International Journal of Online Pedagogy and Course Design
Volume 12 • Issue 1

The Use of Images in Online Learning:
A Qualitative Content Analysis

Jason D. Bader, Mt. San Jacinto College, USA
Chareen Snelson, Boise State University, USA
Patrick R. Lowenthal, Boise State University, USA*
https://orcid.org/0000-0002-9318-1909
Norm Friesen, Boise State University, USA

ABSTRACT

Images can improve learning and performance. However, research suggests that many online educators and instructional designers lack the knowledge, skills, and abilities to effectively create and use images when designing online courses and instructional materials. Given this problem, the authors conducted a qualitative content analysis of images used within 20 different college courses to better understand how images are used in online courses. After creating a new image categorization, they coded 232 images. Results found that while only 27% of images in online courses were educational, other types of images can still serve important roles in online courses. The results were used to create a new framework for image use in online learning. They conclude the paper with recommendations that can help online educators and instructional designers select images for the online courses they design and teach.

KEYWORDS

Graphics, Images, Online Learning, Qualitative Content Analysis, Visual Literacy, Visuals

INTRODUCTION

As enrollment in online courses continues to grow, policymakers, administrators, and online educators alike have become increasingly interested in what makes a quality online course and a quality online learning experience (Baldwin et al., 2018; Papia, 2016; Sadaf et al., 2019; Zimmerman et al., 2020). Research has shown that one element of a quality online course is the appropriate use of images and media (Clark & Mayer, 2016; Davis, 2015; Davis & Frederick, 2020). This is because well-designed image and media use can improve student learning (Mayer, 1993, 2019, 2020; Mayer et al., 1995). For example, the use of text and graphics, rather than text alone, has been shown to produce an increased 55% to 121% performance boost in transfer tests (Clark & Mayer, 2016). Despite the ability of images to improve performance and learning, research also suggests that many online educators and instructional designers lack the knowledge, skills, and abilities to effectively use images in instructional settings and when creating instructional materials (Bader, 2019; Brown et al., 2013; Lohr, 2008; also see Klein & Kelly, 2018; Malamed, 2015; Matusiak, et al., 2019; West et al., 2020). Thus, there remains an opportunity to better support online educators and instructional designers in their visual design

DOI: 10.4018/IJOPCD.302088 *Corresponding Author

efforts. However, online educators, instructional designers, and faculty developers, generally, need to have a better understanding of how images are being used in online courses in order to help improve their use. Given this, we set forth to analyze how online educators use images in the online courses they design and teach. In the following paper, we present a new image categorization we created, the results of our inquiry, and the implications for the research and practice of online learning.

LITERATURE REVIEW

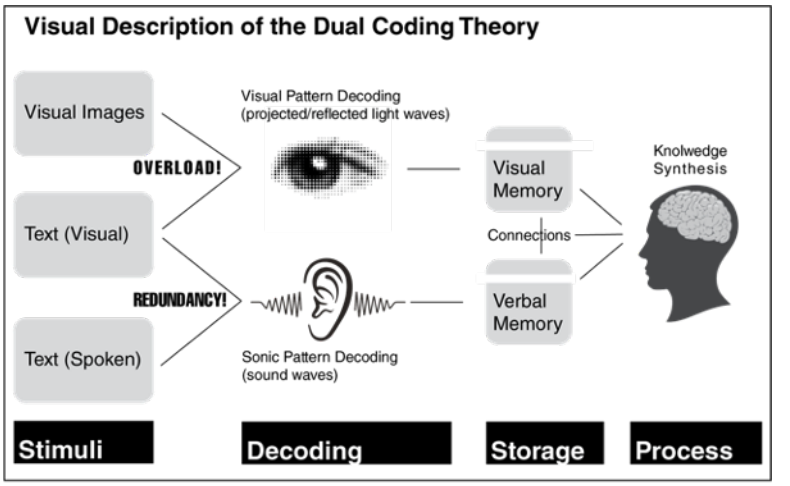
In the following section, we briefly summarize the literature on images' effect on learning, the different types and effective use of educational images, and challenges educators face creating and using images in online learning.

Images Effect on Learning

Using images in education is not new (Mietzner et al., 2005). Researchers have been investigating the educational uses of images for decades dating back to the 1970s (Jordaan & Jordaan, 2013). One of the breakthroughs was Paivio's (1986) dual coding theory of cognitive processing (see Figure 1) which suggests that the primary purpose of using images is for meaning-making (Daley, 2003; Eisner, 2002; Nuzzaci, 2019). Using words and visuals in tandem exemplify possibilities for polysemic understanding of the ability to exploit multiple information channels (Mackay, 2003), and in turn can have a profound effect on learning (Davis, 2015; Dirksen, 2015; Lohr, 2008). Based on theories like dual coding, Mayer developed a theory of multimedia learning positing that students learn best from a combination of text and images rather than from words or images alone (Mayer, 2020).

However, using images in education is a complicated process that requires attention to both the content of the image and the context of the image's surroundings (West et al., 2020). Further, being visually literate is more than being able to interpret (i.e., decode) visuals; people, and educators, in particular, need to be able to create (i.e., encode) visuals. In fact, Braden (1996) conceptualized visual literacy as the ability to efficiently analyze, compose, and create visual images. To help educators become visually literate and specifically to be able to create educational images, Lohr (2008) developed the ACE model. The ACE model stands for the three stages of image creation: analyze, create, and evaluate.

Figure 1. Illustration of the Dual Coding Theory *Note:* **Copyright 2020 by Bader**



Different Types and Effective Use of Educational Images

But even with the existence of models like ACE, we contend that educators need to understand the different types and the specific functions of different images (see Winn, 1993). Several researchers have created typologies to categorize the function or type of different images. Table 1 illustrates a few popular taxonomies from the literature and how diverse, and at times confusing, some of these taxonomies can be (Kress & Van Leeuwen, 2006).

