and some sample words that contain the corresponding sounds. In the verbal analogy, a simple analogy consisting of one sentence (e.g., “A coal car is like a vowel system”) is followed by an

enriched analogy (Orgill & Bodner, 2006). This enriched analogy explicitly identifies analogous functions and structures shared by the base domain and the target domain.

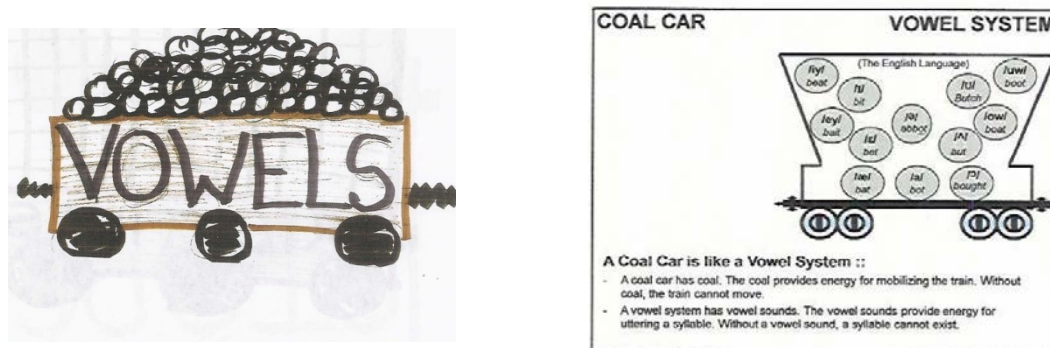


Figure 3. Coal car analogy for vowel sounds: Comparison of the original hand-sketched image and its computer-drawn image on a PowerPoint slide.

As shown in Figure 4, the verbal analogy maps analogous features onto two bulleted points—the first for the train car and the second for the phonological concept. Each bulleted point has the same number of sentences, and each pair of matched sentences has the same sentence structure. The parallelism of this verbal mapping is coded by color. Each color identifies a sentence and the corresponding analogous feature shared by the coal car and vowel system: first sentence=blue (possession), second sentence=red (energy), third sentence=green (purpose). Underlining identifies the identical words that appear in the corresponding sentences of each domain. Through this systematic mapping of analogous features, the analogy becomes an elaborate analogy and exerts an even greater impact on student learning (Paris & Glynn, 2004; Glynn, 2008).

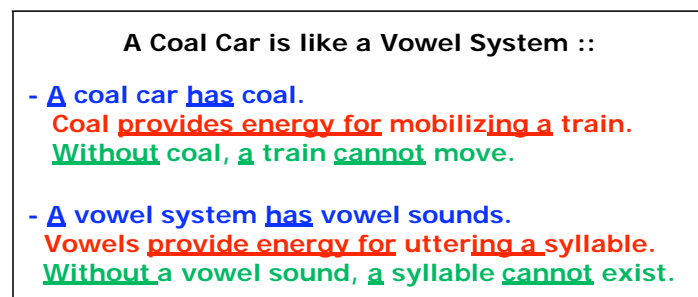


Figure 4. Mapping of analogous features between a coal car and a vowel system.

This coal car analogy for the vowel system is relatively simple when compared to the train analogies for the consonant sounds. Each type of consonant sound (i.e., manner of articulation) requires a detailed explanation of structural and functional similarities between the base domain and the target domain. Figure 5 shows the increased level of complexity required in the analogy between a cattle car and the fricative consonants.

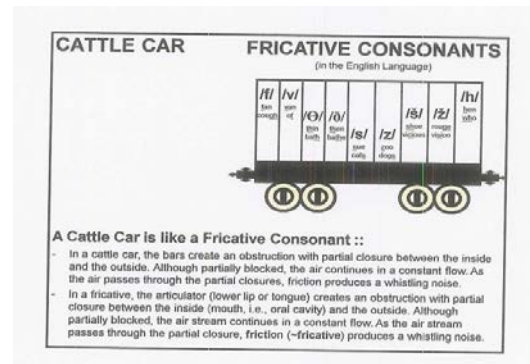


Figure 5. Cattle car analogy for fricative consonants: Comparison of the original hand sketched image and its computer-drawn image on a PowerPoint slide

The verbal mapping of analogous features from the cattle car (base domain) to the fricative consonants (target domain) is shown in Figure 6. Clarity and proper design were essential for enhancing the usefulness of this analogy (Issing, 2000). Once again, color coding illustrates the use of parallel structures between the base domain and the target domain, and underlining indicates the use of identical words. As with all of the other train car analogies, the verbal mapping was instrumental in converting each visual analogy into an elaborate analogy (Paris & Glynn, 2004; Glynn, 2008).

A Cattle Car is like a Fricative Consonant ::

- In a cattle car, the bars create an obstruction with partial closure between the inside and the outside. Although partially blocked, the air continues in a constant flow. As the air passes through the partial closures, friction produces a whistling noise.
- In a fricative, the articulator (lower lip or tongue) creates an obstruction with partial closure between the inside (mouth, i.e., oral cavity) and the outside. Although partially blocked, the air stream continues in a constant flow. As the air stream passes through the partial closure, friction (~fricative) produces a whistling noise.

Figure 6. Parallel structure in the verbal analogy between a cattle car and a fricative consonant

The computer-drawn images facilitated the use of these visual analogies during lectures. The PowerPoint slides were projected on a screen at the front of the classroom. Such visibility was crucial in large classes (i.e., 40+ students) where not all students could easily view hand-sketched images on 8" by 11" sheets displayed along the side wall. Another advantage of PowerPoint was posting these analogies on *Blackboard*, our online course platform. Through this platform, PowerPoint slides provided support to students in between class sessions, which was extremely useful since our Saturday course met only 5 times.

In January 2009, *The Fun-Analogy Train* became the cornerstone of my Phonology course. Through PowerPoint, I was able to develop overview slides for each subsystem (e.g., Freight cars are analogous to manner of articulation.) and also include a series of weather phenomena as visual analogies for the intonation features (Spezzini, 2009). These slides were so powerful that I used each of these visual analogies for introducing each of several sets of PowerPoint slides that I had subsequently developed for my lectures. Thus, by being

used repeatedly and throughout the semester, this elaborate analogy also became an extended analogy (Orgill & Bodner, 2006).

Research Procedure

Data were collected and analyzed from three sources: course exams ($N = 184$), course evaluations ($n = 166$), and electronic surveys ($n = 64$). Table 2 provides the distribution of the participants among these three data sources by the year in which they took *Phonology for ESL Teachers*. In this study, the courses taught without visual analogies (2004 and 2005) are called *non-analogy* courses, and the courses taught with visual analogies (2007, 2008, and 2009) are called *analogy* courses.

