

The Application of Information Visualization to English Lexicology for College English Majors

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Abstract—By employing relative theories of information visualization and teaching methodology, we apply a practical course of College English majors to this information visualization assisted teaching, hoping to find that it is conducive to motivating English learners towards information acceptance and ultimately to improving their memory ability and classroom performance.

Keywords—information visualization, application, teaching methodology

I. INTRODUCTION

Never before has innovation been encouraged as it is today; technological innovation enables the storing of fast-growing quantities of information. Accordingly, our insatiable appetite for information continues to balloon. It is proved that we are suffering from information overload or data glut. And the challenge is to consume and manage data from multiple underlying sources in different formats. Therefore, it has become increasingly important to develop efficient methods to structure large and complex information sets. Recently there have been several attempts to tackle this challenge by using our eyes more. Information visualization is one of the methods.

According to Card, Mackinlay, and Shneiderman, information visualization can be characterized as “computer-supported, interactive, visual representations of abstract nonphysical based data to amplify cognition”[1]. For instance, information visualization has been used to display the information units of abstract data sets like document collections or text-based information contents. Visualization, in such circumstances, is concerned with representing, manipulating and exploring data and information graphically in such a way as to gain understanding and insight into it, i.e., mapping of data or text to a visual form that supports human interaction in a workplace for sense making.

This paper attempts to study the applications of information visualization to the course “English Lexicology” and its effects from the perspective of cognitive theories and ESL teaching methodologies. Considering the fact that information visualization is oriented to learners who want to acquire some knowledge of English culture in a short time, and also the fact that the limitation of class teaching time, this paper only analyzes the problem on its theoretical level. As the study of foreign

language teaching methodology comes down to several disciplines, it is impossible to explore so many fields in a single thesis. Therefore, this paper will only study the major teaching methodologies relevant to the research of information visualization application.

II. THE PEDAGOGICAL POTENTIAL OF INFORMATION VISUALIZATION

There are different cognitive theories and teaching methodologies that can be used to argue that information visualization may be an efficient teaching method to enhance the acquisition of knowledge. This part will introduce the most notable cognitive theory and teaching methodology relevant to the application of information visualization.

A. *The Cognitive Theory of Multimedia Learning*

The cognitive theory of multimedia learning[2], on the basis of dual-channel assumption, is predominantly processed in a verbal system, whereas pictures and graphics are encoded in a pictorial system. In consideration of the limited capacity of both systems, the theory proposes that a well-designed combination of text and graphics leads to better retention than the use of only one representational code because using the capacity of both memory systems could lead to more information being processed than using only one of the systems. David McCandless[3], gave an explanation to the proposal in TED (Technology, Entertainment, Design) talk. He compared patterns and pictures to the language of eyes, while language of mind is about words, numbers, and concepts. People combine text and graphics, just as much as they speak those two languages simultaneously, each enhancing the others. If two languages both working at the same time, it will increase efficiency, or even alter our perspective and change our views. According to the cognitive theory, information visualization combines textual and visual information, and therefore, the cognitive resources needed for information processing are distributed among both information processing systems.

B. *The Cognitive Theory of Computational Efficiency*

The theory of computational efficiency pays specific attention to the inferences learners to understand a task or a domain. The argument here is that some representational codes facilitate some inferential processes better than others.

In their seminal work, Larkin and Simon found, for example, that search processes in physics are more easily performed with diagrammatic representations than with textual ones. This idea that different representations with the same “content” can still offer different processing opportunities is called “computational efficiency”[4]. Following this idea, information visualizations may allow learners to easily draw inferences on how different information units are related with.

C. *The Natural Approach Teaching Methodology*

The Natural Approach teaching methodology was developed by Tracy Terrell and Stephen Krashen in 1983 with the publishing of their co-work *The Natural Approach*, which combined a comprehensive second language acquisition theory with a curriculum for language classrooms. Since then, the Natural Approach came to have a wide influence on language teaching in the United States and around the world. The design and procedures in the Natural Approach are mainly based on the five hypotheses of Krashen’s language acquisition theory[5]. They are the Acquisition-learning Hypothesis, the Monitor Hypothesis, the Natural Order Hypothesis, the Input Hypothesis, and the Affective Filter Hypothesis. Among those, the Acquisition-learning Hypothesis and the Affective Filter Hypothesis can illustrate how visual information affects learning efficiency.

1) *The Acquisition-learning Hypothesis*

Language acquisition is different from language learning in that language acquisition means that an unconscious process developed through using language meaningfully and language learning means learning consciously or discovering rules about a language. The “acquired system” or “acquisition” is the product of a subconscious process very similar to the process students accept information when they watch a beautiful and interesting picture. It requires meaningful interaction in information transferring. On the other hand, the “learned system” or learning is the product of formal instruction and it comprises a conscious process. In Krashen’s theory, “learning” is less desirable than “acquisition” in that learning is a conscious process, demanding effort and attention to the task in hand whereas acquisition is a subconscious process.

2) *The Affective Filter Hypothesis*

A number of affective variables, such as anxiety, motivation, and self-confidence have a powerful effect on subconscious knowledge acquisition. Learner with high motivation, self-confidence, a good self-image, and a low level of anxiety are better equipped for success in knowledge acquisition. On the contrary, low motivation, low self-esteem, and debilitating anxiety can combine to raise the affective filter and form a “mental block” that prevents comprehensible input from being used for acquisition. In other words, when the filter is “up”, it impedes knowledge acquisition. The best methods therefore are those that supply “comprehensible input” in low anxiety situation, containing messages that students really want to accept. Visualizing information is one of these methods that do not force early production in the second language, but

allow students to produce when they are “ready” in the relaxed image enjoying procedure.

