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Image and Multimedia Resources in an Academic Environment: A Qualitative Study of Students' Experiences and Literacy Practices

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Abstract:

The digital environment provides an abundance of images and multimedia and offers a new potential for using resources in multiple modes of representation for teaching and learning. This paper reports the findings of a case study that investigated the use of image and multimedia resources in an undergraduate classroom. The study assumed a contextual approach and focused on different class contexts and students' literacy practices. The class, which took place in a resource-rich, multimodal environment, was perceived by students as a positive learning experience. The distribution of resources and their role in teaching and learning varied and depended on the context of use. The findings indicate that images fulfilled important descriptive and mnemonic functions when students were introduced to new concepts, but their role was

limited in practices that required students to analyze and synthesize knowledge.

Introduction

The development of digital technologies and the growth of the Internet have enabled the quick reproduction of information and its global distribution, and have led to the proliferation of information resources, which have become available in an ever-greater variety of types and formats. Such explosive growth of information and easy access to it is unprecedented in human history. It has dramatically changed the educational landscape and contributed to the resurgence of resource-based learning (Hannafin & Hill, 2007; Hill & Hannafin, 2001). Digital technology has provided access to a greater variety of educational materials and has offered new ways to integrate resources into teaching and learning practices.

The digital transformation is not only associated with an abundance of information, but also with information resources in multiple modes, and particularly with the emergence of the image as the dominant mode of representation. Advancements in digital imaging and the ease of creating, reproducing, and disseminating images in digital format have contributed to a paradigm shift in knowledge representation from textual to visual, a phenomenon described by Mitchell (1994) as a “pictorial turn.”

The influx of resources in multiple modes of representation creates new possibilities for teaching and learning in an academic environment that has traditionally favored the text as a source of knowledge. As Elkins (2007) points out, “images are central to our lives, and it is time they become central in our universities” (p. 8). Emerging digital technologies with a variety of visual and multimedia resources offer new potential for engagement and for addressing students’ cognitive abilities and learning preferences (Mayer, 2005). The cognitive processing involved in learning with images and the connection of the mode of representation to learning preferences

have been the focus of extensive research and a number of experimental studies (Carney & Levin, 2002; Mayer & Gallini, 1990; Riding & Douglas, 1993; Riding & Watts, 1997; Schnotz, 2002).

Qualitative research offers the potential to explore the use of images and multimedia outside the lab environment and to capture learners' perceptions and experiences in classroom contexts. However, qualitative studies investigating the actual use of multimodal resources in the natural classroom environment in higher education are still limited. We know very little about the class contexts in which images and multimedia are being used and about the roles these resources play in students' literacy practices and knowledge construction. How are images and multimedia used in specific class contexts? What are students' experiences with learning using resources in multiple modes of representation? What is the role of images and multimedia in students' literacy practices? This study explores these questions in the current academic information environment using a case study method. It contributes to research by examining the use of visual and multimedia resources in an undergraduate classroom, assuming a contextual approach, and providing an in-depth description of students' experiences in a natural academic setting.

Use of Images and Multimedia in the Classroom Environment: Prior Research

The research examining the use of digital images and multimedia in an academic environment is relatively new and often multidisciplinary. The researchers in the field of library and information science tend to focus on students' image-seeking behavior (Bridges & Edmunson-Marton, 2011; Matusiak, 2006) or visual literacy (Harris, 2007). The growing importance of images as information resources in students' academic work emerges as an important theme in these studies. The researchers explore the image-seeking strategies that students employ when

accessing digital collections and conducting searches on the open Web. The investigation of information behavior, however, rarely extends into classroom contexts or students' literacy practices.

A number of research projects investigate faculty use of images for teaching purposes (Green, 2006; Nitecki & Rando, 2004; Pisciotta et al., 2005; Schonfeld, 2006). These studies note the increasing availability of images on college campuses and faculty interest and even enthusiasm for teaching with visual materials. Nitecki and Rando (2004) report faculty use of images in the classroom for intellectual and motivational goals and outline the role of images in teaching as illustration, secondary evidence, and primary evidence where pictures are the main subject of analysis. Pisciotta et al. (2005) conduct faculty-needs assessment to better understand the use of pictures in higher education, while Schonfeld (2006) compares the use of images at several campuses. Green (2006) extends this research by conducting a comprehensive survey at 33 U.S. colleges and universities. The surveyed faculty reported using images in 83% of the courses and selecting a substantially larger amount of digital images than they did in the analog environment (Green, 2006).

The educational research examining the use of images and multimedia in the classroom environment focuses on the benefits for teaching and learning. Mowat (2002) explores the advantages of using images in support of innovative teaching and points out that images not only illustrate the material, enhance presentations, and make them more memorable, but also aid students in understanding concepts that are difficult to express verbally. Thomas, Place, and Hillyard (2008) and Place, Hillyard, and Thomas (2008) in a series of two articles share their experiences in using images and video in their own teaching practices. The researchers provide an interdisciplinary perspective and demonstrate that images can be used in the classroom setting

to promote student capacities and skills, develop students' understanding of the world, and help in building classroom community. The authors also note the challenges in using video, which proved to be problematic in achieving instructional goals.