Table 1. Common Categories of Educational Images

Doblin (1980), Peterson (2002)	Vekiri (2002)	Sunders (1994)	Levin, Anglin, & Carney (1987)
Figurative	diagrams	maps	decoration
pictures	maps	pictograms	remuneration
schematics	graphs	diagrams	motivation
symbols	charts	graphs	reiteration
Non-Figurative		illustrations	representation
text		composite graphics	organization
labels		models	interpretation
verbal descriptions		photographs	transformation

Despite the different types of educational images, educators often resort to simply using decorative images (Bader, 2019). Decorative images are images that do not enhance the instructional materials (Clark & Mayer, 2016). Many researchers have argued that decorative images are useless or can even be detrimental to learning in certain situations (González et al., 2019; Levin, 1981; Lohr, 2008). For instance, Winn (1993) argued that students can become desensitized to images if too many decorative images are used, which can lead students to ignore more important images. Conversely, other researchers have argued that there can be advantages of decorative images. For instance, Duarte (2010) argued that people desire a human connection and that decorative images can be used to create a personal experience (e.g., in an online course) through the creation of a unique look and feel.

The effective use of images, though, requires adherence to four design elements: content, learner, media, and message (Waldron et al., 1985). However, research suggests that instructors often struggle to do this. In one study, Bader (2019) found that only 36% of instructors were able to customize images to align with course content. This finding aligns with Herold (2015) who argued that instructors often struggle to learn how to effectively use new technologies in online environments. Metros (2008) pointed out, though, that instructors simply "are not taught to use media other than for spicing up lectures with audio and video aids" (p. 106). Which in turn explains why when instructors do use images, they often over decorate or get lost in creating visual appeal as opposed to using an efficient, purposeful approach to visual design (Reynolds, 2012).

Challenges Developing Online Courses and Instructional Materials

There are multiple reasons educators struggle to effectively use educational images. First, college faculty are content experts; most did not take any courses on pedagogy, let alone any courses on online course design during their graduate studies (Chen et al., 2017; Lowenthal et al., 2019). Given this, most college and universities faculty development efforts focus on the basic components of designing online courses (e.g., creating measurable objectives, aligning objectives and assignments, adding content to a learning management system) and do not address more advanced topics such as image creation and visual design (see Lowenthal et al., 2019). In fact, we have found that most online learning quality assurance frameworks (e.g., Quality Matters) only minimally address visual design and the use of images and when doing so, they usually focus on issues of accessibility (Baldwin et al., 2017, 2018; Lowenthal et al., 2020).

Instructional designers in particular struggle with effectively creating and using educational images because they are expected to be a jack of all trades in their day-to-day jobs (see Kumar & Ritzhaupt, 2017; Ritzhaupt & Kumar, 2015; Sugar, 2014). For instance, they are expected to be proficient in a host of skills ranging from instructional systems design, instructional development, graphic design, and project management to name a few. Thus, it is not surprising that many report lacking some of the technical skills needed to effectively do their job (Kumar & Ritzhaupt, 2017; Ritzhaupt & Kumar, 2015). But even popular competencies and instructional design standards, that are often used to structure graduate programs on instructional design, only briefly, if at all, address visual design (see Koszalka et al., 2013; Piña, 2017). This is likely in part due to a long tension in the field of instructional design between the relationship between instructional development, technology, and instructional design (see Lowenthal & Wilson, 2010; Reiser & Dempsey, 2018) as well as the difficulty of having coursework on every possible topic that instructional designers might need in the workplace. However, as online enrollments continue to grow, we posit that there is increasingly a need for online educators and instructional designers to be able to design and develop high-quality online courses and that part of this involves the ability to effectively use images (whether created from scratch or by others) in online courses.

In summary, the literature on educational images suggests the following: (a) based on multimedia theories, images play an important role in learning; (b) while there are many different types and functions of image, online educators and instructional designers often rely on decorative images and a search and selection process more often than creating their own images; and (c) many educators and instructional designers simply do not have the technical competence or even the time to create educational images on their own. Questions remain, though, about how educators use images in practice in their instructional materials and specifically their online courses. Knowing more about how faculty actually use images in online learning can help stakeholders find better ways to support their efforts at designing and developing quality online learning.

METHOD

Research Questions

Given the important role that images can play in online learning and the lack of research focused on such image use, we set out to investigate how images are used in online courses by answering the following research questions:

1. How are images applied in online courses?
2. How might existing educational image taxonomies be used or extended to online learning environments?

Research Design

After getting approval from the institutional review board, we conducted a qualitative content analysis (QCA) to answer the research questions. QCA is "a method for systematically describing the meaning of qualitative material. It is done by classifying material as instances of the categories of a coding frame" (Schrier, 2012, p. 1). QCA offers a systematic and iterative approach to analyze content using both deductive and inductive processes (Potter & Levine-Donnerstein, 1999). With QCA, a coding frame is initially created based on theory or prior research. This is a top-down deductive approach through which content may be classified based on concept-driven or theoretical categories. In the present study, existing taxonomies of educational visuals were used to define concept-driven categories for qualitative analysis. The coding frame was expanded during the coding process. Additional details about the coding process are described below.

Research Setting

This study was carried out at a California community college. The selected college offers over 80 unique online courses and over 450 online sections per semester. The college started offering fully online classes in 2000. The college uses the Canvas learning management system. All instructors are required to complete training on using Canvas prior to teaching online. Additional faculty development on online teaching is also offered each semester.

Sampling

The first author identified 20 courses, taught by instructors with at least one year of experience, to analyze for this study. Courses were purposefully selected from different subject areas, because prior research suggests that some types of images may be used more within specific disciplines (Blummer, 2015). Four different courses were chosen from the following five content areas: (a) Language Studies/ Communication; (b) Quantitative Reasoning (Math, Accounting, Computer Science, & Engineering); (c) Creative Arts, Visual Arts, Performing Arts, and Design; (d) Social & Behavioral Sciences; and (e)Physical Sciences

Data Collection

Data were collected from an introductory module and one learning module from each course. When selecting a learning module, the module needed to have at least seven instructional pages. When there were less than seven instructional pages, we selected an additional module so that we had at least seven instructional pages to analyze. Screenshots were taken of entire instructional pages so that each image could be analyzed within the context of the supporting text. This resulted in 232 images files for analysis.