III. THE USEFUL ASPECTS AND CORRESPONDING SUPERIORITY OF INFORMATION VISUALIZATION TO TEACHING

A brief overview of information visualization reveals features that make it a hospitable application for teaching. This is a piece of good news for college teachers who want to visualize relevant information in text book. Information visualization is making information transmission increasingly viable as a medium for organizing, exploring, analyzing and creatively deriving information from the deluge of information that we face in our lessons. By means of visualizing information, teachers can let students see the patterns and connections that matter, or allow them to focus only on the important information. In general, incorporating information visualization into the course *English Lexicology* for college English majors can be helpful in at least three ways.

First, teachers can display some designing in class to reflect, analyze, and argue largely with quantitative information. As with other modes of communication beyond written text that are finding their way into the classrooms, (e.g., video, audio, gaming), the introduction of information visualization can help teachers rethink the curriculum so that satisfied students’ needs and interests. Visualizing information offers fresh and relevant approaches to the typical contents in courses involved in numbers without relationship, information without context and concepts without image.

A second incentive for the application of information visualization is to develop students’ abilities of analyzing and processing information. The application of information visualization to the course *English Lexicology* offers new opportunities for students in designing and producing activities by typical assignments. The goal is what Stuart Selber[6] described as functional literacy “in order to function most effectively as agents of change, students must also become reflective producers of technology.” Particularly in discussions of some ideas and concepts, as students produce their own photographs, drawings, and digital images, they gain a better understanding of how these abstract notions are embedded in particular design choices. Asking students to both analyze and produce visualizations of information provides yet another way of acquiring knowledge actively.

Finally, for the course teaching activity as a whole, information visualization breaks through the limitations of regular conveyance of basic theory by using technical tools. Because the interfaces, features, and options of information visualization tools are likely to be new to students, these tools are ripe for analysis in a way that more familiar software programs (e.g. Microsoft Word, web browsers) are not. The unfamiliarity of information visualization tools and the fact that they often provide multiple ways to visualize the same information may help students see how software in general influences thinking and reconstructing processes.

Just as Daniel Anderson[7] argued, “experimenting with unfamiliar technologies can facilitate a sense of creativity that can lead to motivation.”

IV. WAYS TO DESIGN INFORMATION VISUALIZATION FOR KNOWLEDGE ACQUISITION IN THE COURSE ENGLISH LEXICOLOGY

Beyond the general claim that information visualization is a tool that might foster the acquisition of knowledge from large and abstract data sets, the research here is to design information visualization that fosters learning outcomes in particular. Thus, the study addresses the steps that can be taken for information designing in the course English Lexicology.

A. Data Collection

The first step is to collect data. Teachers had better not depend on a traditional structured database, where information is categorized as it is collected. Teachers should just gather up the full text in the textbook. The undermining reason of why teachers gave up database is the old way of simply represent the data, i.e., bar diagram and pie charts aren't feasible when data sets get to the large scale. Teachers should guide students to observe the different relationship among numbers. More importantly, it may also encourage students start to see patterns and connections between numbers that would otherwise be scattered across the textbook. Data that was once the domain of governments and large corporations is now available to ordinary users via internet; we have increasing access to structured data sets on a wider array of topics. Teachers can combine the information from the text book and internet to restructure the raw data.

B. Map Drawing

The second step is to map data tables. Researchers in the field of information create effective visualizations by applying their programming expertise as well as their understanding of properties of human perception. But teachers can engage in this step as well by working with an increasing number of tools that allow them to upload and select from a range of visualization options.

C. Information Reducing

In the third step, teachers improve the visual structure through various controls and probes—for instance, using search functions, zooming in and out, or using color-coded. Analysis during this phase often centers on the question that whether the transformation is better for knowledge acquisition? For example, should information visualization be color-coded? As color is a basic element of visual perception, color will be processed automatically, that is, the processing of color information does not require large amounts cognitive capacities. Due to the fact that color coding can be expected to make information more salient, color coding should provide learners with a better understanding of the structures underlying a domain. It has been shown that coloring objects increases learners' ability to retrieve object information from memory[8]. As the color

of objects is stored in long-term memory together with other object information, information on the color of an object provides an additional cue for memory retrieval.

D. Problem Solving

In the final step, the picture helps students capture, understand and memorize a certain amount of information. Here again, the development of free, user-friendly, web-based visualization tool enables teachers to explore data under the circumstance that not possible using visualization software. There is also the option to create a correlation between one dataset and another, again with choices to visualize this data in different ways. Teachers might be particularly interested in information visualization application to the course English Lexicology that allow students' users to visualize text written by themselves or others. Users can rediscover the text, visualize it in different ways, and then analyze it to come to greater insight about the text. These applications evoke some of the other ways that we ask students to visualize texts—for example, text diagramming, outlining, and clustering. We are familiar with the benefits of seeing text disassembled and visually rearticulated in some way. Text visualization multiplies the possibilities both for re-seeing text and for developing analytical insight into it. As Geoffrey Rockwell[9] explained, these applications enable the creation of a hybrid text that is “authored not just by the original author, but also by the user's choices and the procedures used to generate it”.

V. CONCLUSION

Information visualization is entering the mainstream because of technological developments, but the influx of two groups of users—teachers and students—has helped to extend the horizon of information visualization beyond expert, task-driven, analytical applications and into teaching practice. When it is applied in class, it provides us valuable experience, usefulness, supporting an idea of data or text as evocative, ambiguous, and open to interpretation, thereby inviting reflection, contemplation, and even pleasure. Information visualization, as a medium, optimizes the effectiveness for knowledge acquisition.

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