The impact of images on students' engagement and attitudes was the subject of an experimental study conducted in a lower-level, general education class (Ulbig, 2010). The author points out that engaging students in general college courses is challenging because of large class sizes and students' limited interest in required classes outside of their majors. She tested using images in lecture presentations in an experimental design where one group was exposed to PowerPoint presentations with images, while the other group received the same lectures accompanied by slides with text only. The study confirms that using images improves both students' engagement and general attitudes toward the course and the domain, but also finds that the positive impacts are gradual and take some time to become effective.

Theoretical Perspectives

As the review of the literature demonstrates, the use of images and multimedia for teaching and learning is a complex, multidimensional phenomenon and its investigation requires considering multiple lenses and perspectives. The interaction with visual and multimedia resources involves individual cognitive processing, but also occurs in specific social contexts. In the case of the university classroom, it is also shaped by academic conventions and is connected to students' literacy practices. The current study assumed an interdisciplinary approach and was informed by research on resource-based learning (Hannafin & Hill, 2007; Hill & Hannafin, 2001), the concept of literacy practices (Barton & Hamilton, 2000), and cognitive multimodal theories, including the dual-coding theory (Paivio, 1971; 1986), the cognitive theory of multimedia learning (Mayer,

1997; 2005; Moreno & Mayer, 1999), and the elements of cognitive load theory related to modality, redundancy, and split-attention effects (Sweller, 1994; Sweller, van Merriënboer, & Paas, 1998).

Resource-Based Learning

Resource-based learning represents an emergent approach to learning that focuses on the use of digital resources in building flexible and engaging learning environments. Hannafin and Hill (2007) define resource-based learning as “the use and application of available assets to support varied learning needs across contexts” (p. 526). The authors recognize that the concept is not entirely new. Information resources, such as print-based textual and visual materials as well as analog video and audio, have been used to support teaching and learning for decades, but pre-digital resources were static and had limited reproduction and distribution capabilities. Digital resources, on the other hand, are dynamic, interactive, flexible, and easy to reproduce and disseminate. Due to their increasing accessibility, variety, and flexibility, digital resources offer considerable promise for creating user-centered learning environments. In their overview of resource-based learning, Hill and Hannafin (2001) point out the transformative role of learning with digital resources, but also acknowledge the limitations and challenges in regard to stability, credibility, content validity, and reliability.

Resource-based learning has been applied not only as a pedagogic strategy in various educational settings, but also in the field of library and information science as a framework for conceptualizing information literacy (Branch, 2003; Li, 2007; Macdonald et al., 2001). With its emphasis on establishing contexts for resources and tools, it proved to be useful in the current study in examining the relationships between resources, students’ literacy practices, and different classroom contexts.

The Concept of Literacy Practices

Literacy is the subject of scholarly research in several academic disciplines ranging from education, English studies, and communication, to information and library science. Despite a variety of approaches and theoretical perspectives that those disciplines offer, the understanding of literacy remains elusive. Scholars tend to concede that definitions of literacy are difficult or even contentious (Brandt, 2001; Kwasnik, 1990). The concept of literacy is also fluid and changes depending on the historical and social context and the technology used for knowledge representation.

The linguistic activities of reading and writing have traditionally formed the basis of the concept of literacy (Ong, 1982; Graff, 1995). The concept of literacy, however, has evolved over time and become associated not only with writing and reading text, but also with other information-processing activities and non-textual resources. The adjectives that are often attached to the term literacy, such as *technological*, *information*, *visual*, or *media*, reflect the changing nature of literacy and an attempt to include non-linguistic activities.

The socio-cultural approach to literacy challenged the view that equated literacy only with technical skills in reading and writing. Street (1984) demonstrates that literacy is not just an acquired, neutral, value-free skill, but rather a range of practices embedded in social settings.

The concept of literacy practices represents a basic unit of the social theory of literacy that views literacy as a social practice rather than an isolated, autonomous skill associated with individuals (Barton, 1994; Barton & Hamilton, 2000; Hamilton, 2000). Literacy practices involve participants, activities, settings, and artifacts, such as texts and technologies. They are shaped by social institutions and power structures and influenced by non-visible elements, including social relationships, values, ways of thinking, skills, and structured routines and

pathways.

The understanding of literacy as a situated social practice is generally related to the use of language in reading and writing. For the purpose of the current study, the concept of literacy practices is extended to other activities that are part of student learning but involve the use of non-linguistic resources, such as images. Barton and Hamilton (2005) recognize the multimodal nature of literacy in the digital environment where practices involve a combination of speech, visuals, and written text. For this study, the concept of literacy practices provides a useful framework for analyzing the relationships between resources and students' activities in specific class contexts.

Cognitive Multimodal Theories

Research in cognitive psychology and instructional design offers several theories of human cognition and models of cognitive architectures that are useful to interpreting user interaction with resources in multimodal environments. As Reed (2006) points out, the theories are not rivals, but focus on different aspects of multimedia learning. Of particular relevance to this study are Paivio's dual-coding theory, Sweller's cognitive load theory, and Mayer's cognitive theory of multimedia learning. The multimodal theories provide a foundation for understanding how students learn with resources in multiple modes of representation.

