Assessing Visual Literacy: A Review and An Attempt

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Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Curriculum and Instruction

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July 08, 2021
Blacksburg, VA

Keywords: visual literacy assessment, visual literacy vocabulary, visual elements, visual actions, digital visuals

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Abstract

This dissertation was driven by a lack of evidence substantiating the current state of visual literacy knowledge and skills of instructional design professionals and the continuing call for visual literacy assessment research. The project has contributed two manuscripts that examine the existing visual literacy assessment research and document an attempt at designing and developing an evidence-based visual literacy assessment product. The first manuscript, a comprehensive literature review, offers insights into how visual literacy has been assessed over the years and the challenges associated with establishing a research agenda for visual literacy assessment as revealed by current research and practice. The second manuscript, adopting the design and development research methodology, aims to design and develop a product that instructional designers can use to assess or diagnose the strengths and weaknesses in their knowledge regarding a fundamental vocabulary of visual literacy.

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General Audience Abstract

Learning and training design professionals are often expected by the job market to communicate effectively using static or moving visual messages throughout the learning or performance problem-solving process. This process typically includes the analysis of the problem and the design, development, implementation, and evaluation of the corresponding solution. However, research has reported a mismatch between employers' and employees' perceptions of the visual competencies of learning and training professionals. Moreover, there is very limited evidence-based research assessing these visual competencies or producing assessment products or procedures. Therefore, this dissertation has contributed two manuscripts to address this issue.

In the first manuscript, a comprehensive review of the relevant literature is presented to inform how these visual competencies have been assessed by previous efforts and to identify the difficulties or challenges associated with the assessment as revealed by the researchers and their work. The second manuscript designed and developed an open-access digital product for learning and training professionals to assess or diagnose their knowledge of a collection of foundational terms and concepts that underpin many visual competencies. Therefore, this product helps learning and training professionals to remediate their visual knowledge accordingly. As part of the design and development process, a group of learning and training professionals and another group of visual competency experts experienced the product and provided valuable feedback that has guided product modifications and identified areas for future development.

Dedication

To Grandpa & Grandma

Acknowledgements

I would like to thank my advisor and dissertation chair, Dr. Ken Potter, for bringing to my attention an article that raised many questions and challenges around the concept of visual literacy, which sparked my interest in visual literacy assessment. In addition to his endless support and guidance throughout my doctoral journey, Dr. Potter has given me the opportunity to serve as a course facilitator in the Instructional Technology Master of Arts (ITMA) program, where I've had the privilege of helping many students learn about the field of instructional design and grow as instructional design professionals themselves. I would also like to thank my committee members, Dr. Barbara Lockee, Dr. Alicia Johnson, and Dr. Michelle Ervine, who have continued to advance my dissertation process by providing invaluable suggestions. I am very grateful to have taken several of Dr. Lockee's instructional design courses and have been endlessly inspired by her professionalism and scholarship. I am also thankful for the instructional design projects I worked on with Dr. Johnson and the many conversations I've had with her. She truly exemplifies what it means to be a caring educator. I also appreciate Dr. Ervine for agreeing to serve on my committee, for our shared interest in visual literacy, and for the insights she provided at each of my doctoral milestones.

I am also extremely grateful to my pilot testers and expert reviewers whose feedback on the assessment product developed from the second manuscript was not only helpful in identifying areas for modification, but also vital for its future development. This dissertation would not have been possible without their support and contribution. I am also thankful to Dr. Giridhar for proofreading my draft and providing timely feedback.

Additionally, I want to extend my gratitude to the faculty, staff, colleagues, and friends of the School of Education who have lifted my spirits countless times, from retrieving my lost

MacBook charger to giving me random Asian snacks they bought from Oasis but did not know what they were. I am especially grateful to the faculty and students of the Instructional Design and Technology program for their acceptance, encouragement, and commitment to building a diverse community. Pursuing and earning a doctoral degree 7000+ miles from home would not have been possible without their support. I am truly thankful for having spent the past five years of my life with them.