Table 2. Data sources and study participants

<i>Phonology for ESL Teachers</i> (Saturdays)	$n = 104$	Non-Analogy Courses		Analogy Courses		
		2004	2005	2007	2008	2009
Course Exams	184	45	25	41	49	24
Course Evaluations	166	37	24	35	46	24
Survey (Sept. 2009)	64	15	10	17	13	9

Quantitative data came from exams, course evaluations, and an electronic survey. Such data were analyzed with descriptive statistics, some inferential statistics (t tests), and correlations (Aron, Aron, & Coups, 2005). Qualitative data were gleaned from the course evaluations and the electronic survey. Such data were analyzed via content analysis (Patton, 2002). Participants were identified only by when they took phonology and whether it was a *non-analogy* course or an *analogy* course. As such, the study participants are categorized as having been either *non-analogy* students or *analogy* students

Course Exams

Students took two quizzes and a midterm, which together counted for 40% of the final grade. Students did the first 45-minute quiz at the start of their second class session, the second quiz at the start of their third class session, and the 2-hour midterm at the start of their fourth class session. All class sessions took place on Saturdays. These tests consisted of multiple choice questions, phonetic symbols, application exercises, and either essay questions or structured white space questions (Brightman, 2006). Although the exam content and structure were kept consistent from year to year, items were adjusted. I compared course means for the first quiz, second quiz, and midterm across all five courses, specifically examining differences between non-analogy courses (2004 and 2005) and analogy courses (2007, 2008, and 2009). I also examined the exam scores of individual survey respondents to determine whether a relationship existed between course performance and survey responses.

Course Evaluations

At the end of each semester, students in all SOE courses complete a course evaluation anonymously and in the absence of the instructor. This SOE course evaluation consists of 19 questions with bubbled multiple choice options and a three-part open-ended question (Appendix A). For this study, I selected the 10 multiple-choice questions that showed the greatest difference over time (Q3, Q5, Q6, Q8, Q9, Q10, Q15, Q16, Q17, Q18). The number of students completing course evaluations differed slightly from the number of students doing exams because of excused absences in the final class session (e.g., illness) or early departure from that session (e.g., family emergencies).

Electronic Survey

To specifically identify effects of the visual analogies on learner outcomes, I designed and conducted an electronic survey. Two introductory sections preceded the survey. The first section was an electronic consenting process. The second section consisted of questions about professional experiences: years teaching, years teaching ELLs, current position, and grades taught. The survey contained eight Likert-scale questions followed by two open-ended questions (Appendix B). The first six questions elicited student perceptions at 4 points in time: before taking the phonology course, after the first class session, upon completing the course, and right now, i.e., at the moment of doing the survey. Non-analogy and analogy students self-reported a Likert-scale level for each of these constructs: knowledge of phonology (Q1), ability to teach pronunciation (Q2), motivation for learning phonology (Q3), motivation for learning to teach pronunciation (Q4), anxiety about course content (Q5), and attitudes towards the course (Q6). The analogy students also responded to the last four questions (Q7-Q10). On the seventh Likert-scale question (Q7), they provided perceptions about how visual analogies had influenced constructs in the first six questions. On the final Likert-scale question (Q8), analogy students provided self-reported frequency with which they perceived using visual analogies in their own teaching, both before and after having taken the phonology course. The open-ended questions were: (Q9) "If you wish, please provide comments and/or insights regarding the use of visual analogies for teaching and learning" and (Q10) "If you wish, please provide comments and/or insights regarding the use of visual analogies in courses like phonology."

The content validity of the survey was established by basing items directly on research literature, having them reviewed by a panel of experts, and conducting a pilot study (February 2009). After completing the pilot study, I made minor adjustments to the instrument. I also shared the results from the pilot study at *The 2nd SoTL Commons: A Conference for the Scholarship of Teaching and Learning* (Spezzini, 2009). For the actual study, I sent an invitational email to the study participants in September 2009. I sent two follow-up emails at 1-week intervals. During this 3-week collection period, 64 of the 184 former students (35%) responded to the survey questions. This response rate was distributed quite evenly among the 5 courses.

Findings

This study validated initial anecdotal evidence suggesting that students were experiencing greater satisfaction and success after visual analogies were introduced in 2007. Significant increases occurred in exam scores, from lower performance by the 70 non-analogy students to higher performance by the 114 analogy students. Measurable trends were observed on course evaluations, becoming increasingly more positive year-by-year, especially after the incorporation of visual analogies. A significant increase was self-reported by the analogy students in their use of visual analogies when teaching. Additional qualitative and quantitative data also indicated that the use of visual analogies had positively influenced satisfaction, learning, and impact on teacher pedagogy.

Results are provided for each research question based on the following data sources: question 1—exams and course evaluations, question 2—survey, and question 3—survey.

Effect of Visual Analogies as Indicated by Exams and Course Evaluations

Course Exams

In the course exams, improved performance indicated a greater understanding of course content on the part of the analogy students. The higher performance of the analogy students seems to have been influenced by structural and functional similarities in the visual analogies (Brightman, 2006; Marzano et al., 2001), by elaborate verbal analogies that accompanied the visual analogies (Glynn, 2008; Issing, 1990; Paris & Glynn, 2004), by computer representations of these analogies (Lin & Chiu, 2000; Perkins & Unger, 1994), by meeting the needs of college students with diverse learning styles (Brightman, 2006), and by support provided by such analogies to low-achieving students (Lin et al., 1996).

The mean percentages on course exams are displayed in Table 3. This table provides the means for the first quiz, second quiz, and midterm exam.

Table 3. Means on course exams

Phonology for ESL Learners (Saturday)	N	Non-Analogy Courses		Analogy Courses		
		2004 N = 45	2005 N = 25	2007 N = 41	2008 N = 49	2009 N = 24
Quiz 1	184	78.2	78.0	87.6	89.4	89.7
Quiz 2	184	84.2	79.3	82.4	84.9	88.9
Midterm Exam	184	76.8	81.4	85.0	89.5	90.5

As shown in Table 3, measurable trends can be observed across all five courses for student performance on each of the exams (Quiz 1, Quiz 2, and Midterm). These measurable trends do not seem to have been affected by variations in student demographics (Table 1). Analogy students scored higher on the first quiz with means (M) of 87.6 (2007), 89.4 (2008), and 89.7 (2009) as compared to the non-analogy students with means of 78.2 (2004) and 78.0 (2005). The composite mean on the first quiz was significantly higher ($t=6.76$, $<.0001$) for the 114 analogy students ($M=88.8$, $SD=10.4$) than for the 70 non-analogy students ($M=78.1$, $SD=10.4$). Analogy students also scored higher on the midterm with means of 85.0 (2007), 89.5 (2008), and 90.5 (2009) as compared to the non-analogy students with means of 76.8 (2004) and 81.4 (2005). The composite mean on the midterm was again significantly higher (Satterthwaite $t=6.54$, $<.0001$) for the 114 analogy students ($M=88.1$, $SD=7.4$) than for the 70 non-analogy students ($M=78.4$, $SD=10.9$).

Student performance on the second quiz was different. Here the 2004 students seemed to excel. This surge was a direct result of my having prepared an easier second quiz in 2004, albeit with the same content and exam structure, to offset the mounting anxiety and to reward student efforts. After the incorporation of visual analogies in 2007 and the much-improved results of the analogy students on the first quiz, I prepared a second quiz that was more challenging. This adjustment is reflected in the fact that the analogy students received lower scores on the second quiz than they had on the first quiz.