Allan Paivio (1969) brought renewed attention to the role of imagery in learning when he began to explore the relationships between images, memory, and associated learning. He analyzed verbal (abstract and concrete words) and visual systems for representation along the abstract-concrete dimension and found that images and concrete words create better memories than abstract words. Images are not only superior in memory functions, such as recognition and recall, but also play a positive role in mediating meaning where through their "concreteness"

they evoke mental representations. Paivio's research (1971; 1986; 1991) led to the development of the dual-coding theory, a model of two parallel systems for coding verbal and visual information. According to the theory, resources in verbal and visual modes are coded by two separate systems during the learning process. The existence of the dual-coding system is beneficial to human memory since it addresses the limitations of working memory by reducing interference and allowing humans to alternate between the systems. Paivio's model provided a foundation for other multimodal theories that expanded on multimedia learning and addressed the limitations of dual-coding processing in regard to the integration of visual and verbal modes.

The cognitive theory of multimedia learning, developed by Richard Mayer and his colleagues (Mayer, 1997; 2005; Moreno & Mayer, 1999) builds on the dual-processing model and assumes two channels for information processing: verbal and visual-spatial. Messages in verbal and visual modes are processed through parallel channels and result in two kinds of mental constructs that are eventually integrated in long-term memory. The theory posits that, in general, people learn more effectively from a coordinated presentation of information in verbal and visual modes. Mayer states simply, "people learn more deeply from words and pictures than from words alone" (2005, p. 3). Mayer (2005) argues that presenting material in verbal and visual modes allows instructors to take advantage of the full capacity of learners' cognitive processing. Meaningful learning occurs when learners can build connections between words and images and integrate them in long-term memory.

Mayer and his colleagues proposed a number of principles regarding how the information in visual and verbal modes can be presented effectively to create interactive multimodal learning environments (Moreno & Mayer, 1999; 2007). The modality principle, for example, maintains that presenting information in both the visual and verbal modalities results in enhanced learning,

provided that verbal information is presented orally. The researchers also tested the relationship between the mode of representation and cognitive load in an environment where learners have to process resources in two or more formats, such as in words and in pictures (Mayer & Moreno, 1998).

The cognitive load theory examines the modality of resources in relation to the limitations of working memory and outlines the implications for instructional design (Sweller, 1994; Sweller et al., 1998). The complexity of using resources in multiple representations lies in the fact that multiple modalities can either enhance the capacity of working memory or contribute to the increase in cognitive load, depending on how modes are integrated and presented. The modality effect supports Paivio's dual-coding theory that presenting resources in visual and verbal modes allows the brain to take advantage of two processing systems and augments the capacity of working memory (Sweller et al., 1998). However, the inappropriate presentation of resources in multiple modes can create split-attention or redundancy effects and, in fact, lead to an increase in cognitive load (extraneous cognitive load). The split-attention effect is caused by a lack of integration of information in verbal and visual modes that need to be presented simultaneously, while the redundancy effect occurs when the same information is presented in two different modes. The research on cognitive load and multimedia learning not only identifies the challenges of using multimodal resources for teaching and learning but also offers instructional guidelines for the effective coordination of resources and for reducing cognitive load in multimodal learning environments (Mayer & Moreno, 1998; 2003; Sweller, 1994; Sweller et al., 1998).

Methodology

The purpose of this case study was to explore students' experiences in using images and multimedia for academic work in the midst of the rapidly changing information environment.

The focus of the study was on the use of visual and multimedia resources in specific classroom contexts, such as lectures, discussion sections, and students' projects and assignments. The study addressed the following research questions: What types of digital resources do students encounter in the classroom and in their academic practices? What are students' experiences in using the resources in multiple modes of representation?

Qualitative Case Study

The study was designed as a qualitative case study. The emphasis was on users of digital information resources and their experiences and perceptions. Since this type of inquiry assumes an interpretive approach to the study of human behavior and attempts to make sense of the phenomena in terms of the meanings people bring to them, qualitative methodology was selected as an overall research strategy (Patton, 2002). The case study approach helped to concentrate the research in a specific environment and establish the boundaries for the study.

Case selection

An undergraduate geography class at a large, public U.S. university was selected for the study. The selection of the class was intentional, as it represented an information-rich case, characterized by extensive use of digital materials in the classroom. As Stake (2008) notes, the selection of an instrumental case implies a purposeful sampling of an environment where phenomena critical to the research purpose occur naturally. The decision to choose a geography class was based on prior research indicating that geography faculty are among the heaviest users of digital resources (Borgman et al., 2005; Harley, 2006). The focus on a class, as opposed to a random selection of undergraduate students, made it possible to examine the use of images and

multimedia in a natural classroom environment and to observe students in the context of their regular academic practices.

The class observed for the study provided an introduction to world geography. The course examined colonial legacies in Latin America and Africa, Islam and democracy in Southwest Asia and North Africa, environmental issues and cultural nationalism in Europe, and economic development in Asia. This was a lower-level course that fulfilled general education requirements. A junior faculty member of the Geography department taught the class and was assisted by two teaching assistants, Ph.D. students in geography.

The class represented a face-to-face model of instruction with on-site lectures and discussion sections, enhanced by an extensive selection of digital resources and the use of D2L (Desire-To-Learn) course management software. D2L served as an important communication platform, a repository for all class resources, and an environment for uploading papers and taking quizzes and exams.

Data collection techniques

Multiple qualitative data collection techniques were used to provide a thorough examination of the phenomena under study and to ensure standards of credibility and trustworthiness.