Finally, I owe the world to my family back home, whose endless love and support forms the strongest armor I could ask for. I would first like to thank my grandparents who have taken me under their wing for many years, especially my grandpa who was a retired elementary school teacher and quite possibly the root of my passion for education. I am grateful to my mom, dad, and sister for their support, guidance, encouragement, and our facetime calls and group chats over the years. I would also like to thank my aunts and uncles who have taught me love, passion, resilience, and empathy. I thank this big family for shaping me into the person I am today.

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Introduction to the Dissertation

The Research Problem

While visuals have a long and rich history of serving human society as a way to encode and communicate messages and knowledge, they are saturating human society at an unprecedented rate due to advances in technology and economic growth. However, in contrast to the prevalence of visuals and visual communication in everyday life and the workplace, the teaching of visual arts in educational settings (one of the quintessential sources for the general public to acquire learned visual knowledge and skills), has declined in the first decade of the 21st century at the elementary and secondary levels (Seemiller & Grace, 2015). In higher education, visual education has been, "pushed to the periphery of the core curriculum" (Williams & Newton, 2007, p. 4). According to Avgerinou (2001), many have attributed the lack of visual literacy in education to the lack of research on visual literacy assessment. A literature search also revealed a lack of procedures and instruments or products for assessing visual literacy, and even more limited access to some of these products resulting from existing studies (e.g., Turner, 1978).

Looking at visual literacy research through the lens of the instructional design (ID) field, which shares many research interests with visual literacy enthusiasts, there is a fairly robust line of research in the field examining the impact of visuals on learning. (e.g., Clark & Lyons, 2011; Mayer, 2009; Paivio, 1986). However, the field falls short in validating the visual literacy competencies of instructional design students and professionals despite that job analyses and interviews with practicing instructional designers have revealed a need for visual competencies among ID professionals (Chen, 2020; Klein & Kelly, 2018; Sugar et al., 2011).

As evidenced, the above dilemma calls for research on visual literacy assessment and the design and development of visual literacy assessment products. From that point, an array of studies can be conducted to advance both the fields of visual literacy and instructional design, and strategies can be identified in order to facilitate the attainment of visual literacy competencies.

Purpose

This dissertation aims to respond to the lack of visual literacy assessment research and products through the lens of instructional design by contributing two manuscripts with distinctive focuses but connected purposes. The first manuscript is a comprehensive literature review that delineates the changing meaning of *literacy,* and synthesizes the challenges of establishing a research agenda for assessing visual literacy by examining the existing theoretical voices and empirical assessment studies over the past few decades. During this process, an intentional effort was made to locate original publications, particularly products or procedures resulting from or employed by the corresponding studies. The second manuscript, building on the challenges and factors associated with establishing a research agenda for assessing visual literacy identified in the first manuscript, has initiated an effort to design and develop a product for instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, to assess or diagnose their knowledge of a fundamental vocabulary of visual literacy.

Manuscript I: Visual Literacy (VL) Assessment: A Review of Critical Voices and Practices

Contrary to the continued call for research on visual literacy assessment (Robinson et al., 2018; Spitzer & McNerny, 1975), the number of attempts to design and develop products or to implement procedures to obtain a depiction of an individual's visual literacy has been

inadequate. This lack of assessment has hindered research on visual literacy and contributed to the paucity of it in educational curricula (Avgerinou, 2001; Cassidy & Knowlton, 1983). At the same time, few have examined the merits of existing empirical studies and generated insights for future research. Therefore, the purpose of this literature review was to provide a relatively comprehensive picture of visual literacy assessment by organizing and critically reviewing a selection of empirical studies contributed by scholars on a global scale since the emergence of the visual literacy movement in the late 1960s. This manuscript first examined the surface interchangeability between test, measurement, assessment, and evaluation, with the intent of providing a framework for mapping assessment procedures and techniques of different natures. It then examined and summarized the research on visual literacy assessment and the resulting products in light of how this concept has been assessed across the years. This manuscript also described the difficulties and challenges revealed by existing research and pointed to potential directions for establishing a robust research agenda for visual literacy assessment.

The research questions addressed in this article include:

1. How has visual literacy been assessed since the emergence of the visual literacy movement in the late 1960s?
2. What are the challenges of establishing a robust and productive research agenda for visual literacy assessment in light of existing research and practice?