Data Analysis

The images were analyzed in Nvivo (QSR International), a qualitative data analysis application, using Schreier's (2012) three coding cycles: concept-driven coding, data-driven coding, and coding verification. During the first cycle, the researchers used a coding frame based on Lohr's (2008) image categorization as a starting point for our content analysis that differentiated between decorative and educational images (see Table 2). If images did not fit into one of the existing categories, they were placed in a category labeled *residual*. During the second cycle of coding, the images within the residual category were analyzed using descriptive coding, adding information about how instructors diverge from this traditional image categorization. To achieve this, the images were descriptively coded (Saldaña, 2015) based on their visual content. The researchers analyzed the supporting text to assist in coding the images. Through the visuals and supporting text, analytical notes were taken to

Table 2. Initial Coding Frame and Image Count During the First Cycle Coding

Decorative (n=64)	
No Subcategories	Images with no reference to learning material. They are used to make the learning content more appealing and motivating.
Educational (n=59)	
Representational Organizational Interpretive Transformative	Images that are direct visualizations of people, places, or things. Images that demonstrate the structure sequence and hierarchy. Visuals that represent difficult and ambiguous of information. Images that make information more memorable, typically relying on analogy.
Residual (n=109)	
No Subcategories	Images that could not be assigned as above

describe the function of the image. Through this process the researchers generated selective codes and subcodes. If the function of an image could not be determined, the instructor who used the image was contacted to explain its function; these explanations, or analytical notes, were recorded as annotations to the images. Finally, the third cycle of coding used selective coding to build the final themes and sub-categories in the final framework, which was then verified for coding accuracy.

Validity and Reliability

We calculated inter-rater reliability on a random selection of 20% of the images, resulting in 90% agreement between two of the researchers at code level but only 58% when including the sub-codes. After two months had passed, the first author retested the final coding scheme, including subcategories, resulting in 100% agreement at the top-level and 96% when including the sub-codes. This finding demonstrates that the top-level theme building, which describes the functional purpose of image function is very strong. It also suggests that the coding framework needs better descriptions of each code in order to be more reliable. As an example, it was evident that an image (as represented in Figure 2 below) was decorative as opposed to educational, both of which were top level themes. However, determining if an image was humorous or engaging brought subjective criteria into analysis, which is why the test-retest results were important to note.

RESULTS

First Cycle: The Initial Coding Framework

Our review of the literature underscored the importance of educational images but also highlighted inconsistencies in useable image frameworks (see also Author, 2018). As previously mentioned, we started with Lohr's (2008) image categorization. Of the 232 images coded, 127 images (54.7%) were coded as decorative (n=64; 27.6%) or educational (n=59; 25.4%), leaving 109 or 47% of the remaining images as residual.

The study used text integration to further describe how the image directly related to textual or learning content through the image position relative to the text. This helped to appropriately label each image. Optimally, the context and the content should have precise and clear alignment. In terms of alignment, Marsh and White (2003) suggest that educational images either have *no relationship with the text, a close connection to the text*, or *extend beyond the text.* These relationships were noted to explain how the images linked with the textual content, which assisted in building image metafunctions in the next cycle of coding.

Second Cycle: Elaboration of Initial Codes and Building Codes for Residual Images

Images, especially those used in education, must be able to represent ideas that are linked to content-relevant objects. Kress and van Leeuwen (2006) state that any representative semiotic mode must be able to facilitate relations between the producer and the receiver. Kress and Van Leeuwen (2006), building on the work of Halliday and Webster (2003), took a communicative approach to encode language built within images using three metafunctions (i.e., ideational, interpersonal, and textual). These metafunctions were used to categorically structure the content of the analytic notes in order to assign codes to the residual images. Table 3 demonstrates how the initial framework was elaborated into new coding themes and categories.

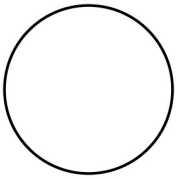
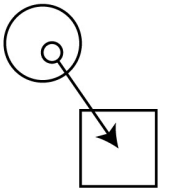
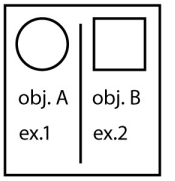
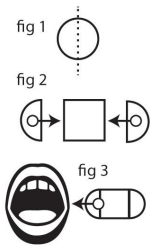
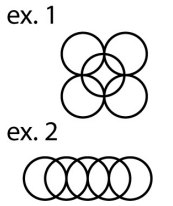
Educational Images

During this cycle, we adapted past taxonomies by categorizing educational images as: concrete, conceptual, organizational, procedural, and exemplary. The first four terms are a simplification of past taxonomies with a new category defined as exemplary (see Table 4).

Table 3. Examples of metafunctions for image types to expand the initial framework in the first cycle

Ideational **Applied to coding frame**	**Interpersonal** **Relationship of viewer**	**Textual** **Supporting text to create image relevance**
	Educational	
1. Concrete a. Direct b. Mnemonic 2. Exemplary a. Standard b. Unorthodox 3. Conceptual a. Classificatory b. Analytical c. Symbolical 4. Organizational a. Conjoined/informational b. Topographical/spatial c. Dimensional/temporal 5. Procedural a. Kinetic b. Symbolic	• Translate a word into a visual definition. • Define abstract ideas as visual representations. • Juxtapose multi-layered, multi-dimensional data to create comparison, contrast, and organization. • Demonstrate a how-to process. • Give examples of solutions to ill-defined problems.	• External text reinforces the visual, giving meaning or relevance to it. • Internal text completes the function of the visual, and is almost always necessary in organizational, procedural, and conceptual images.
	Decorative	
1. Content Theme a. Metaphorical b. Direct 2. Personalization a. Engaging b. Humor c. Visual Aesthetic d. Typographical e. Avatars	• Aesthetical visual enhancement. • Creates value in the course • Reach emotional and personal communication with the users • Connects the physical world and the virtual world with self-representation	• Themed images usually are supported by the general content of the text or section. • May offer a visual experience to enhance or structure text. • Some images are of "fun" typefaces not available in the LMS selections to give emphasis or emotional appeal.
	Affordance	
1. Media a. Video b. Documents c. Presentations 2. Labels/Links a. Banners/Headers b. Icons/Logos c. Buttons d. Book covers 3. Styles a. Visual Patterns b. Structural Elements	• Describes how the interface functions • Create Styles, Motifs, and Visual Cues through repetitive patterns (Can work in conjunction with decorative). • Label a type of activity or application through iconography. • Can organize and appropriately label the function and importance of text.	• Direct juxtaposed text to reinforce the visual labels. • Text that is consistent in size, font, color, and positioning to give visual standards of function. (Especially for images that exist as headlines) • External Text from media to describe the purpose of the media footage in relation to the learning module.