Triangulation was achieved by using multiple sources of evidence. The data collection techniques included: a survey, field observations in the classroom, interviews, a questionnaire, and documentary evidence.

A survey was administered at the beginning of the study to gather basic demographic data. Students' participation was voluntary. The class had 243 enrolled students. As Table 1 indicates, 27% of the students participated in the survey.

Table 1. *Number of participants in data collection activities.*

Data Collection Technique	Number of Participants	Percentage of Class Population
Total class population – 243 students		
Survey	65	27%
Questionnaire	60	25%
Faculty and TAs interviews	3	

Field observations represented the major source of data. Fieldwork lasted one semester and consisted of 64 hours of observation. The researcher observed lectures and discussion sections and took notes, focusing on the type and mode of resources presented in the classes, students' reactions to those resources, students' engagement in class activities, and their practices in taking notes during lectures. The field notes became part of the case record and were uploaded to NVivo software for coding.

Document analysis extended the investigation of resources. This process included an examination of syllabi, assignments, PowerPoint slides, selected student papers, and digital materials available as part of the course management system. The researcher was granted access to the class D2L site and had permission to download lecture PowerPoint slides. Nine students voluntarily shared copies of their first essay assignment, which represented a very small sample of class assignments. A questionnaire with five open-ended questions was administered at the end of the semester to gather students' opinions on their experiences with using digital resources. 25% of the students participated in the questionnaire (Table 1).

Semi-structured interviews were conducted with the professor teaching the class and 2 teaching assistants (TAs) to address the questions that arose during field observations and document analysis. The interviews were conducted in person at the end of the semester and lasted from 60 to 90 minutes. The interviews were recorded with a digital recorder and later

transcribed with the participants' permission. Member checking was conducted to ensure credibility and trustworthiness of the data gathered in interviews. The interviewees received copies of the transcripts and were asked to review them and verify their statements for accuracy and completeness. The participants were also encouraged to correct and expand their statements. The faculty member submitted additional comments on designing PowerPoint presentations with images and on the use of videos to provide students with the necessary context.

Participants

As Table 2 demonstrates, the majority of students taking this class were underclassmen (freshmen and sophomores); juniors and seniors represented 19% of the class. The students who participated in the survey represented 30 different majors, ranging from architecture and engineering to global studies, history, philosophy, and psychology. The majority of students (69%) were of college age (18-21 years old), 23% were between 22 and 25 years old, and 8% were older than 26.

Table 2. *Student status.*

Student Status	Registered Students		Survey Participants	
	No. of Students	%	No. of Students	%
Freshman	95	39%	21	9%
Sophomore	103	42%	24	10%
Junior	29	12%	15	6%
Senior	16	7%	5	2%
Total	243	100%	65	27%

Data analysis

Data analysis was conducted as qualitative content analysis focusing on themes and patterns that emerged from data collection. The study adopted an inductive approach to content analysis that

involved open coding and discovering categories, patterns, and themes in the data (Corbin & Strauss, 2008, p. 195). The analytical process was thoroughly grounded in the data and guided by the research questions.

The actual analytical procedures consisted of several phases, including open coding, developing of a codebook, assigning the codes and revising the coding schema, and finally searching for patterns and reoccurring themes. Open coding constituted the initial phase of comprehensive coding and involved careful examination of the data, looking closely, almost line by line, at the field observation notes, transcribed questionnaire comments, and interview transcriptions. In the reduction process, the research questions were used to structure the list of codes generated through open coding and organize them around the core categories. The process of developing a systematic codebook, based on open coding and research questions, required several revisions and careful examination of the data, including asking questions about the data, making comparisons between the data, and deriving the concepts (Corbin & Strauss, 2008, p. 66). The codes developed as a result of this process included both descriptive codes, such as type of resources, format, and mode of representation, as well as more interpretive categories related to the participants' perceptions and experiences. The codebook consisted of 22 core categories and two levels of sub-codes.

The categories generated from the open coding process and organized in the codebook were then used systematically to code the primary set of data, including the field observation notes, transcribed questionnaire comments, and interview transcriptions. The coding process was conducted twice, looking particularly in the second turn for commonalities and differences between the categories. During this process, the data was examined for recurring themes and patterns. In the second round of coding, the researcher was looking for relationships between the

categories and the emerging themes, such as the connection between the mode of resources and students' literacy practices. The NVivo software was used in all the phases of the coding.

The documents collected throughout the study, such as syllabi, copies of PowerPoint presentations, assignment worksheets, study guides, and selected student papers represented secondary sources of evidence and complemented the data gathered through observations, the questionnaire, and interviews. The documents were analyzed for evidence supporting or contradicting the themes that emerged from content analysis of primary data. All lecture PowerPoint slides were analyzed in regard to the characteristics of information, such as layout, font, type, amount of visual resources, ratio of text to visual elements, and sources of visual material presented in the slides. The results of data analysis provided the foundation for the case description and reporting of the analytical findings.

Limitations

The case study approach selected for this study presents limitations to interpretations and generalization of results. Each case is unique and it would be difficult to replicate the same research in a different setting or imply that all classrooms are like the one observed in this study. Inability to generalize qualitative findings to larger populations is an acknowledged limitation of qualitative research (Marschall & Rossman, 1999; Patton, 2002). On the other hand, empirical study in a specific context reveals broader patterns in human behavior. Although one cannot imply that all undergraduate classes utilize image and multimedia resources in the same way as the class in this study, the findings on student learning with multimodal resources can be applied to other educational settings.