As reflected by higher scores (first quiz and midterm) received by analogy students as compared to non-analogy students, the latter seemed to experience greater challenges in this phonology course. Yet, upon starting phonology, which is a branch of linguistics, many students from both groups could have probably identified themselves with the following:

Typically, these students come to the first class session [of a required linguistics course] feeling both apprehensive and resentful. They are nervous about having to take the class, and, at the same time, they suspect it will be of no use. No other class, with the possible exception of statistics, triggers these emotions so strongly. (Freeman & Freeman, 2004, p. ix)

In addition to potentially negative emotions, the students who were elementary teachers consistently expressed surprise that their knowledge of *phonics*, a reading strategy, was not a basis for learning *phonology*, the scientific study of sound systems. Yet, regardless of the possible source that evoked negative emotions towards phonology, a significant negative correlation was found between the non-analogy students' level of anxiety after the first class session, as self-reported on the survey (Q5), and their first quiz score ($r = -0.374$) at the 0.05 level (2-tailed). A significant negative correlation was also found between their self-reported level of anxiety after this first session and their midterm score ($r = -0.548$) at the 0.01 level (2-tailed). In other words, higher anxiety after the first class session was related to lower scores on the first quiz and midterm. Since a similar relationship did not exist between these exams and non-analogy students' self-reported anxiety before the phonology course, it appears that their anxiety increased in this first class session. Similarly, since a significant correlation did not exist between analogy students' exam scores and their self-reported anxiety after the first class session, it appears that any initial anxiety on their part may have become sufficiently reduced so as not to have been related to exam performance.

This analysis of the course exams confirmed anecdotal evidence that student performance was improving. Several factors, such as my experience in teaching this specific course, probably contributed to the year-by-year increase in student performance. Nonetheless, it can be assumed that the use of visual analogies was among these factors.

Course Evaluations

In the course evaluations, increases were observed in overall course rating, importance of the course, course impact on learning and reflection, student preparedness vis-à-vis content difficulty, and instructor qualities related to teaching effectiveness, application, and variety of teaching methods. Brightman (2006) had indicated that common images and the *Big Picture Diagram*—a type of visual analogy—would improve instruction and, to an even greater degree, increase students' perception of the quality of instruction. Indeed, such perceptions were higher among the analogy students than among the non-analogy students. The analogy students were also able to perceive how visual analogies can serve in providing a *Big Picture*.

A positive trend was also observed from 2004 to 2009 in each of the 19 Likert-scale questions on the SOE course evaluation (Appendix A). Once again, although such trends cannot be attributed directly to the use of visual analogies, the greatest increases were observed as of 2007 when the train analogies were first introduced and, to an even greater degree, as of 2008 when hand-sketched images were converted to computer-drawn images, projected via PowerPoint, posted on *Blackboard*, and accompanied by elaborate verbal analogies.

Guided by the SOE Center for Educational Accountability, which conducts these evaluations, I selected the 10 questions that showed the greatest difference from 2004 to 2009 and the greatest consistency between the two non-analogy courses (2004 and 2005) and the three analogy courses (2007, 2008, and 2009). For one of these questions, I examined the last of its five descriptors: *extremely difficult* (Q8). For the other 9 questions, I examined the first descriptor: *very well* (Q3), *one of most effective* (Q5), *one of the best* (Q6), and *strongly*

agree (Q15, Q16, Q17, Q18). For analysis purposes, I classified these questions in two groups, the first with questions related directly to the course and the second with questions related to students or to the instructor.

The five questions related directly to the course are provided in Table 4. They refer to its overall rating, importance, and impact on learning, knowledge and reflection. This table also provides the selected descriptor for each question and its response percentage.

Table 4. Course evaluation questions related directly to the course

Selected Questions and Choices with the Corresponding Response Percentages		No Analogies		With Analogies		
		2004	2005	2007	2008	2009
		Students (N)	25	41	49	24
	Responses* (n)	37	24	35	46	24
Overall Rating of Course and the Importance of Course						
6. What is your overall rating of this course?	<i>one of the best</i>	46%	48%	68%	72%	91%
10. In my own judgment, what I am being asked to learn in this course is important .	<i>strongly agree</i>	<u>73%</u>	<u>52%</u>	83%	91%	96%
Course Impact on Learning, Knowledge, and Reflection						
3. Rate how well the various elements of the course worked together in helping you learn .	<i>very well</i>	57%	56%	60%	74%	83%
15. The course prepared me with knowledge and skills that related to standards of my profession.	<i>strongly agree</i>	59%	78%	85%	89%	92%
16. The course encouraged me to reflect on my knowledge and practices in order to improve my understanding and skills as a professional.	<i>strongly agree</i>	65%	67%	<u>91%</u>	<u>89%</u>	<u>83%</u>

The responses to all five questions were increasingly positive from 2004 to 2009 except in two instances. The importance of the course (Q10) was viewed more positively by the 2004 students than by the 2005 students (red, single underlined). Since both courses were non-analogy and had similar demographics, the more positive response from the 2004 students as compared to the 2005 students may be related to the positive personal attributes often associated with individuals who join the first cohort of a given program. The reflection question (Q16) showed a surge in 2007 (blue, double underlined) followed by a slight drop in 2008 and a further drop in 2009. Since all three were analogy courses, student demographics may have had an influence. As indicated earlier, the 2007 students were the most diverse with respect to gender, languages, and program. As such, their focus on reflection was perhaps sufficiently different to have triggered a 91% response on Q16. Although the 83% response in 2009 is the lowest of the three analogy courses, it is still substantially higher than the 65% and 67% in the non-analogy courses. The only other decline was in Q3 with a negligible decrease from 57% in 2004 to 56% in 2005.

These trends are illustrated in Figure 7. Other than the instances described above, steady improvements are illustrated by a line graph for course importance (red) vis-à-vis overall course rating (blue) and by a bar graph for course impact on learning (blue), knowledge (red) and reflection (yellow).

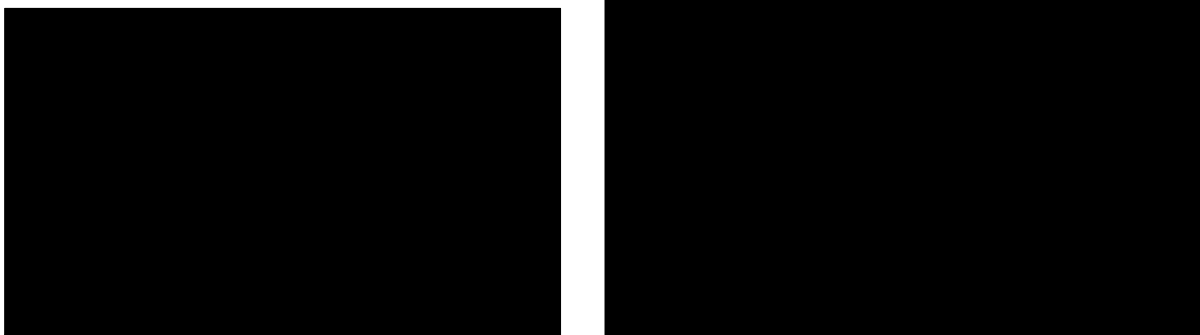


Figure 7. Course Evaluations: Overall Course Rating and Course Impact

.....