Manuscript II: Creating a Product for Instructional Designers to Assess Their Knowledge of a Fundamental Vocabulary of Visual Literacy: A Design and Development Study

The field of instructional design (ID) shares many interests with visual literacy, such as designing visual and mixed forms of meaning-making involving visuals for specific audiences and purposes. It can be seen through ID job analysis research and reports by practicing

instructional designers that competencies in visual decoding and encoding are expected in the instructional design workplace (Chen, 2020; Klein & Kelly, 2018; Sugar et al., 2011). Nevertheless, despite the wealth of theories and best practices regarding visuals for learning, evidence validating the state of visual literacy among instructional designers has been rarely studied and reported. Therefore, employing a design and development research methodology, this study set out to design and develop a product for instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, to assess their knowledge of a fundamental vocabulary of visual literacy. Feedback from the invited pilot testers and expert reviewers during the formative evaluation phase was analyzed and used to guide modifications to the product. In addition, the formative evaluation resulted in directions for future development and research centered on the product.

The questions addressed in the second manuscript are:

1. What terms and concepts have been identified as comprising a fundamental vocabulary of visual literacy?
2. What factors can be identified as important in the design and development of a product for assessing knowledge of the fundamental vocabulary of visual literacy?
3. How might the factors of such a product be operationalized in the context of this study?
4. How do instructional designers and experts perceive the effectiveness of the product?

Benefits

By addressing the lack of visual literacy assessment research and products through the lens of instructional design, this dissertation benefits the fields of instructional design and visual literacy in a variety of ways.

First, in providing a diagram or framework to organize the techniques and procedures adopted by measurement, test, assessment, and evaluation, the first manuscript assists instructional design students and novice instructional designers in understanding the similarities and differences between these terms. This then allows them to select appropriate assessment or evaluation techniques and procedures that correspond to the instructional needs and contexts to be addressed. Second, in addition to modeling the design and development research methodology for an assessment product, the second manuscript yielded an easily accessible digital product for instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, to assess or diagnose their knowledge of a fundamental vocabulary of visual literacy. Results from the assessment may then inform future targeted visual literacy learning and training for the assessees, which can help to prepare instructional design students for the job market and guide professional development for practicing designers. Third, for instructional design programs, the product resulting from the second manuscript has the potential to be employed as a data collection tool for evaluating program curricula in terms of its adequacy to nurture the visual literacy competencies of students. In addition, the product could serve as a front-end analysis tool for instructors to build prior knowledge for a course or section of a course that emphasizes visual decoding and encoding.

Additionally, for the field of visual literacy, this dissertation has responded to the call for visual literacy assessment research by contributing an assessment product that resides in a digital environment, is easily accessed by its audience, and addresses some of the challenges revealed by existing research. It should be noted that, since an intentional effort has been made to obtain original assessment products and procedures, some observations discussed in the first manuscript have not been thoroughly described by the existing literature. With respect to the product

developed in the second manuscript, the assessment items therein may be carefully modified and customized for potential application to other audiences and disciplines.

Limitations

Overall, there are two layers of factors that have contributed to the limitations of this dissertation. Internally, the researcher's knowledge and skills in digital technology and specific computer programs resulted in some degree of compromise in the operationalization of the product design. Externally, the designated resources and schedule of the dissertation allowed for a small number of pilot testers and expert reviewers to participate in one formative evaluation round. As revealed in the second manuscript, a few more iterations of user testing and expert review may have been beneficial to the development of the product. At the same time, only a small percentage of the invited expert reviewers have completed the review process. While their feedback was invaluable in guiding product modifications and identifying directions for future development, a higher response rate has the potential to provide insights from an even wider range of perspectives to better serve the formative evaluation. Additionally, although the objectives and corresponding assessment items were consistent with the purpose of the study and served the targeted audience as intended, the focus of the study was placed on the lower-level visual literacy knowledge given the full spectrum of visual literacy competencies.

Definitions

Considering the multitude and variety of voices associated with the definitions, it is desirable for this author to provide the following definitions of the concepts that apply to both manuscripts in this dissertation. These definitions are based on a comprehensive review and synthesis of the existing literature.