Findings

The notion of *resources* and their relationship to teaching and learning practices were central to the inquiry and the analysis of the findings. Based on a broad definition adopted from the resource-based learning approach, the concept of resources encompasses people, places, ideas, and forms of recorded knowledge that have the potential to support learning (Hill and Hannafin, 2001). For the purpose of this study, the resources that faculty used in class or students encountered in their independent study were analyzed in regard to type and mode of representation.

Type classifies resources by common characteristics and allows them to be organized into categories, such as books, journal articles, maps, images, films, datasets, websites, etc. The term *mode* refers to the way information is represented. It can be applied to permanent, recorded forms of knowledge as well as more fleeting ones, such as speech. Generally, meanings can be made, distributed, and interpreted through many representational modes, not just through language, whether written or spoken, but also through visual, spatial, or gestural modes. The term *image* is used according to the classification offered by Enser (2008) and refers to a two-dimensional visual artifact. The concept of *multimedia* is used according to Mayer's definition and implies a combination of modes and modalities, which may include spoken word, text, visuals, music, movement, etc. (Mayer, 1997).

Students in the observed class encountered a wide variety of resource types in the classroom and in their independent research and learning, including images, maps, journal and news articles, datasets, video and audio clips, and educational and commercial websites. Resources often merged and overlapped, making a precise classification difficult. In the course of one lecture, students could be introduced to video clips, maps, and images delivered through PowerPoint, and maps and images that were part of a website launched during lecture. Students

interacted predominantly with resources in the digital format that appeared in multiple modes, including visual, textual, and multimedia.

Students responded positively to the wide and varied use of resources, especially when those resources were used in combination with each other. One of the students noted the variety of materials including “the PowerPoint, maps, videos, images, practically everything we used in class or online” (Student 18, Questionnaire), while another commented on the multimodal nature of resources to which they were exposed in this class: “PowerPoint and films incorporated looking at what we’re learning about, hearing what we’re learning about and applying it to the way we took in the information through multiple sources” (Student 12, Questionnaire).

Use of Images and Multimedia in Class Contexts and Students’ Literacy Practices

The empirical evidence gathered through this study made it possible to examine the use of digital resources in class contexts and to trace the relationship between the types of resources, their modes of representation, students’ activities, and selected literacy practices. As demonstrated in Table 3, four major contexts of use were identified in the observed case, including lectures, discussion sections, student assignments, and exams. Students’ literacy practices were embedded in those contexts and involved a number of activities and a wide range of resources.

Table 3. *Examples of students’ literacy practices in the context of use.*

Context of Use	Resource Type	Resource Mode of Representation	Student Activities
Lectures	Practice: Note Taking		
Lecture delivered by the instructor with the assistance of Power Point	People (instructor) PowerPoint slides; images; maps; charts;	Verbal/Oral Visual + Verbal (text); Visual	Listening Reading Writing Looking

slides	Video and audio clips	Multimedia	Looking Listening
Discussion Sections	Practice: Note Taking in Preparation for Group Discussion		
Group discussions facilitated by a teaching assistant (TA)	PowerPoint slides;	Verbal/Oral	Listening
	Images; maps; charts;	Visual + Verbal	Looking
	Journal articles;	(text);	Reading
	Video and audio clips;	Verbal (text)	Writing
	Video films	Multimedia	Looking
Individual Student Assignments	Practice: Writing Papers		
	Journal articles;	Verbal (text)	Reading
	News articles;	Visual + Verbal	Writing
	Websites;	(text);	Looking
	Video films	Visual + Verbal (text); Multimedia	
Online Quizzes and Exams in D2L	Practice: Reviewing Class Material/Note Taking		
	Student notes	Verbal (text)	Reading
	PowerPoint slides	Visual + Verbal	Looking
	Textbook	(text); Verbal (text)+ visual	Writing

Note-taking during lectures, engaging in group work in preparation for class discussion, paper-writing, and reviewing class materials for online quizzes are examples of students' literacy practices. It is necessary to emphasize here that the four practices listed in Table 3 represent only a sample of literacy practices that was useful for analyzing the use of resources in class contexts and in connection with the mode of representation and students' activities. Resources presented in the class often consisted of a combination of visual and textual modes, typically with one

mode dominating the other. The phrase “visual + verbal (text)” indicates the dominance of a visual mode, while “verbal (text) + visual” refers to a primarily textual resource with some pictorial elements.

Lectures represented the dominant form of instruction but had a rather unusual, non-academic prelude. A few minutes before each class, the instructor would play a video clip of a musical performance. As students entered the lecture hall, they were surrounded by sounds of music from the country or region that was to be covered in the lecture. For example, for the lecture on South Africa, students watched a musical performance of Miriam Makeba singing “Khawuleza.” The instructor also presented pictures of Miriam Makeba in PowerPoint and talked about her as a singer and anti-apartheid activist (see Figure 1). The following slide had several links to online resources about Miriam Makeba and her role as a civil-rights activist. Video and audio clips were presented in every lecture and were also used occasionally in discussion sections. Students also used visual and multimedia resources when preparing for the assignments.