The questions that were related either to the students or to the instructor are provided in Table 5. The first two questions refer to students' preparedness vis-à-vis content difficulty. The other three refer to instructor effectiveness, application, and teaching methods. This table also provides the selected descriptor and corresponding percentage for each question.

Table 5. Course evaluation questions related either to the students or to the instructor

Selected Questions and Choices with the Corresponding Response Percentages	Students (N) Responses* (n)	No Analogies		With Analogies		
		2004	2005	2007	2008	2009
Student Preparedness: Educational Background vis-à-vis Content Difficulty						
8. The difficulty level of the course activities and materials is:	<i>extremely difficult</i>	51%	30%	26%	18%	4%
9. My educational background prepared me with the skills and information I need to achieve success in this course.	<i>strongly agree</i>	24%	35%	57%	59%	67%
Instructor Qualities: Effectiveness, Application, and Variety of Teaching Methods						
5. What is your overall rating of this instructor's teaching effectiveness compared with other college instructors you have had?	<i>one of most effective</i>	<u>73%</u>	<u>61%</u>	77%	85%	100%
17. The instructor related course content to applied situations related to my profession.	<i>strongly agree</i>	73%	74%	<u>91%</u>	<u>85%</u>	88%
18. The instructor used a variety of teaching methods to meet the diverse learning needs of students.	<i>strongly agree</i>	51%	56%	79%	83%	83%

Except for two instances, the responses to all five questions were increasingly positive from 2004 to 2009, decreasing in Q8 and increasing in the other four questions. The instructor's overall rating with respect to effectiveness (Q5) was viewed more positively by the 2004 students than by the 2005 students (red, single underlined). Once again, since both courses were non-analogy and had similar demographics, the more positive response from the 2004

students (which was identical to Q10) as compared to the 2005 students may have been related to the positive personal attributes associated with individuals who join a program's first cohort. The application question (Q17) showed a surge in 2007 (blue, double underlined) followed by a drop in 2008. As indicated earlier, because these 2007 students were the most diverse, their focus on professional application may have been sufficiently different to have triggered a 91% response (identical to Q16 above).

These trends are illustrated in Figure 8. The line graph shows an expected inverse relationship between student preparedness (blue) and content difficulty (red). Other than the instances described above, the bar graph shows steady improvements for instructor qualities related to effectiveness (blue), application (red), and teaching methods (yellow).



Figure 8. Course Evaluations: Student Preparedness and Instructor Qualities

.....

Student Perceptions of How Visual Analogies Affected Learner Outcomes

Survey

Participant responses to the electronic survey also served in validating the use of visual analogies in the EESL 625 course. Based on the perceptions of these former students, the visual analogies had positively affected their learning outcomes with respect to knowledge, ability, motivation, and attitudes. These same analogies had also been instrumental in reducing their anxiety. Such results are similar to those from earlier studies, especially for adult learners (Bailey, 2003; Brightman, 2006; Krieger, 2008).

Of the 64 participants who responded to the electronic survey, 25 were non-analogy students (2004 and 2005) and 39 were analogy students (2007, 2008, and 2009). They answered six Likert-scale questions at four points in time: before taking phonology, after the first class session, upon finishing the course, and right now (i.e., when doing the survey). When compared to the non-analogy students, the analogy students self-reported greater increases in their knowledge about phonology (Q1), ability to teach pronunciation to ELLs (Q2), motivation to learn about phonology (Q3), motivation to learn to teach pronunciation (Q4), and attitudes towards the course (Q6). The analogy students also self-reported a decrease in anxiety (Q5).

However, as explained earlier, this question (Q5) had also served to establish a significant correlation between the non-analogy students' high level anxiety after the first class session (Q5) and their low scores on the first quiz and the midterm. Because no similar correlation could be established between the analogy students' anxiety and their exam scores, it appears that the analogy students' anxiety had become reduced as of that first class

session. In response to the survey's open-ended questions (Q9 and Q10), several analogy students described how visual analogies had helped in reducing their anxiety.

On this survey, 38 analogy students also responded (Q7) to how visual analogies had affected their knowledge, ability, motivation, and attitudes. Table 6 provides these perceptions.

Table 6. Participant perceptions of how visual analogies affected learning in *Phonology for ESL Teachers*

How do you think the visual analogies used in the phonology course affected ... ?	n	very negatively		negatively		I'm not sure		positively		very positively	
		f	%	f	%	f	%	f	%	f	%
Your knowledge about phonology	38	0	0%	0	0%	5	13%	22	58%	11	29%
Your ability to teach pronunciation to ELLs	38	0	0%	0	0%	7	18%	15	40%	16	42%
Your motivation to learn about phonology	38	0	0%	0	0%	7	18%	19	50%	12	32%
Your motivation to learn how to teach pronunciation to ELLs	38	0	0%	0	0%	6	16%	15	39%	17	45%
Your attitude towards the phonology course	38	0	0%	1	3%	4	10%	17	45%	16	42%

When collapsed, the last two columns provide the percentage of survey respondents who perceived the visual analogies as having exerted positive or very positive effects. Of these 38 participants, 33 (87%) felt that visual analogies had exerted a positive or very positive effect on their knowledge about phonology and on their attitude towards the course, 32 (84%) perceived a positive or very positive effect on their motivation to learn how to teach pronunciation to ELLs, and 31 (82%) perceived a positive or very positive effect on their ability to teach pronunciation and on their motivation to learn phonology.

The results in Table 6 were corroborated by the analogy students in two open-ended survey questions (Q9 and Q10). These questions elicited comments and insights regarding the use of visual analogies for teaching and learning, especially in courses like phonology. Three students actually referred to the train analogy as having a role similar to that of the *Big Picture Diagram* (Brightman, 2006): "It [the train] really helps to understand the overall picture and how each 'car' depends on the other," "Cute analogy—helped with initially grasping the big picture when so much was new and overwhelming," and "This was a helpful visual to remember the progression of the course."

The analogy students referred to visual analogies and, more specifically, the train analogy as having been effective in learning abstract concepts (Brightman, 2006; Hargittai & Hargittai, 2007): "The train helped the difficult information to be more understandable," "One of my favorites! It (the train) helped to solidify the concepts," "It helped me learn the concepts very quickly," "Super helpful in learning so much new information!" "The use of analogies has always been something that helps me learn new material," and "They [visual analogies] are very useful in making abstract concepts more concrete." One student also referred to how visual analogies helped in learning new vocabulary: "It was good to have visuals for the new terms. They [visual analogies] still help me when categorizing sounds in my mind for the manner of articulation."