Visual Literacy

Visual literacy (VL) refers to a set of knowledge, skills, and abilities of varying complexity that enable an individual to effectively decode or encode visuals for purposeful human activities, such as learning and instruction (Ausburn & Ausburn, 1978; Debes, 1970; Baca, 1990; Braden & Hortin, 1982).

The Fundamental Vocabulary of Visual Literacy

In the context of this dissertation, the fundamental vocabulary of visual literacy refers to a collection of terms and concepts that are essential to visual decoding and encoding activities, regardless of the format of the visual or the media and technology through which visual meaning-making takes place. Each of the terms and concepts comprising this vocabulary has a verbal component that one can refer to in conversation or writing, and has a corresponding variety of visual counterparts or equivalents.

Instructional Design Professionals

Instructional design professionals refer to learning and training professionals whose work revolves around the analysis of learning or performance problems and the design, development, implementation, and evaluation of corresponding solutions. They work in diverse settings, such as education, business, medicine and health care, military, etc. Depending on the context of their work, the focus of their job responsibilities, or other factors, instructional design professionals can have different designations, such as *Instructional Designer, Instructional Technologist, Learning Consultant, Learning Specialist, Learning Engineer, Learning Architect*, and so on.

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Manuscript I: Visual Literacy (VL) Assessment: A Review of Critical Voices and Practices

Since the emergence of the visual literacy movement in the United States in the late 1960s, scholars from a variety of disciplinary backgrounds have frequently emphasized the need and significance of assessing visual literacy. Among the earliest proponents of VL assessment, Spitzer and McNerny (1975) noted that the lack of an operational definition of visual literacy was, "one of the fundamental problems that has hampered the investigation of 'visual literacy'" (p. 30). Although some of their assertions were perceived to be implausible (Wescott, 1998), Cassidy and Knowlton (1983) pointed out that, "concepts central to the field must be identified and then defined operationally" for visual literacy to, "survive as a legitimate domain for scholarly inquiry" (p. 88). Later, as seen in a Delphi study conducted by Baca (1990), one of the statements agreed upon by approximately 60 VL scholars specified that there was a need to develop and validate devices to measure visual literacy. Most recently, at an invited panel session in Chicago celebrating the 50th anniversary of International Visual Literacy Association (IVLA), Avgerinou (Robinson et al., 2018) highlighted that assessment should remain the focus of the field, "because without it, VL's likelihood to find its place in the curriculum is extremely slender" (p. 246).

Nevertheless, this shared awareness of the necessity of visual literacy assessment does not seem to have been successfully translated into empirical research and practice. Specifically, since Debes (1970) coined the concept of visual literacy, Turner's *Visual Literacy Test* (1978) has been the only documented standardized VL test in nearly 30 years (Avgerinou, 2001). In regards to research born following the turn of the century, Brumberger (2019) revealed in a study published in the *Journal of Visual Literacy* that assessment has not been one of the priorities. On the other hand, fewer articles have systematically examined the merits of existing assessment

studies, partly due to limited access to some of the assessment devices employed by or developed from existing research. Therefore, careful examination of available empirical studies, including those that have not been widely accessed and discussed, is of particular value for researchers and practitioners to establish a sound research agenda for visual literacy assessment.

In examining the existing visual literacy assessment research and practice, this article first discussed the changing meaning of *literacy*. It then clarified what *measurement, test, assessment*, and *evaluation* entail respectively and how these concepts relate to each other. Building upon the clarification of the terms, a selection of existing visual literacy assessment studies was classified and reviewed. In the process, issues and challenges revealed by the devices themselves, as well as their development are identified and analyzed. While it is not possible to locate and analyze every existing VL assessment study, the literature reviewed has been retrieved from a wide variety of journal articles, conference presentations, and unpublished theses and dissertations that were accessed through keyword searches in databases including WorldCat, ERIC, ProQuest Dissertations & Theses Global, etc. Additionally, the interlibrary loan service was used, and authors were contacted directly in order to access copies of the original assessment instruments.

1) How has visual literacy been assessed since the emergence of the visual literacy movement in the late 1960s?
2) What are the challenges of establishing a robust and productive research agenda for visual literacy assessment in light of existing research and practice?