Figure 1. Slide with images of Miriam Makeba presented during lecture.

As one of the students remarked, “video clips were great attention getters!” (Student 19, Questionnaire). The instructor intended not only to get students’ attention, to “literally wake them up” (Instructor A, Interview), which was not a trivial factor in the morning lecture, but also to provide a contextual framework for the lecture topic and to raise student awareness of the political and social conditions of a particular country or region. As she expressed in the interview, “I want them to come in and not just be in the lecture hall that is isolated from the rest of the world. I feel like they need to come in and see, ‘oh there is something from somewhere else that is relevant to what we are going to be talking about,’ because I feel like this is part of setting the context” (Instructor A, Interview).

The video presentation and its discussion usually took about 5 minutes at the beginning of the class. Most of the class time was then devoted to a lecture accompanied by PowerPoint presentations. The instructor usually would show 20-30 slides per lecture. Slide presentations functioned as an aid to the lecture and a tool to display images and maps (see Figure 2 for an example of a map presented in a PowerPoint slide during lecture).



Figure 2. Slide with a map of Mexico and a circle pointing to the Chiapas state.

The emphasis of PowerPoint was on visual elements. The instructor used text sparingly to introduce a topic or emphasize a point and used slides primarily for presenting images and maps. Maps and images represented approximately 60%-70% of the slides' content. There were no sound effects or animations in the PowerPoint presentations. The instructor avoided redundancy or split-attention effects in her presentations, although it is unclear whether she was aware of the research on cognitive load in multimodal presentations. During the interview, she mentioned that her approach to creating PowerPoint presentations for lectures was influenced by Edward Tufte's work *The Cognitive Style of PowerPoint*. She had researched the topic of creating effective presentations in preparation for teaching a graduate-level class:

I taught geography methods class this past semester and I watched a lot of presentations, a lot of job talks that are just bad presentations, so I went and I looked for resources how to teach to geography graduate students, how to be better at presentations. I thought "I can learn myself a lot from that" and I ran across Edward Tufte's work (Instructor A, Interview).

Maps, images, and charts were featured prominently in lectures. This came as no surprise, as previous studies have shown that these resources are commonly used in geography classes (Borgman et al., 2005). Geography instructors tend to supplement their lectures with maps and images to provide visual representations of places, people, and cultures. The surprising finding of this study is, however, the sheer amount of resources in multiple modes that were used and the dominance of the visual mode in lectures.

Visual resources were used predominantly in lectures when students were introduced to new material. Images displayed in PowerPoint presentations had primarily a descriptive function and were used to introduce new concepts, represent spatial relationships, and convey detailed information about subjects, regions, and countries under study. Images of mosques in Baghdad and Dubai as well as an image of a mosque interior were presented to illustrate the non-

hierarchical nature of Islam. The instructor used images to introduce different religious factions in Islam - Sunni, Shia, Sufi, and Wahhabi - and to explain the differences in Islamic traditions by showing illustrations of different types of head coverings for Muslim women (see Figure 3).

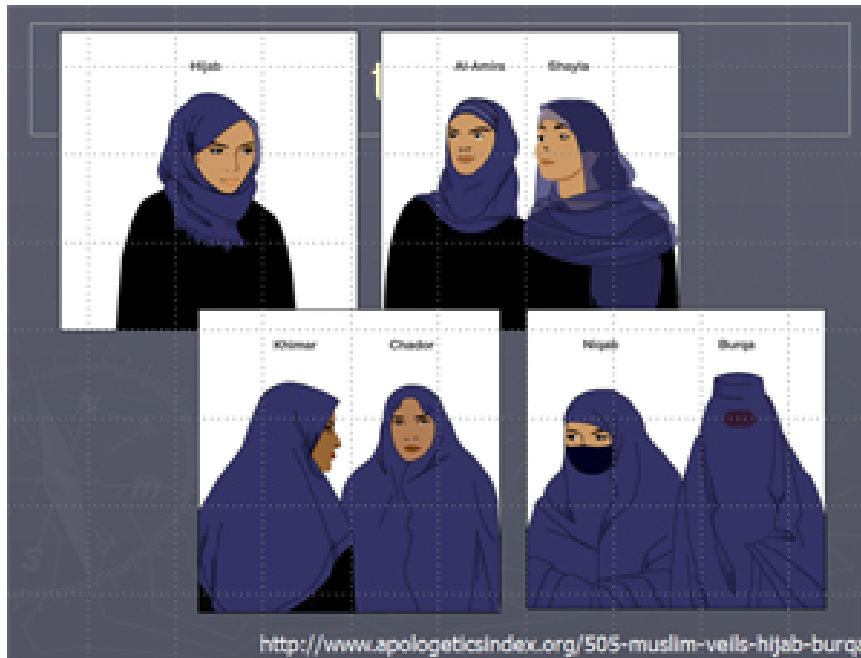


Figure 3. Slide illustrating different types of head coverings for Muslim women.

As the instructor explained in an interview, she tried to structure her lectures around “a big question,” such as: “Is Islam compatible with democracy?” or “Why is Africa plagued by ethnic violence?” She then used PowerPoint slides with maps and images to explore multiple aspects of the issue (see Figure 4 for an example of slide that was used to discuss the controversy of head covering in Turkey). The images included in the PowerPoint presentations often depicted young people in other countries. The instructor admitted that she made a conscious effort to select images that could relate directly or personally to college-age students: “I keep trying to include things that show students, ‘Here what’s going on for university students at other places. If you were there, your life might be different, so understand the social conditions that they are operating in’” (Instructor A, Interview).