Many analogy students mentioned how analogies had helped them in retaining new information and often referred specifically to the mental images created (Bailey, 2003; Brightman, 2006; Marzano et al., 2001): "The visual analogies have also helped the content REMAIN in my head... a very effective technique," "More visuals are better; they helped us remember," "I was better able to associate the phonological categories with sounds and phonemes by the mental images created by the analogies," and "I think connecting content to visual analogies helps make the content accessible to more learners." Other students commented on using visual analogies whenever needed as a learning strategy: "I appreciated the visual; It made it easier to commit to memory," "A good visual reminder of what we had been learning," "Helped in recall for the quizzes," "Very useful—nice to view repeatedly," and "This was great; I referred to it often."

As educators, these analogy students made specific references to learning styles. The study participants who were visual learners felt that they had benefited greatly from the use of visual analogies (Brightman, 2006):

Visual analogies are an excellent way to reinforce concepts and to reach visual learners.

I am a visual learner and the train analogy was very helpful in learning how segmentals [vowels and consonants] and suprasegmentals [intonation features] work together in speech.

I loved the train! I'm a visual learner; so it really helped me remember the suprasegmentals.

I loved this analogy and pictorial representation of phonology. As a visual learner, I was able to visualize and recall facts on the tests and even in conversation.

I tend to be a visual learner so for me the train analogy was very helpful in learning how, although segmentals and suprasegmentals are separate, they work together in speech.

I am a visual learner, so I think that visual analogies are especially beneficial for me, and for students like me.

Not being visual learners, other participants did not feel that they had benefitted much from the train analogy: "For me—a fairly straightforward learner, I preferred the charts and graphs [phonetic symbols and vocal tract drawings]. That's how I learn best." Nonetheless, such participants did recognize that visual analogies had been useful for other students:

I felt very positively about the use of the visual analogies; however, for me the vocal tract diagrams were most helpful. It is my opinion that they [visual analogies] work more effectively for some learning styles than for others.

I find them [visual analogies] interesting but not essential as I am able to understand the concepts without them. I think they may be very helpful to those learners who struggle with concepts.

Though I believe visual analogies are helpful teaching aids, I personally do not use them to learn. I believe it is strictly a personal preference and am aware that they are helpful for many. I remember what the train looked like, but I personally did not use it. It also may have been something as simple as where I was seated in the room [2007 hand-sketched drawings].

As shown in earlier studies, the effectiveness of visual analogies is increased when accompanied by elaborate verbal analogies—explanations that clarify the structural and functional similarities between the base domain and the target domain (Glynn, 2008; Issing, 1990; Paris & Glynn, 2004). Three comments from 2007 participants illustrate that the hand-sketched train analogy had not been immediately clear: "It was a little hard to follow at first, but after the initial discussion, it was helpful," "Once explained, it made a lot of sense and was a great resource," and "It was not until later in the course that I understood

the train. I found it overwhelming the first day with no background in phonology.” For these three students, the hand-sketched drawings were not helpful until accompanied by a verbal analogy, and this did not happen until their second class session. In direct contrast is a comment from a 2008 participant. In her class, the structural and functional similarities of each visual analogy were explained in a verbal analogy, and both analogies (visual and verbal) were on the same PowerPoint slide:

When analogies mean something, they are very helpful. The train analogy had meaning behind every part of it, and it was logical and helpful. The instructor’s excitement about the train analogy was contagious and allowed all of us to connect with it more freely.

Another comment related to verbal analogies was how one student connected the train analogy with our course’s phonology song: “Excellent analogy—it worked well with the *We’ve been workin’ on phonology* song.” In 2006, prior to introducing the train analogy, I had written lyrics, based on these same phonological concepts, to the melody of “I’ve been workin’ on the railroad.” I used this song each succeeding semester as a means to maximize learning by providing different sensual experiences. For this student, the railroad song and the train analogy worked in concert with one another to support meaningful learning.

Other participants felt that the train analogies helped to ameliorate potentially adverse emotional reactions to phonology (Freeman & Freeman, 2004; Krieger, 2008): “For me, I found them [visual analogies] to be helpful in lowering my affective filter toward the content of the phonology course,” “They made the content material less intimidating and easier to understand,” and “They are great for reducing the anxiety that sometimes goes along with learning new things. Difficult new vocabulary or concepts are far less intimidating when they are part of a familiar/silly/funny analogy.” These comments directly addressed one of my major reasons for having introduced visual analogies—that of reducing student anxiety. Moreover, reducing anxiety to help students “focus on the task at hand” was the first purpose given by Krieger for using visual analogies when teaching complex subject matter (2008, p.2).

Studies have shown that images and visual analogies promote long-term learning (Bailey, 2003; Marzano et al., 2001). Although more than 2 years had passed since having viewed the hand-sketched train, a student commented on still being able to see it and on remembering its corresponding concepts: “Today, I can still see the train and how it was used to explain concepts. It was truly a life saver when learning detailed information.” Another student, though just vaguely remembering the train, commented on being able to apply the concepts that were associated with it:

I vaguely remember the train analogy, but I would not be able to tell you much now about it unless you provide some details to refresh my memory. At any rate, I taught a section on phonology to TESOL students, and I was well prepared from having taken the phonology course. Thank you.

Two participants expressed a preference for creating their own visual analogies: “I think students should draw it,” and “This was not very helpful to me. I prefer to come up with my own analogies. It’s much more meaningful to me that way.” Creating one’s own analogy is indeed an empowering experience, especially as a problem solving strategy (Davies et al., 2005). However, an underlying reason for these comments could be that a train is no longer common sense knowledge for many of today’s students, especially in the region served by this university. In creating visual analogies, a major criterion is selecting a common object that is known by students and, if possible, part of their everyday experiences (Bailey, 2003; Brightman, 2006). For example, two of the other study participants felt that they did not

know enough about trains for this image to have been immediately helpful for learning abstract concepts related to phonology:

I honestly did not know anything about trains. I imagine I would have caught on faster if the visual analogy had been an airplane or a truck.

Not knowing much about trains to begin with, I have to admit that all the different types of train cars could sometimes get confusing. I think a train poster posted in the classroom might have helped a lot for reference purposes.

Both of these participants had been in the 2009 course. Since this was after I had fully developed the PowerPoint presentations, I was no longer showing the hand-sketched drawings. Yet, given the students' diverse backgrounds and their varied learning styles, I should have continued posting the hand-sketched drawings along the wall such as I had in 2007 and 2008. By doing so, the visual analogies would have remained in sight at all times, and this might have helped both of these students.

Students' Use of Visual Analogies in Their Own Teaching

Of great importance to teacher education, analogy students reported a significant increase in the frequency of using visual analogies in their own teaching. As such, their responses support the use of visual analogies in teacher preparation courses to serve as a model for teachers to use in their own classrooms (Curtis, 1988; Lin & Chiu, 2000; Paris & Glynn, 2004). This impact on teacher pedagogy was also described by several students in the open-ended questions.