Table 4. Graphic Representations of Educational Images

Concrete	Conceptual	Organizational	Procedural	Exemplary
				
A visual display of Object A.	Concept X shows how Object A undergoes a change through process X to become Object B.	Table X exhibits direct comparisons of Object A and Object B.	Procedure X demonstrates how to manipulate and merge Objects A and B for use.	Problem X asks Object A to be repeated five times in a composition. These are examples of solutions.

Concrete images are direct representations of people, places, or things. For instance, an illustration depicting Abraham Lincoln's delivery of the Gettysburg Address would be a concrete image. These types of images have been called representational images in past studies, but we contend that every image is representation therefore classifying an image as representational is a misnomer. In a divergence from past taxonomies, we posited that diagrams can also be concrete images that display multiple visualizations in a single image. An example is a plant cell diagram or identifying parts of a cell in a biology class.

Conceptual images represent an idea through visual cues embedded in an otherwise concrete image. One example is arrows that show directions of blood flow to demonstrate how blood circulates within an organ. Unlike concrete images that identify parts, the conceptual images describe a process or theory. These images can also be arranged as multiple images to show changes over time which demonstrates how a certain concept evolves.

Organizational images are the juxtaposition of multiple individual informational components that has been explicitly organized to show a comparison of textual information, visual data, or a combination of both. Typically, these are tables, maps, flowcharts, or other sets of multidimensional data that when put together describe an entire system and how each individual component exists therein.

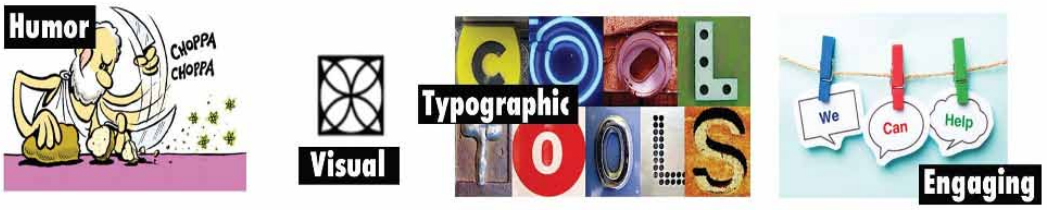
Procedural images demonstrate a process over time or action that is meant to be physically followed. With video media common in online education, procedural images are not as relevant as they once were since these processes are better described in time-based media, but they did appear in some of the courses in this study. For instance, in a business administration class, there was an image of an excel file with arrows showing where the user would need to click to complete certain actions in the software.

Exemplary images are the visualizations of abstract ideas or example solutions. They are not always meant to be replicated or followed and are well-represented in creative disciplines that use problem-based learning. An example would be a visual problem in graphic design, communication media, environmental design, or architecture that showcases how past students or professionals have addressed an ill-defined problem. These images can offer a standard of excellence for the students to achieve towards or problem areas that students should avoid.

Decorative Images

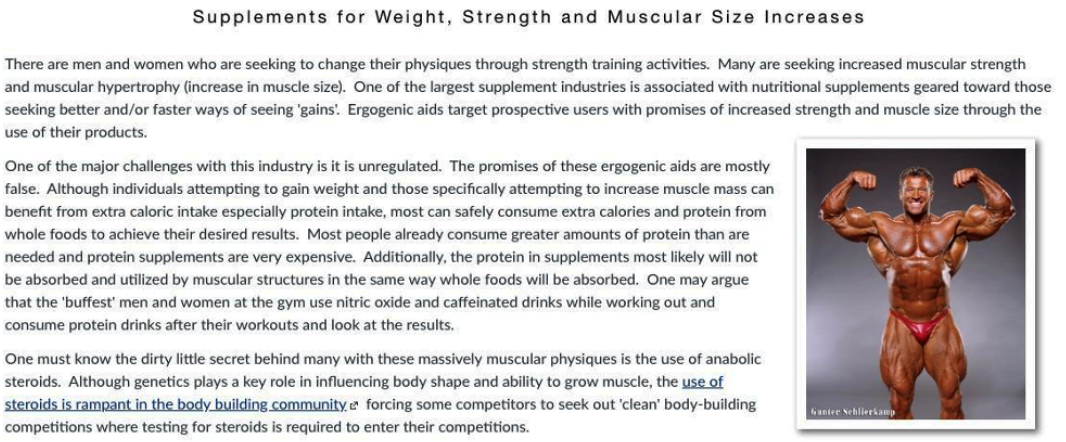
While many studies have regarded decorative images as having little-to-no value and as something that should be avoided, there were many instances where decorative images could be useful, especially in online courses. Our content analysis identified decorative images that were utilized in ways that had distinct communicative purposes. These images were used by instructors to make personal connections, visualize content themes, and build styles. Reynolds (2011) lists various approaches that make emotional connections in presentations, describing content delivery that can be personal, unexpected, novel, challenging, and humorous. Not all of these subcategories mentioned by Reynolds were found in the data pool of this study, but some were definitely used by an instructor to form their own voice and connect with students on a personal level. To this extent, the new category that emerged was *personalization.* Figure 2 includes examples of images found in our study that were used for personalization.