Figure 4. Slide used to discuss the controversy of head covering in Turkey.

For assignments, students had to write six short two-to-three-page essays, responding to class readings and other materials, including images and videos. For the first assignment, for example, students had to view a 20-minute video on the Cofan tribe and read two BBC articles on oil drilling in Ecuador. The video had an emotional impact on students, which was evident in the class discussion. In the questionnaire, students reported that they used videos and news articles for writing essays and found them useful. The TA grading the essays noticed that “the video had the largest impact” and added, “it definitely had a real emotive effect on them, this particular video, but they failed to contextualize within a larger significance of the events” (TA2, Interview). The video on the Cofan tribe made a strong impression on students, but their emotional reaction did not translate into a persuasive argument in writing.

The practice of writing papers involved an interaction of a variety of digital resources in multiple modes of representation and was connected to a number of cognitive practices, such as

listening, looking, reading, and writing. Interestingly, students used images and multimedia resources while studying the topic they were going to write about, but the papers were recorded only in the textual mode. Students did not include images in their written assignments at all. The assignment instructions did not provide any suggestions or guidelines on using images in papers.

The use of textual resources increased when students had to prepare for quizzes or exams and worked on papers. In contexts where students had to analyze or synthesize knowledge, the role of images diminished while a distinct role of language as the system for the representation of argument became evident. The detailed analysis of specific class contexts also demonstrates that resources in a visual mode of representation were rarely used alone, without a verbal or textual explanation. In most situations, a visual mode was combined with a linguistic mode, either in the form of an oral narration during lectures or in a variety of textual forms.

The limited role of images as analytical tools in academic discourse was acknowledged by the instructor of the observed class, who, despite using a variety of images, was not always satisfied with her selection: “I try in my lectures to tell the story, but sometimes I find it really hard because, you know, the stories get complicated, and sometimes it’s very difficult to come up with an image” (Instructor A, Interview). This study indicated some challenges of using images and multimedia in an academic environment. The instructor took advantage of the unparalleled descriptive function of images in her lecture presentations, but at the same time felt that images may be limited in presenting a point of view and did not encourage students to use images in their papers.

Students’ Experiences

The students’ overall assessment of the class was positive. Students liked “a wide variety of sources of information that made finding information for this class easier” (Student 7,

Questionnaire) and felt that “this class had a lot of resources available to help you with homework, quizzes, and exams” (Student 42, Questionnaire). Many took the time to fill out the “optional comments” section of the questionnaire where they noted “this was a very good class and resources were well taken advantage of” (Student 10, Questionnaire). They noticed not only a wide variety of sources, but also multiple formats that, in their opinion, made learning easier. One student commented, “any learning process that involved more than just reading, like watching a video, obviously listening to audio, and discussing it was extra helpful” (Student 12, Questionnaire).

The use of resources in multiple modes was met with overall approval from students. In response to the question posed in the questionnaire – “What resources, presented as part of this course, made the biggest impression on you and why?” – students emphasized the impact of visual and multimedia resources. Student 1 highlighted the use of PowerPoint: “I would say that PowerPoint and maps made the biggest impression on me for this class. During lecture the Power Points really helped as an outline for discussion and also helped for studying purposes” (Student 1, Questionnaire). Student 50 commented: “the PowerPoint presentations, video clips, articles, [I] like these sources because they give information visually,” while Student 56 noted, “[I prefer] video clips, PowerPoint, images. Visually seeing something that we’re learning about is more compelling” (Questionnaire). Some students expanded on the role of PowerPoint slides and visual materials in the learning process: “PowerPoint during class is huge because I’m a visual learner” (Student 20, Questionnaire). This comment was echoed by Student 59: “all of the PowerPoint presentations provided in class helped out greatly. I’m a visual learner so it was great to see this way of learning was provided” (Questionnaire).

Students’ comments point out yet another important role of visuals in learning. Images

served as mnemonic aids and helped them recall lecture materials better. One of the students observed that visual resources help in learning and assist in remembering: “Images and PowerPoint presentations make the biggest impression on me because they are visual and catch my attention. They make things easier to remember” (Student 3, Questionnaire).

Discussion

This case study provides an insight into a classroom environment imbued with educational technology and shaped by a wide variety of digital resources in multiple modes. The abundance of images and multimedia was evident in the class and met students’ expectations. It is true that the subject matter in geography lends itself to the use of visual materials, but the sheer amount of images in the observed class confirms the prediction of the “pictorial turn” (Mitchell, 1994). The study supports the findings of prior research on faculty adoption of visual resources for classroom teaching (Green, 2006; Schonfeld, 2006).

The resource-rich, multimodal class was perceived by students as a positive learning experience, contributing to their engagement and addressing different learning preferences. The findings of this study support the major premise of the resource-based learning approach, which holds that environments that integrate a variety of flexible and dynamic resources are beneficial to students’ learning (Hill and Hannafin , 2001). Although the class was not designed intentionally as a resource-based learning environment, the instructor took full advantage of the multitude of digital resources available on the Web.