Analogy students responded to a question (Q8) that asked "How often have you used visual analogies in your own teaching?" As shown in Table 7, their responses indicated an increase in the frequency with which they have used visual analogies in their own teaching since having taken *Phonology for ESL Teachers*.

Table 7. Use of visual analogies by analogy students in their own teaching

<i>Phonology for ESL Teachers (with analogies)</i>	<i>n</i>	<i>M</i>	<i>SD</i>	How often have you used visual analogies in your own teaching?									
				<u>1=never</u>		<u>2=rarely</u>		<u>3=sometimes</u>		<u>4=often</u>		<u>5=always</u>	
				f	%	f	%	f	%	f	%	f	%
Before taking phonology	38	2.61	1.08	7	18%	9	24%	16	42%	4	11%	2	5%
After taking phonology	38	3.61	0.86	1	3%	2	5%	12	31%	19	50%	4	11%

Of the 38 analogy students who responded to this question, only 6 (16%) reported having used visual analogies *often or always* in their teaching prior to having taken the phonology course, and 16 (42%) reported that they had *never or rarely* used visual analogies before that time. However, after having taken the phonology course, 23 (61%) reported using visual analogies *often or always* in their own teaching, and only 3 (8%) reported that they *never or rarely* use them. By conducting a *t*-test on the numeric values associated with the ratings in Table 7, the difference between the means is significant ($t=7.09$, $<.0001$, $df=37$). Within a range of 4 intervals, the participants' use of visual analogies increased 1 full interval, from $M=2.61$ before the phonology course to $M=3.61$ after the course. The standard deviations decreased from 1.08 before the phonology course to 0.86 after the course. These results suggest that the participants' firsthand experience with using visual

analogies to learn phonology may have influenced how often they now use visual analogies in their own teaching.

This statistically significant outcome was corroborated by the participants' responses to the open-ended questions. As trained educators, most had been aware that visual analogies could serve an important role in supporting the learning process: "I believe visual analogies are helpful teaching aids," "They [visual analogies] should definitely be used by all teachers when teaching," "I love using analogies because it helps learners connect new concepts to things they already know," and "Generally I find visual analogies useful, especially for visual learners and/or for those with limited English skills." Based on the following comments, study participants also realized that visual analogies promote learning for all learners—children and adults: "I find them to be very beneficial for students of all ages," "These [visual analogies] are useful with younger as well as with older learners," "Visual analogies are very helpful whether you're teaching children or adults!" and "Visual analogies are quite useful tools for adult learners."

However, prior to having taken the phonology course, several of the analogy students had apparently never used visual analogies in their own learning, and most had rarely (if ever) used them when teaching. Yet, after experiencing firsthand how the train analogy helped them to learn phonology, they became converts to using visual analogies in their own teaching:

I didn't understand the full impact that visual analogies have on learning until I used them in my phonology course.

It was so valuable to use the techniques [visual analogies] in our own learning and studying in order to see how well those techniques would work in the instruction of our own students. Educators learn the "how" and the "why" of using visual analogies.

The use of visual analogies was not only helpful in regard to learning the material in the phonology course, [but] it was a fantastic way to model for us how visual analogies can be used to teach our students. I really appreciated that we were taught the way we are expected to teach.

As explained by these participants, the modeling of best practices (i.e., visual analogies) in education courses is an excellent way to guide teachers for using these same practices in their own classrooms. *The Fun-Analogy Train* served in providing graduate students with personal experiences regarding the effectiveness of visual analogies in the learning process and, as such, served as a model for them when teaching their own students. To that end, the phonology course was instrumental in making an impact on teacher pedagogy.

Implications and Future Research

The findings from this study support the three main purposes for using visual analogies in college courses as proposed by Krieger (2008): reducing anxiety, focusing on content, and retaining information. According to Brightman (2006), common images and the *Big Picture Diagram* help college instructors and their students. On the one hand, instructors are able to communicate in everyday language and to explain complexity simply (Bailey, 2003; Hargittai & Hargittai, 2007). As a result, the instructor's teaching improves greatly, especially from the student perspective (Brightman, 2006). Students, on the other hand, are able to make connections to meaningful-integrated learning, critical thinking, increased retention, and long-term learning (Brightman, 2007; Halpern et al., 1990; Marzano et al., 2001). Thus, when instructors use visual analogies, and especially when these images are

part of an elaborate verbal analogy (Glynn, 2008; Paris & Glynn, 2004), students have access to a familiar image for understanding a new idea and can more effectively bridge the gap between the known and the unknown.

A number of factors in the phonology course may have contributed to the improvements seen in student satisfaction, student learning, and impact on teacher pedagogy. Based on study findings, it can be assumed that the use of visual analogies, which evolved into elaborate analogies (Glynn, 2008; Paris & Glynn, 2004), was significant among these factors. As such, the current study serves to validate the use of visual analogies for teaching abstract concepts in higher education.

Yet, not all students were able to benefit equally from these visual analogies. Some students stated that they were not visual learners, and as such, the analogies, though helpful for other students, were neither necessary nor helpful for themselves. Fortunately, as pre-service and in-service teachers, they felt strongly that these analogies should continue to be used for the benefit of the students who needed them.

A situation that occurred in my phonology courses, and that often occurs in all courses, is a lack of shared knowledge. I assumed that my students would know something about trains, not necessarily from personal knowledge, but from childhood books and the transportation curriculum learned in elementary school. However, this was not the case. Some students commented that they did not know enough about trains for the analogy to be useful, especially at the beginning. Because I had selected the train as a common everyday object (Brightman, 2006), I did not attempt to build background knowledge. One student suggested having a train poster for reference, and I will follow up on that suggestion. I will also tape my hand-sketched train cars along the wall in each class session. This way, all of the images will be visible for immediate recall, which was not the case in 2008 and 2009.

Another student explained how analogies are more helpful for her if she is able to create her own. Students should definitely be encouraged to move beyond the analogy provided by the instructor and to develop their own analogies. This could be as an optional or required assignment. However, having an instructor-selected analogy as of the first class session is instrumental for immediately focusing on the first two objectives stated above: reduce anxiety and focus on content. An instructor-selected analogy also lends itself to being further developed into an elaborate analogy (Glynn, 2008), one that extends throughout the semester (Orgill & Bodner, 2006). Yet, in order to more fully meet the third objective (retain information), students should definitely be led in creating their own analogies.

These visual analogies positively affected learner outcomes and also served to change the pedagogical practice of these pre-service and in-service teachers. For many, it was their first experience using visual analogies as a learning strategy for themselves when trying to understand difficult content. For the in-service teachers, ESL was an additional teaching field, one that was often unrelated to what they were teaching. Yet, because of their success in learning phonology, these in-service teachers took the initiative of using visual analogies to teach their own subjects. Many reported using different images; however, a few found new uses for the train analogy as explained by this high school teacher:

I completely redesigned my method of teaching basic nutrition during this semester. ...I have students create train cars that represent the food groups. For minerals, we created flat cars with rocks; minerals come from rocks, and the students associate the material better this way. For proteins, we created circus cars with cattle, sheep, and chickens. For carbohydrates, we created hopper cars filled with grains. The

students really appreciated the visual aspects of the lessons, and told me how the whole picture fits together! I am very satisfied with the outcomes.