Figure 2. Examples of decorative images and corresponding labels



Thematic images are other types of decorative images that may be useful in linking textual content with visual associations. Figure 3 shows an example of a thematic image used in a nutrition course in a lesson on weight lifting. The image is decorative by standards of the initial framework but functions as a visualization of the textual theme. The bodybuilder image relates to the text, but the content of the image is not directly supported by the text. The image could be described as a metaphorical visualization of the content of the text. For instance, in the example in figure 3, the

Figure 3. Example of Decorative Image for Theme Building in a Nutrition Course



Supplements for Weight, Strength and Muscular Size Increases

There are men and women who are seeking to change their physiques through strength training activities. Many are seeking increased muscular strength and muscular hypertrophy (increase in muscle size). One of the largest supplement industries is associated with nutritional supplements geared toward those seeking better and/or faster ways of seeing 'gains'. Ergogenic aids target prospective users with promises of increased strength and muscle size through the use of their products.

One of the major challenges with this industry is it is unregulated. The promises of these ergogenic aids are mostly false. Although individuals attempting to gain weight and those specifically attempting to increase muscle mass can benefit from extra caloric intake especially protein intake, most can safely consume extra calories and protein from whole foods to achieve their desired results. Most people already consume greater amounts of protein than are needed and protein supplements are very expensive. Additionally, the protein in supplements most likely will not be absorbed and utilized by muscular structures in the same way whole foods will be absorbed. One may argue that the 'buffest' men and women at the gym use nitric oxide and caffeinated drinks while working out and consume protein drinks after their workouts and look at the results.

One must know the dirty little secret behind many with these massively muscular physiques is the use of anabolic steroids. Although genetics plays a key role in influencing body shape and ability to grow muscle, the use of steroids is rampant in the body building community forcing some competitors to seek out 'clean' body-building competitions where testing for steroids is required to enter their competitions.

text is about steroids in the bodybuilding community, but the image does not tie in conceptual values of steroid use or concrete representations of steroids. Optimally, the instructor should have either used an image of the effects of steroids or placed a case study of the pictured bodybuilder related to steroids. The instructor could have also used the image as a link to extend the education beyond the text, thus combining the theme to an educational moment or reference that exists outside of the page.

Another method of text visualization came as direct representations whereby banners and typographical images were created as a headline to underscore the main theme of the text; sometimes the visual headlines were paired with theme building images as well, as seen in Figure 4. The image uses typography as a point of emphasis, but it includes grains, fish, fruits, and vegetables which are all foods that are typically perceived as nutritious, thereby, developing the theme of nutrition. These are probably the best and most appropriate applications of theme building since they tie in with the aesthetic of the visual style of the course.

Figure 4. Theme building images

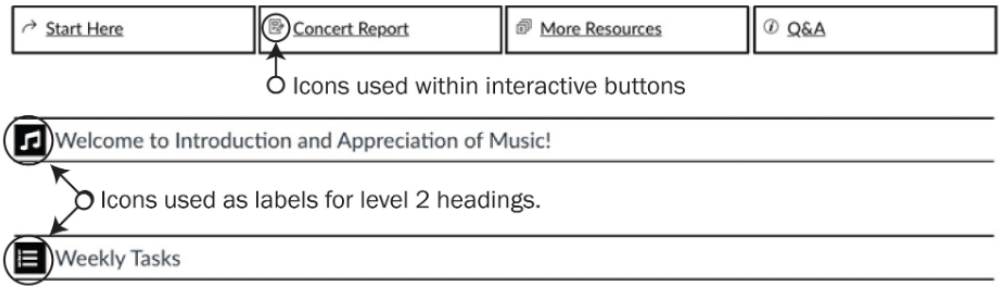
Figure 5 is another example of integrated themed images we found in the study. Non-representational vector art like these falls into this category, as well as stylized image-based typography. These types of images vary the aesthetic of the course using personal preference while also giving clues to the top headlines and visual structure of the document. Both Figure 4 and Figure 5 demonstrate this concept using banners found throughout the course, giving both a textual hierarchy and a visual pattern that might span multiple pages.

Figure 5. Non-objective graphic forms

New categories were developed during the second cycle through further analysis of the residual images. We found it difficult to categorically sort images, because some images that were decorative by nature did have significance towards user experience. For example, some images had repetitive colors,

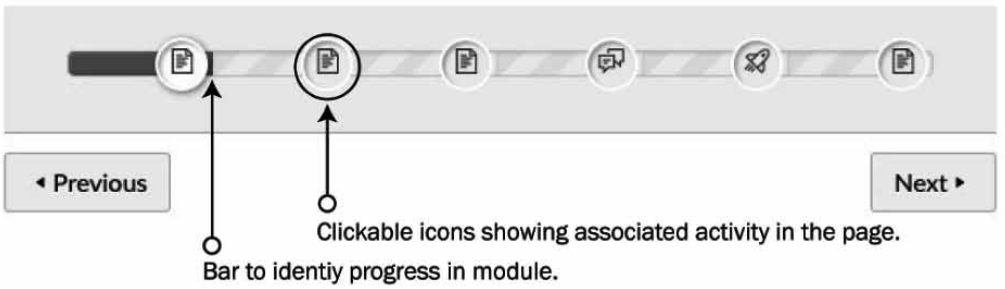
iconography, and clues to how the interface usability. Figure 6 demonstrates this where decoration was applied to banners that become headlines for the upcoming text. These images became part of a visual system we classified as affordance that we address next.

Figure 6. Icons as repetitive images for headers and buttons



There were images that existed outside the initial framework (see Table 2) that could be described as interactive based on embedded navigational cues. Unlike video-based or typical face-to-face learning, the landscape of the online classroom follows a non-linear, interactive modality. Author (2018) describe how online courses function as interactive webpages which leave some images to be classified as an affordance. The concept of affordance became commonplace within the Human Computing Interactivity (HCI) community based upon a book by Donald Norman called *The Psychology of Everyday Things*. Norman (1988) defines an affordance as allowing the design of an object to communicate how it should be used without the need for textual reinforcement. Therefore, images that had a navigational relationship with the interface, allowing for a functional user experience (UX), were organized under this theme. Examples of these images found in the observed classrooms were embedded videos, PowerPoint presentations, or windows containing Adobe PDF documents. There were also hyperlink buttons which a user could click to navigate between pages or launch new pages. We also found icon-based labels that defined the type of content the student was viewing (see Figure 7).