Literacy, Literacies, and Visual Literacy

Literacy and Literacies

What *literacy* entails varies across ages and is often associated with social changes (Felten, 2008; Hlynka & Smith, 2013; Hoechsmann & Poyntz, 2012; Kellner, 2001). In a rather comprehensive review of *literacy*, Lankshear and Knobel (2006) noted that the word, *literacy*, was mainly used in informal educational settings prior to the 1970s, especially in relation to adults labeled as *illiterate*. In formal education, the focus was on *reading* instead. Later, in the 1970s, *literacy* became a buzzword in education and many other social settings. According to Lankshear and Knobel (2006), the drastic emergence of literacy as "an educational focus" was evidenced by many phenomena, one of which was the word being applied to a growing number of practices where it was used as a metaphor for being competent, such as "being computer literate" (p. 20). This discussion of the metaphorical use of literacy as competence is similar to that of Barton (2007) who claimed that one of the ways the meaning of *literacy* was extended was to mean "competent and knowledgeable in specialized areas" (p. 19), such as in the case of *computer literacy, visual literacy, political literacy*, and many more. The metaphorical use can also be seen in *The Oxford Dictionary of English* (Stevenson, 2010) where *literacy* is said to refer to, "the ability to read and write" or "competence or knowledge in a specified area."

In a more literal association with language, terms like *visual literacy* and *media literacy,* "foreground the notion of being able to communicate or make meaning-as a producer or receiver-using signs, signals, codes, graphic images" (Lankshear & Knobel, 2006, p. 20). This use implies that people need to learn to become efficient in receiving or producing messages (Lankshear & Knobel, 2006). Similarly, in the words of Hlynka and Smith (2013), these terms

are attempts to, “either re-focus or expand the meaning of literacy into other modes of communications” (p. n).

This interest in reconsidering the very meaning of *literacy* for one to effectively participate in society and to navigate various contexts has led to many initiatives and movements at the beginning of the 21st century. Known as the *New London Group* (Jacobs, 2013), a group of international scholars from the U.S., the U.K., and Australia coined the term, *multiliteracies*, to advocate for an adapted approach to literacy pedagogy that addressed cultural and linguistic diversity and multiple modes of meaning-making, including visual design, audio design, multimodal design, and others (The New London Group, 1996). On the west coast, driven by the expanded access to information and the changes it brought to education and the workplace, the Pacific Bell/UCLA Initiative for 21st Century Literacies (Pacific Bell/UCLA Initiative, 2001) claimed that educators should rethink the knowledge and skills that students were being encouraged to adapt to the economy and society. Highlighting *visual literacy, media literacy, multicultural literacy*, and *information literacy*, which were referred to as *21st Century Literacies*, the initiative not only provided lesson plans and resources on their website and published articles on the literacies, but also delivered a two-day in-person workshop series to nearly 50 librarians across the west coast (SBC Knowledge Ventures, 2002).

Many however, were confused by these “new” domains of literacy (Hlynka & Smith, 2013). In an attempt to detangle some of the emerging literacies, Bawden (2008) explained that the concept of *digital literacy* was introduced by Gilster (1997), who described it to be an ability to understand and use information from various sources. It was emphasized that digital literacy involved knowing how to complement digital information with information from non-digital resources. As commented in Bawden (2008), digital literacy, at least in its origin, concerned the

mindset rather than specific technologies or forms of meaning-making. Nevertheless, the concept of digital literacy is often used restrictively to denote, "effective use of information and communications technology (ICT)" (Koltay, 2011, p. 216). In describing the connection between digital literacy and some other concepts, Bawden (2008) pointed out that digital literacy may have had some of its origins in *computer literacy* and *information literacy* populated in the 1980s and 1990s. While the former highlighted hardware and software skills, the latter drew attention to the ability to recognize the need for information, and to effectively locate, evaluate, and use information (American Library Association [ALA], 2000; ALA & Association for Educational Communications and Technology [AECT], 1998). Because digital literacy (Gilster, 1997) has a basis in technology skills, but focuses on knowledge assembly and attitudes that are independent of forms of meaning-making, Bawden (2008) saw it as a framework for integrating other literacies while pointing out that it need not include them all.