A major goal of teacher education is to provide a model for how teachers should teach. When, based upon having personally experienced visual analogies to enhance her own learning, a seasoned teacher redesigns her pedagogical practices and does so within that same semester, our goal has indeed been met.

Although this study examined evidence in only one discipline and at only one institution, its instructional design and research methodology can be replicated for conducting similar analogy-based studies in other disciplines and at other institutions of higher education. As an extension to the current study, I will explore its findings by conducting interviews with study participants. The two-fold purpose of this pending study will be to identify how the use of visual analogies may support “exceptional learning” on the part of college students (Bain, 2004, p. 189) and to examine those aspects of visual analogies that are most effective at helping college students with bridging from the known to the unknown.

Acknowledgements

I thank UAB’s Office of Faculty Development for a Scholarship of Teaching grant to conduct the current study. I am also thankful to the graduate students for their participation, to Harvey Brightman for his guidance, to Maria O’Neal for her statistical analysis, and to Julia Austin for her ongoing support throughout the project. I am especially grateful to my husband Luis Spezzini for his patience and encouragement during this SOTL process, especially as related to the teaching of phonology.

References

- Aron, A., Aron, E. N., & Coups, E. J. (2005). *Statistics for the behavioral and social sciences: A brief course* (3rd ed.). Upper Saddle River, NJ: Pearson Prentice-Hall.
- Bailey, T. (2003). Analogy, dialectics, and life-long learning. *International Journal of Lifelong Education*, 22 (2), 132-146.
- Bain, K. (2004). *What the best college teachers do*. Cambridge, MA: Harvard University Press.
- Bean, T. E., Searles, D., Singer, H., & Cowen, S. (1990). Learning concepts from biology text through pictorial analogies and an analogical study guide. *Journal of Educational Research*, 83 (4), 233-237.
- Brightman, H. (2006, December). Master Teacher Seminar sponsored by the Office of Faculty Development. University of Alabama at Birmingham. Birmingham, AL.
- Brightman, H. (2007, Summer). Unlocking the Gate to Critical Thinking: The Meaningful-Integrated Learning Level. *MBA Innovation*. 16-25.
- Bulgren, J. A., Deshler, D. D., Schumaker, J. B., & Lenz, B. K. (2000). The use and effectiveness of analogical instruction in diverse secondary content classrooms. *Journal of Educational Psychology*, 92, 426–441.

- Curtis, R. V. (1988). When is a science analogy like a social studies analogy: A comparison of text analogies across two disciplines. *Instructional Science*, 17, 169–177.
- Dagher, Z. R. (1995). Review of studies on the effectiveness of instructional analogies in science education. *Science Education*, 79, 295–312.
- Davies, J., Nersessian, N. J., & Goel, A. K. (2005). Visual models in analogical problem solving. *Foundations of Science*, 10, 133-152.
- Feild, C. T., & Graves, R. L. (1981). The hint factor in pictorial analogies. *Teaching English in the Two-Year College*, 7 (3), 205-207.
- Freeman, D. E., & Freeman, Y. S. (2004). *Essential linguistics: What you need to know to teach reading, ESL, spelling, phonics, and grammar*. Portsmouth, NJ: Heinemann.
- Glynn, S. M. (2008). Making science concepts meaningful to students: Teaching with analogies. In S. Mikelskis-Seifert, U. Ringelband, & M. Brückmann (Eds.). *Four decades of research in science education: From curriculum development to quality improvement* (pp. 113-125). Münster, Germany: Waxman.
- Glynn, S. M. (2007). Methods and strategies: Teaching with analogies. *Science and Children*, 44(8), 52-55.
- Halpern, D. F., Hansen, C., & Riefer, D. (1990). Analogies as an aid to understanding and memory. *Journal of Educational Psychology*, 82, 298–305.
- Hargittai, B., & Hargittai, M. (2007). The use of artistic analogies in chemical research and education, part 2. *Leonardo*, 40 (4), 357-361. MIT Press.
- Hutchings, P., & Shulman, L. S. (1999). The scholarship of teaching: New elaborations, new developments. *Change*, 31 (9):10-15. Retrieved November 9, 2009, from <http://www.carnegiefoundation.org/elibrary/scholarship-teaching-new-elaborations-new-developments>
- Issing, L. J. (1990). Learning from pictorial analogies. *European Journal of Psychology of Education*, 5 (4), 489-499.
- Krieger, P. A. (2005). *A Visual Analogy Guide to Human Anatomy*. Englewood, CO: Morton.
- Krieger, P. A. (2008). *A Visual Analogy Guide to Human Physiology*. Englewood, CO: Morton.
- Lin, H., & Chiu, H. (2000). Using computers to support a beginning teacher's professional development. *Journal of Science Education and Technology*, 9 (4), 367-373.
- Lin, H., Shiau, B., & Lawrenz, F. (1996). The effectiveness of teaching science with pictorial analogies. *Research in Science Education*, 26 (4), 495-511.
- Marzano, R. J., Pickering, D. J., & Pollock, J. E. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Alexandria, VA: Association for Supervision and Curriculum Development.

Orgill, M. K., & Bodner, G. M. (2006). An analysis of the effectiveness of analogy use in college-level biochemistry textbooks. *Journal of Research in Science Teaching*, 43 (10), 1040-1060.

Paris, N. A., & Glynn, S. M. (2004). Elaborate analogies in science text: Tools for enhancing preservice teachers' knowledge and attitudes. *Contemporary Educational Psychology*, 29, 230-247.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

Perkins, D. N., & Unger, C. (1994). A new look in representations for mathematics and science learning. *Instructional Science*, 22 (1), 1-37.

Radford, D. (1989). *The effects of student achievement of the use of extended verbal analogies in high school biology textbooks*. Unpublished doctoral dissertation, University of Georgia, Athens.

Siqueira, A. J. S., Remiao, J. O. R., & Azevedo, A. M. (1988). Metabolonograms to teach biochemistry. *Biochemical Education*, 16 (1), 20-22.

Spezzini, S. (2009, March). *Visual analogies for enhancing the scholarship of teaching and learning*. Paper presented at the 2nd SOTL conference, Statesboro, GA (USA). Retrieved on November 9, 2009, from http://academics.georgiasouthern.edu/ijsotl/conference/proceedings/2009/proc_docs/Susan%20Spezzini/SoTL%202009%20Spezzini.ppt#256

Thiele, R. B., Venville, G. J., & Treagust, D. F. (1995). A comparative analysis of analogies in secondary biology and chemistry textbooks used in Australian schools. *Research in Science Education*, 25, 221-230.