Figure 7. Interactive Icons as Reference Points



Third Cycle: Categorizing the Images in Practice

Drawing from the initial coding frame and using the analytical notes paired with the image analysis in the second cycle, the final themes and subcategories emerged where every image was assigned a code that existed under a main category and their subcategory with seven residual images. In three cases the images were broken links and in the other five cases the images were decorative but did not have supporting text, thus making it difficult to determine the images' purpose. Table 5 shows the final tally of all the image's main categories and subcategories for all 232 images analyzed.

Table 5. Count of Image Type with Main Category in Caps and Subcategory (n=232)

EDUCATIONAL	**63 (27.1%)**	**AFFORDANCE**	**105 (45.3%)**	**DECORATIVE**	**64 (27.6%)**
Concrete	25 (10.7%)	Media	55 (23.7%)	Theming	32 (13.8%)
Conceptual	15 (6.5%)	Labels	28 (12.1%)	Personalization	31(13.3%)
Procedural	12 (5.2%)	Structural	12 (5.2%)	Unknown	5 (2.2%)
Organizational	7 (3%)	Links	10 (4.3%)		
Exemplary	4 (1.7%)				

DISCUSSION

QCA helped us investigate how images were used in online courses in a California community college. The results of the study are discussed below separated by each research question.

Research Question #1: How are images being applied in higher-education online classrooms?

Our results aligned with the literature that suggests that educators do not always use images optimally to improve student learning (Bader, 2019; Metros, 2008; Winn, 1993). In the sample for this study, images were rarely rich in data or integrated in instructional content. For example, only 27% of the images analyzed in this study were considered educational and 3% of all images were organizational. This supports the survey results from a study by Bader (2019) where he found that 30% of community college online educators used images from educational textbook publishers. Interestingly, most of the images used in this sample were not standalone images. The visuals (23.7%) were labeled as media-based affordance images that linked to external media or other applications, like integrated PowerPoint presentations or PDF documents. This suggests that there are many times that instructors prefer to supplement their courses with content from external videos, self-contained documents, and interactive slideshows rather than combining educational images with lecture-based text directly in the LMS. At the time of this study, most of these types of images were embedded HTML videos from YouTube. There were also PowerPoint slides, some which looked like they were developed from the instructor based on a lack of visual organization, while others appeared to be interactive PowerPoint presentations developed by a publisher or professional organization. This points to the trend of online courses often being a container or curation for external content created by others rather than instructional material created and delivered by the instructor (see Lamb & Groom, 2010; Morris & Strommel, 2015, 2018). The practice of integrating interactive content inside of interactive content might be acceptable but it might also be redundant. More research is needed on how students interact with this content.

Research Question #2: How might existing educational image classifications be used or extended in online learning environments?

As a result of our analysis, we were able to develop a taxonomy to categorize how images are used in online courses (Table 3), demonstrating that images, not classified as educational may hold value for online learning

environments. We were able to categorize over 230 images that were spread amongst 20 unique courses with only 5 residual images remaining unclassifiable. While the inter-rater reliability was not as strong as we would have liked for the exact specifications of images, all raters were able to classify the images based upon their own perspective and there was a high level of reliability at the top levels.

A main finding from this study is that existing taxonomies do not adequately represent the real-world image choices of online educators. We did find three notable things for image classifications in online courses: (a) We found that affordance is an important concept to understand in image creation and selection; (b) We were able to generate sub-themes for decorative images into different functions that might be beneficial to the online learning environment, even if they are not educational in the strict sense; and, (c) We were able to elaborate on the conventional frameworks of educational images towards images used in college-level online courses.

LIMITATIONS

This study, like all research, had some limitations. This study was limited by focusing on only one college. Every institution has its own support systems which may affect the images that are used and how they are used. For instance, some colleges may have extremely rigorous course approval processes that demand specific content to be placed into the LMS, while others may simply give instructors a blank slate and say, "go do it" (Lowenthal et al., 2019; Lowenthal & White, 2009). As mentioned, the college that served as a research setting has faculty development workshops every semester for online educators but there are not any workshops on creating, selecting, and using images for online learning. Also, the data collection process did not include the observation of images within linked media like videos, presentations, and documents. Some instructors may have preferred to present their lectures and discussions in these formats instead of creating pages of content in the LMS. But as an aside, the researchers noted that most of the external media used did not appear to be instructor created. Subsequently, the images within the videos and other embedded media formats were not counted.

CONCLUSION

This study was conducted to better understand how images are used in online courses. The findings suggest that instructors might still struggle understanding how to use images purposefully and effectively in their in online courses. For instance, it was found that in many cases images were not used to form an explicit relationship to the text, demonstrating that instructors need training in selecting educational images and pairing the images with text-based content. The results also suggest that decorative images may not be as much of a problem as other studies have suggested. Online courses are places where an instructor can construct and express a unique personality and visual identity, as well as their instructor social presence and teaching presence, in which images can play a special role. However, for this to be effective, we believe this requires some attention to aesthetic and visual design decisions in using images, specifically through banners, engaging images, and typographical images.

The results from this study point for the need for additional research on how images are used in online courses. The images in this study were broken down using a systematic framework, leaving out personal interpretations of the image selections. Thus, future research could be conducted using the framework developed in this study in other higher-education settings to see if instructors use images in the same types of ways. Further, future research could be conducted on students' perceptions of image use in their online courses.

Our research also has implications for practice. It suggests that instructors, and the instructional designers that support them, need training on the different types of images as well as effective ways to find and create images for educational purposes. We also contend that popular quality assurance course design rubrics (e.g., Quality Matters) should focus more on the use of visual images in quality online courses.

FUNDING AGENCY

This research received no specific grants from any funding body in the public, commercial, or not-for-profit sectors.

REFERENCES

Bader, J., & Lowenthal, P. R. (2018). Using visual design to improve the online learning experience: A synthesis of research on aesthetics. In I. Bouchirka, N. Harrati, & P. Vu (Eds.), *Handbook of research on learner experience and usability in online education* (pp. 1–35). IGI Global. doi:10.4018/978-1-5225-4206-3.ch001

Bader, J. D. (2019, March). Image use in higher education online classrooms: A survey of California community college online instructors. In *Society for Information Technology & Teacher Education International Conference* (pp. 787-792). Association for the Advancement of Computing in Education.