Another pair of literacies that are often compared contains *media literacy* and *visual literacy*. According to Robinson (2015), a notable difference between the two is that "visual literacy is less connected to any particular medium" (p. vii). Media literacy is relatively more fluid as it responds to media technologies available (Robinson, 2015). To some extent, this perspective echoes the National Association for Media Literacy Education's (NAMLE, n. d.) depiction of "media", a term that refers to a variety of existing media technologies or tools, as well as "communication technologies that we haven't even dreamed of yet." (para. 3) Accordingly, media technology skills form an important part of the media literacy identity. From the perspective of the European Commission, media literacy involves technical capacities to access and interact with media (Viola, 2016). In Schilder (2014), a significant number of media literacy professionals recognized "developing technological or practical skills" as an important

media literacy outcome (p. 127). In the case of visual literacy, many have not explicitly described visual technologies and visual technical skills, such as Debes' (1970) *A Hierarchy of Visual Skills* and Avgerinou's (2001) *Visual Literacy Index*. Nevertheless, a focus on specific media or technologies and tools seem to emerge often when it comes to the dimension of visual creation (Baca, 1990; The Visual Literacy Standards Task Force, 2012). For example, nearly 60 visual literacy scholars and professionals agreed that creating a visual involved the selection of appropriate medium and the utilization of equipment and technology (Baca, 1990).

Visual Literacy

Historically, visual literacy has been defined or described by abilities, skills, or competencies. Although a definition of visual literacy agreed upon by scholars of diverse disciplines and contexts has yet to emerge, many perceive this concept to entail both the abilities to decode and encode visuals with minimum emphasis on specific visual communication technologies. Voted as the "father of visual literacy" (Williams & Debes, 1970, p. ii), Debes (1970) proposed an early definition of VL along with *A Hierarchy of Visual Skills* that consisted of 35 statements delineating a selection of visual literacy skills using observable behavioral terms, such as, "distinguish hues from greys" and, "'read' a sequence of objects and/or body language arranged to express, so that others may understand it, a personal emotion" (p. 12). For Debes (1970), visual literacy is, "a group of vision competencies" that is "fundamental to normal human learning," the use of which enables one to communicate with others. Later, Ausburn and Ausburn (1978) described visual literacy as, "a group of skills which enable an individual to understand and use visuals for intentionally communicating with others" (p. 291). Moreover, Braden and Hortin (1982) perceived visual literacy as, "the ability to understand and use images, including the ability to think, learn, and express oneself in terms of images" (p. 41). Then,

Avgerinou (2001), in developing a visual literacy measurement device, presented the following definition:

> In the context of human, intentional visual communication, visual literacy refers to a group of largely acquired abilities, i.e. the abilities to understand (read), and to use (write) images, as well as to think and learn in terms of images. (p. 410)

When "media" does appear in a visual literacy definition or description, it often refers to visual means or forms (e.g., photographs, paintings, 3D models, and others) rather than specific technologies or tools (e.g., computer, smartphone, tablet, and others). For example, the *Visual Literacy Competency Standards for Higher Education* (the Visual Literacy Standards) (The Visual Literacy Standards Task Force, 2012) describes visual literacy as, "a set of abilities that enables an individual to effectively find, interpret, evaluate, use, and create images and visual media." (p. 97) As evidenced in many of the performance indicators delineated in the Visual Literacy Standards, the "media" refers to visual means or forms, such as, "creates images and visual media to represent and communicate concepts, narratives, and arguments (e.g., concept maps, presentations, storyboards, posters)." (p. 103)

Nevertheless, the outset of the visual literacy movement in the United States is closely tied to the development of visual media technologies. As revealed by Fransecky and Debes (1972),

> … just as widespread verbal literacy had to wait until printing was easy and typewriters were common, visual literacy didn't really become possible until visual communication was made easy by visual technology and possible on a mass scale. Nor was it so important prior to the arrival of the electronic age when visual stimuli permeate every corner of our lives. (p. 9)