Appendix A

UAB-SOE Teacher-Course Evaluation Questionnaire Center for Educational Accountability, University of Alabama at Birmingham

INSTRUCTIONS: This questionnaire is designed to provide instructors in the UAB School of Education with information to assist them in providing quality instruction. Please respond to each item on this questionnaire. Your responses will be combined with those of other students and summarized. These summaries will be given to your instructor and the department chair after grades have been finalized.

COURSE: _____

INSTRUCTOR: _____

1. The instructor inspired interest and excitement in the content of the course.
 - strongly agree
 - agree more than disagree
 - agree and disagree (uncertain)
 - disagree more than agree
 - strongly disagree

2. The course goals or objectives presented by the instructor were met.
 - strongly agree
 - agree more than disagree
 - agree and disagree (uncertain)
 - disagree more than agree
 - strongly disagree
 - no goals or objectives were presented

3. Rate how well the various elements of the course (e.g., class activities, textbooks/readings, and outside assignments) worked together in helping you learn.
 - very well
 - better than average
 - about average
 - worse than average
 - very poorly

4. Overall, how much do you feel you have learned in this course?
 - an exceptional amount
 - more than usual
 - about as much as usual
 - less than usual
 - almost nothing

5. What is your overall rating of this instructor's teaching effectiveness compared with other college instructors you have had?
 - one of the most effective
 - more effective than average
 - about average
 - less effective than average
 - one of the least effective

6. What is your overall rating of this course?
 - one of the best
 - better than average
 - about average
 - worse than average
 - one of the worst

7. The workload for this course is:
 - one of the lightest
 - lighter than average
 - about average
 - heavier than average
 - one of the heaviest

8. The difficulty level of the course activities and materials is:
 - extremely easy
 - easier than average
 - about average
 - more difficult than average
 - extremely difficult

9. My educational background prepared me with the skills and information I need to achieve success in this course.
 - strongly agree
 - agree more than disagree

- agree and disagree (uncertain)
 - disagree more than agree
 - strongly disagree
 - no opinion or do not understand the question
10. In my own judgment, what I am being asked to learn in this course is important.
- strongly agree
 - agree more than disagree
 - agree and disagree (uncertain)
 - disagree more than agree
 - strongly disagree
 - no opinion or do not understand the question
11. Overall, I tried to do my best to meet the requirements of this course.
- strongly agree
 - agree more than disagree
 - agree and disagree (uncertain)
 - disagree more than agree
 - strongly disagree
 - no opinion or do not understand the question
12. In my program, this course is:
- required – AND in my major area of study
 - required – BUT NOT in my major area of study
 - elective – AND in my major area of study
 - elective – BUT NOT in my major area of study
 - other (e.g., non-credit or audit)
13. My class is:
- freshman or sophomore
 - junior or senior
 - 5th year student
 - masters student
 - 6th year student (e.g., Ed.S.)
 - doctoral program
14. I expect to receive a grade closest to:
- A
 - B
 - C
 - D
 - F or U (fail or unsatisfactory)
 - S or P (satisfactory or pass)
15. The course prepared me with knowledge and skills that relate to standards of my profession.
- strongly agree
 - agree
 - agree and disagree (cannot decide)
 - disagree
 - strongly disagree
 - does not apply
16. The course encouraged me to reflect on my knowledge and practices in order to improve my understanding and skills as a professional.

- strongly agree
- agree
- agree and disagree (cannot decide)
- disagree
- strongly disagree
- does not apply

17. The instructor related course content to applied situations related to my profession.

- strongly agree
- agree
- agree and disagree (cannot decide)
- disagree
- strongly disagree
- does not apply

18. The instructor used a variety of teaching methods in order to meet the diverse learning needs of students.

- strongly agree
- agree
- agree and disagree (cannot decide)
- disagree
- strongly disagree
- does not apply

19. To what extent was technology used in this course?

(Mark all that apply.)

- Students developed new skills with technology.
- Students used technology as part of the course.
- The instructor frequently used technology to support instruction.
- The instructor occasionally used technology to support instruction.
- Technology is not used in this course.

Please write your responses to each item below. Use additional sheets of paper if you need more space.

Please comment on the instructor's strengths:

Please comment on the instructor's weaknesses:

What are your suggestions to improve this course for future students?

Appendix B

Electronic Survey

Survey Questions about EESL 625

For non-analogy students (2004 and 2005) and analogy students (2007, 2008, and 2009)

1. Please rate your knowledge about phonology:

none just a little some quite a bit a lot

Before taking EESL 625	0	0	0	0	0
After the first class session for EESL 625	0	0	0	0	0
After finishing the EESL 625 course	0	0	0	0	0
Right now	0	0	0	0	0

2. Please rate your ability to teach pronunciation to English language learners:

	none	just a little	some	quite a bit	a lot
Before taking EESL 625	0	0	0	0	0
After the first class session for EESL 625	0	0	0	0	0
After finishing the EESL 625 course	0	0	0	0	0
Right now	0	0	0	0	0

3. Please rate your motivation to learn about phonology:

	none	just a little	some	quite a bit	a lot
Before taking EESL 625	0	0	0	0	0
After the first class session for EESL 625	0	0	0	0	0
After finishing the EESL 625 course	0	0	0	0	0
Right now	0	0	0	0	0

4. Please rate your motivation to learn how to teach pronunciation to ELLs:

	none	just a little	some	quite a bit	a lot
Before taking EESL 625	0	0	0	0	0
After the first class session for EESL 625	0	0	0	0	0
After finishing the EESL 625 course	0	0	0	0	0
Right now	0	0	0	0	0

5. Please rate your anxiety regarding the EESL 625 course:

	none	just a little	some	quite a bit	a lot
Before taking EESL 625	0	0	0	0	0
After the first class session for EESL 625	0	0	0	0	0
After finishing the EESL 625 course	0	0	0	0	0
Right now	0	0	0	0	0

6. Please rate your attitude towards the EESL 625 course:

	very negative	negative	indifferent	positive	very positive
Before taking EESL 625	0	0	0	0	0

After the first class session for EESL 625	0	0	0	0	0
After finishing the EESL 625 course	0	0	0	0	0
Right now	0	0	0	0	0

Survey Questions about Visual Analogies

For students who took EESL 625 with analogies (2007, 2008, and 2009)

7. How do you think the visual analogies used in EESL 625 affected ...

	very negatively	negatively	I'm not sure	positively	very positively
Your knowledge about phonology?	0	0	0	0	0
Your ability to teach pronunciation to ELLs?	0	0	0	0	0
Your motivation to learn about phonology?	0	0	0	0	0
Your motivation to learn how to teach pronunciation to ELLs?	0	0	0	0	0
Your anxiety regarding the EESL 625 course?	0	0	0	0	0
Your attitude towards the EESL 625 course?	0	0	0	0	0

8. How often have you used visual analogies in your own teaching?

	never	rarely	sometimes	often	always
Before taking EESL 625	0	0	0	0	0
After taking EESL 625	0	0	0	0	0

9. If you wish, please provide comments and/or insights regarding the use of visual analogies for teaching and learning.

10. If you wish, please provide comments and/or insights regarding the use of visual analogies in courses like EESL 615.