Baldwin, S., Ching, Y. H., & Hsu, Y. C. (2018). Online course design in higher education: A review of national and statewide evaluation instruments. *TechTrends*, *62*(1), 46–57. doi:10.1007/s11528-017-0215-z

Baldwin, S. J., & Trespalacios, J. (2017). Evaluation instruments and good practices in online education. *Online Learning*, *21*(2). doi:10.24059/olj.v21i2.913

Blummer, B. (2015). Some visual literacy initiatives in academic institutions: A literature review from 1999 to the present. *Journal of Visual Literacy*, *34*(1), 1–34. doi:10.1080/23796529.2015.11674721

Braden, R. A. (1996). Visual literacy. In D. H. Johanssen (Ed.), *Handbook of research for educational communications and technology* (pp. 491–520). Simon & Schuster.

Brown, L. A., Lohr, L. L., Gall, J. E., & Ursyn, A. (2013). Where is the design in instructional design? The role of visual aesthetics in the field. In M. Orey, S. A. Jones, & R. M. Branch (Eds.), *Educational media and technology yearbook* (pp. 7–25). Springer. doi:10.1007/978-1-4614-4430-5_2

Chen, K.-Z., Lowenthal, P. R., Bauer, C., Heaps, A., & Nielsen, C. (2017). Moving beyond smile sheets: A case study on the evaluation and iterative improvement of an online faculty development program. *Online Learning*, *21*(1), 85–111. doi:10.24059/olj.v21i1.810

Clark, R. C., & Mayer, R. E. (2016). e-Learning and the science of instruction: Proven guidelines for consumers and designers of multimedia (4th ed.). Wiley.

Daley, E. (2003). Expanding the concept of literacy. *EDUCAUSE Review*, *38*(2), 33–39.

Davis, T. (2015). *Visual design for online learning*. Jossey-Bass.

Davis, T., & Frederick, T. V. (2020). The impact of multimedia in course design on students' performance and online learning experience: A pilot study of an introductory educational computing course. *Online Learning*, *24*(3), 147–162. doi:10.24059/olj.v24i3.2069

Dirksen, J. (2015). *Design for how people learn*. New Riders.

Doblin, J. (1980). A structure of visible language. In P. A. Kolers, M. E. Wrolstad, & H. Bouma (Eds.), *Processing of visible language* (pp. 89–111). Plenum Press. doi:10.1007/978-1-4684-1068-6_7

Duarte, N. (2010). *Resonate: Present visual stories that transform audiences*. John Wiley & Sons.

Eisner, E. (2002). *The arts and the creation of mind*. Yale University.

Goldfarb, B. (2002). *Visual pedagogy: Media cultures in and beyond the classroom*. Duke University Press.

González, F. M., Saux, G., & Burin, D. (2019). The decorative images' seductive effect in e-learning depends on attentional inhibition. *Australasian Journal of Educational Technology*, *35*(3). Advance online publication. doi:10.14742/ajet.4577

Halliday, M., & Webster, J. (2003). On language and linguistics. *Continuum*.

Herold, B. (2015, June). *Why ed tech is not transforming how teachers teach*. https://www.edweek.org/ew/articles/2015/06/11/why-ed-tech-is-not-transforming-how.html

Jordaan, C., & Jordaan, D. (2013). The case for formal visual literacy teaching in higher education. *South African Journal of Higher Education*, *27*(1), 76–92.

Klein, J. D., & Kelly, W. Q. (2018). Competencies for instructional designers: A view from employers. *Performance Improvement Quarterly*, *31*(3), 225–247. doi:10.1002/piq.21257

Koszalka, T. A., Russ-Eft, D. F., & Reiser, R. (2013). *Instructional designer competencies: The standards*. Information Age Publishing.

Kress, G. R., & Van Leeuwen, T. (2006). *Reading images: The grammar of visual design* (2nd ed.). Routledge. doi:10.4324/9780203619728

Kumar, S., & Ritzhaupt, A. (2017). What do instructional designers in higher education really do? *International Journal on E-Learning*, *16*(4), 371–393.

Lamb, B., & Groom, J. (2010). The open ed tech: Never mind the edupunks; or, the great web 2.0 swindle. *EDUCAUSE Review*, *45*(4), 50–52.

Levin, J. R. (1981). On functions of pictures in prose. In F. J. Pirozzolo & M. C. Wittrick (Eds.), *Neuropsychological and Cognitive processes in reading* (pp. 203–228). Academic Press. doi:10.1016/B978-0-12-185030-2.50013-5

Levin, J. R., Anglin, G. J., & Carney, R. N. (1987). On empirically validating functions of pictures in prose. In E. H. Willows & H. A. Haughton (Eds.), *The psychology of illustration* (Vol. 1, pp. 51–85). Springer. doi:10.1007/978-1-4612-4674-9_2

Lohr, L. (2008). *Creating graphics for learning and performance: Lessons in visual literacy*. Pearson.

Lowenthal, P. R., Greear, K., Humphrey, M., Lowenthal, D. A., Conley, Q., Giacumo, L. A., & Dunlap, J. C. (2020). Creating accessible and inclusive online learning: Moving beyond compliance and broadening the discussion. *Quarterly Review of Distance Education*, *21*(2), 1–21.

Lowenthal, P. R., Shreaves, D., Gooding, M., & Kepka, J. (2019). Learning to teach online: An exploration of how universities with large online programs train and develop faculty to teach online. *Quarterly Review of Distance Education*, *20*(3), 1–9.