The prevalent use of images and their important descriptive, motivational, and mnemonic functions emerge as important themes in this study. The motivational and intellectual functions of images have been recognized in research literature (Mowat, 2002; Nitecki & Rando, 2004;

Thomas et al., 2008; Ulbig, 2010). This study confirms that images and multimedia can indeed play a positive role in engaging students with the class material and influencing their attitudes. It also points out a unique role of video clips in providing context for lecture materials.

Images and multimedia played an important role in engaging students, but the descriptive function of images proved to be useful for teaching content. Images appear to be particularly relevant to teaching subjects such as geography where the reality of other worlds must be represented. As Messaris (1994) emphasizes, images have a unique ability to convey a tremendous amount of information instantly, and their descriptive power is unsurpassed. Images are capable of expressing an enormous amount, and a remarkable range, of information that otherwise would be very difficult to capture in words. This function appears to be particularly important in light of Laurillard's approach to academic teaching as mediated learning. Laurillard (2002) argues that academic study is removed from experiential learning and represents a second-order experience. The knowledge that students gain is not acquired from direct experience, but instead is mediated by their teachers and augmented by the resources that provide a description of the worlds under study.

The findings of this study also indicate another important role of images that has received little attention in recent literature. Students participating in the study emphasized that images in PowerPoint presentations helped them recall the material covered in lectures. The function of images as memory adjuncts and as a part of "memory arts" has a long tradition. Eisenstein (2005) points out the important role that illustrations played as mnemonic aids in scribal culture, before the printing press was invented. Paivio's research on the role of imagery in memory also supports these findings and indicates that images can play a mediating function in memory and learning (Paivio, 1969; 1971). The shift from print to digital and the proliferation of images bring

those “old fashioned” mnemonic functions to the foreground and demand new attention if images are to be used effectively in teaching and learning.

Many study participants described themselves as “visual learners” and believed that they benefited from the instruction with visual materials. Educational psychology research examining the relationship between cognitive styles and mode of presentation in learning actually supports those claims (Mayer, 1997, 2005; Riding & Douglas, 1993). The analysis of students’ stated preferences indicates a general positive perception of the use of images for teaching and learning. The investigation of students’ practices, however, demonstrates that the use of images was not uniform across class contexts. The distribution of resources by mode depended on class context. Visual resources were used predominantly in lectures that introduced students to new topics; textual materials were used more extensively in student research and independent study. This observation supports cognitive psychology research on the benefits of using visual materials in contexts characterized by low prior knowledge, when students are introduced to new subjects (Mayer & Gallini, 1990; Schnotz; 2002).

The reduced use of images and multimedia in contexts where students had to analyze and synthesize knowledge and the difficulty of using videos in written assignments point out some challenges of using non-textual resources in academic practices. In contexts where students had to present arguments and synthesize knowledge, they relied more on textual resources. In this particular study, visual and textual resources therefore played complementary, yet distinct, functions. The limitations of using videos in the college classroom were also found in other studies (Thomas et al., 2008). The challenges of using multimodal resources for teaching and learning have also been identified in research on multimedia learning and cognitive load (Mayer & Moreno, 1998; 2003; Sweller, 1994; Sweller et al., 1998).

Students' literacy practices observed in this study indicate an academic environment that is in transition, still clinging to old traditions but also embracing the new digital world. Students used a wide selection of visual and multimedia resources while preparing for written assignments, but did not include any images in their assignments. Students produced purely textual assignments, despite the fact that their classroom was a richly multimodal environment. The use of written assignments as way of assessing students' knowledge is part of a prevailing academic practice. As Barton and Hamilton (2000) point out, literacy practices are shaped by social values and norms. The digital environment is evolving rapidly, but literacy practices shaped by academic conventions tend to be slower in adapting to change.

This study provides an example of an undergraduate course that widely adopted visual and multimedia resources for teaching and learning. The use of visual resources in the classroom played positive roles as it addressed the individual differences in students' cognitive styles, helped students remember the material, provided a rich description of the subjects under study, engaged students, and met their expectations for a learning environment that is enhanced by technology. However, it needs to be acknowledged that this study provides a description of an individual case. Recognizing the benefits of images for student learning does not automatically imply recommending a pedagogic design dominated by visual materials and this is an area that not only requires more in-depth research, but also instructional guidelines. This study also points out the limitations of the visual mode and underscores the importance of the linguistic mode for academic learning. As the research on multimedia learning and cognitive load indicates, effective use of visual and multimedia resources for teaching and learning would entail carefully considering the mode of representation, type of resources, and their unique strengths and limitations in the contexts of specific academic practices.

Conclusion

This case study provided an in-depth description of the use of digital resources in a college classroom. It demonstrated that digital technology not only enables wider access to information resources, but also increases the possibilities for knowledge representation while providing a greater variety of educational resources. The findings of the study indicated that the distribution of resources depended on the context of use and pointed to different roles of visual and multimedia resources in student academic practices.

Digital technology has enabled faster and easier creation and reproduction of visual and multimedia resources and their integration into the teaching and learning processes. The proliferation of images and multimedia in the digital environment and their increasing roles in teaching and learning represent a new area of interdisciplinary research that deserves further attention. The evolving relationship between text and image in knowledge representation, and the new potential that digital technology offers for using visual resources in academic instruction, represent new and fascinating lines of scholarly research.

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