Lowenthal, P. R., & White, J. W. (2009). Enterprise model. In P. Rogers, G. Berg, J. Boettcher, C. Howard, L. Justice, & K. Schenk (Eds.), *Encyclopedia of distance and online learning* (2nd ed., pp. 932–936). IGI Global. doi:10.4018/978-1-60566-198-8.ch130

Lowenthal, P. R., & Wilson, B. G. (2010). Labels do matter! A critique of AECT's redefinition of the field. *TechTrends*, *54*(1), 38–46. doi:10.1007/s11528-009-0362-y

Malamed, C. (2015). *Visual design solutions: Principles and creative inspiration for learning professionals*. John Wiley & Sons. doi:10.1002/9781119153801

Marsh, E. E., & White, M. D. (2003). A taxonomy of relationships between images and text. *The Journal of Documentation*, *59*(6), 647–672. doi:10.1108/00220410310506303

Matusiak, K. K., Heinbach, C., Harper, A., & Bovee, M. (2019). Visual literacy in practice: Use of images in students' academic work. *College & Research Libraries*, *80*(1), 123–139. doi:10.5860/crl.80.1.123

Mayer, R. E. (1993). Illustrations that instruct. In R. Glaser (Ed.), *Advances in instructional psychology* (Vol. 5, pp. 253–284). Erlbaum.

Mayer, R. E. (2019). How multimedia can improve learning and instruction. In J. Dunlosky & K. A. Rawson (Eds.), *The Cambridge handbook of cognition and education* (pp. 460–479). Cambridge University Press., doi:10.1017/9781108235631.019

Mayer, R. E. (2020). *Multimedia learning* (3rd ed.). Cambridge University Press. doi:10.1017/9781316941355

Mayer, R. E., Steinhoff, K., Bower, G., & Mars, R. (1995). A generative theory of textbook design: Using annotated illustrations to foster meaningful learning of science text. *Educational Technology Research and Development*, *43*(1), 31–43. doi:10.1007/BF02300480

Metros, S. E. (2008). The educator's role in preparing visually literate learners. *Theory into Practice*, *47*(2), 102–109. doi:10.1080/00405840801992264

Mietzner, U., & Peim, N. (2005). *Visual history: Images of education*. Peter Lang.

Morris, S. M., & Stommel, J. (2015). The course as container: Distributed learning and the MOOC. In *Global innovation of teaching and learning in higher education* (pp. 167–180). Springer. doi:10.1007/978-3-319-10482-9_10

Morris, S. M., & Stommel, J. (2018). *An urgency of teachers: The work of critical digital pedagogy*. Hybrid Pedagogy.

Norman, D. A. (1988). *The design of everyday things*. Doubleday.

Nuzzaci, A. (2019). A picture is worth a thousand words: Visual thinking between creative thinking and critical thinking in the teaching-learning processes. *Img Journal*, *1*(1), 234–253. doi:10.6092/issn.2724-2463/11071

Paivio, A. (1986). *Mental representations: A dual coding approach*. Oxford University Press.

Papia, B. (2016). Retention in online courses: Exploring issues and solutions—a literature review. *SAGE Open*, *6*(1). 1-11. https://doi.org/10.1177%2F2158244015621777

Peterson, J. S. (2002). Visualizing interactive graphics design for testing with users. *Digital Creativity*, *13*(3), 144–156. doi:10.1076/digc.13.3.144.7341

Piña, A. A. (Ed.). (2017). *Instructional design standards for distance learning*. Association for Educational Communication and Technology.

Potter, W. J., & Levine-Donnerstein, D. (1999). Rethinking validity and reliability in content analysis. *Journal of Applied Communication Research*, *27*(3), 258–284. doi:10.1080/00909889909365539

Reiser, R. A., & Dempsey, J. V. (2018). *Trends and issues in instructional design and technology*. Pearson.

Reynolds, G. (2011). *The naked presenter: Delivering powerful presentations with, or without, slides*. New Riders.

Reynolds, G. (2012). *Presentation Zen: Simple ideas on presentation design and delivery*. New Riders.

Ritzhaupt, A. D., & Kumar, S. (2015). Knowledge and skills needed by instructional designers in higher education. *Performance Improvement Quarterly*, *28*(3), 51–69. doi:10.1002/piq.21196

Sadaf, A., Martin, F., & Ahlgrim-Delzell, L. (2019). student perceptions of the impact of "quality matters" certified online courses on their learning and engagement. *Online Learning*, *23*(4), 214-233. doi:10.24059/olj.v23i4.2009

Saldaña, J. (2015). *The coding manual for qualitative researchers* (3rd ed.). Sage.

Schreier, M. (2012). Qualitative content analysis in practice. *Sage*.

Sugar, W. (2014). *Studies of ID practices: A review and synthesis of research on ID current practices*. Springer. doi:10.1007/978-3-319-03605-2

Waldron, J. S., Hudepohl, N. C., Rimm, N. J., & Hendrickson, W. D. (1985). Instructional message design: Problems and solutions. *The Journal of Biocommunication*, *12*(1), 8–13. PMID:3997800

West, D., Allman, B., Hunsaker, E., & Kimmons, R. (2020). Visual aesthetics: The art of learning. In R. Kimmons & S. Caskurlu (Eds.), *The students' guide to learning design and research*. EdTech Books. https://edtechbooks.org/studentguide/vis

Winn, W. (1993). Perception Principles. In M. L. Fleming & W. H. Levie (Eds.), *Instructional message design: Principles from the behavioral and cognitive sciences* (pp. 55–126). Educational Technology Publications.

Zimmerman, W., Altman, B., Simunich, B., Shattuck, K., & Burch, B. (2020). Evaluating online course quality: A study on implementation of course quality standards. *Online Learning*, *24*(4). 147-163. doi:10.24059/olj.v24i4.2325

Jason Bader currently is the Art department chair at Mt. San Jacinto College. Jason does research in Visual Communication Design and Educational Technology. Jason holds an MFA from UCLA in Design/Media Arts, an MA in Education from UCR, and an Ed.D. in Educational Technology from Boise State University.

Chareen Snelson is an associate professor and associate department chair in the Department of Educational Technology at Boise State University. Her scholarly activity emphasizes scoping reviews in educational technology, using video in online education, and teaching qualitative research methods courses online.

Patrick R. Lowenthal is an associate professor in the Department of Educational Technology at Boise State University where he teaches in a fully online graduate program. Patrick is interested in problems of practice with teaching and learning online. He researches how faculty and students communicate using emerging technologies and, specifically, how they establish presence, community, and identity online.

Norm Friesen is a Professor in the Department of Educational Technology at the College of Education, Boise State University. He recently published The Textbook and the Lecture: Education in the Age of New Media with Johns Hopkins University Press.