Fransecky and Debes (1972) went on to emphasize that the generation that grew up with the burgeoning of television since the 1950s challenged the educational experiences and curricula provided by the schools, forcing them to expand their options "in language, communication, and in sharing experience with others" (p. 7). Similarly, in an early magazine focused on photography, White (1957) noted that photographic education should include "the reading of all kinds of pictures" and, "start in grade school along with reading words" (p. 135). According to White (1957), at a time when the world was turning to communicating through pictures, neglect of visual literacy is "criminal" (p. 135). Overall, the growing interest in visual literacy in the late 1960s and the 1970s led to the establishment of the International Visual Literacy Association and some visual literacy initiatives across the U.S., such as the National Center for Visual Literacy at Gallaudet College (Seels, 1994; Turner, 1978). However, as revealed in Seels (1994), the visual literacy movement had a relatively limited impact on schools, because the field, "has been building a theoretical and political base". According to Avgerinou (2001), the lack of visual literacy in schools is closely related to the difficulty and lack of assessment. In the words of Baylor et al (1976), without effective measurement of outcomes of visual literacy education, "schools will be forced to cease their pursuit of visual literacy by a public demanding demonstrable results" (p. 108).

However, despite the challenges in assessing visual literacy competencies, some have subjected this concept to assessment, primarily to facilitate educational curriculum reform and understanding of the visual literacy concept (Avgerinou, 2001). Considering that the first few years of visual literacy research (1960s-1970s) had focused on definition rather than research and had not developed instruments to assess visual literacy competencies, Turner (1978) initiated an effort to develop a visual literacy measure targeting educators. They (1978) believed that visual

literacy must reside in educators before it could serve as a means of educating the generation that was exposed to expanded visual communications through television. A number of efforts have followed Turner (1978) in the assessment of visual literacy, but before examining the existing empirical studies on this very topic, it is necessary to first examine the surface interchangeability between *measurement, test, assessment*, and *evaluation.* Although these concepts are often used interchangeably in the literature, they may refer to specific assessment techniques or procedures that are different in nature. Clarifying the meaning of each of these concepts is a prerequisite for understanding the examination of the merits of existing empirical research later in the article.

Measurement, Test, Assessment, and Evaluation

To begin with, it is widely noted in the social science literature that *measurement, test, assessment*, and *evaluation* are often used interchangeably or synonymously (Choppin, 1990; Popham, 2000). These terms are similar in that outcomes of these processes are often used to make inferences about characteristics of entities. The apparent interchangeability is also facilitated by an activity encompassed by all four terms—testing (Keeves & Masters, 1999; Popham, 2000). Correspondingly, in everyday life, people tend to think of testing when reminded of any of the four terms, which, according to Hart (1994), is due to the reality that people have been assessed and evaluated by standardized tests for generations. However, this perceived similarity does not preclude the necessity to specify what each term entails since, "words influence action" (Worthen & Sanders, 1987, p. 23). As indicated by Bachman (1990) in relation to examining language testing research, "attention to the superficial similarities among these terms, however, tends to obscure the distinctive characteristics of each" (p. 18), and understanding their differences, "is vital to the proper development and use of language tests" (p. 18). For the purpose of this review, it is essential to explain what each term denotes and how

they are connected, which will function as a primer for mapping out and classifying the VL assessment studies pertaining to the specific techniques or procedures.

Measurement

To quote Thorndike (1918), "whatever exists at all exists in some amount" and to know it thoroughly, "involves knowing its quantity as well as its quality" (p. 16). Commenting on Thorndike (1918), Hills (1982) pointed out that "knowing its quantity" was equivalent to "measuring it." Measurement, therefore, conveys, "certain rules and procedures for assigning numbers to attributes in such a way that the numbers represent the quantity of the attribute" (Hills, 1982, p. 31). These rules and procedures can be as simple as using a ruler to measure the length of a physical object, and as complex as using established processes or instruments to measure abstract human attributes, such as intelligence. In the world of social sciences, researchers and educators are mostly concerned with the complex end of the spectrum, which entails quantifying not only attributes of a person or a group of people, but also other abstract entities, such as "the readability of texts" (Bachman, 1990, p. 51). Whether simple or complex, measurement implies assigning numbers (quantification) to attributes, features, or characteristics of objects, events, or individuals following explicit rules and procedures (Bachman, 1990; Lester & Bishop, 2000; Linn & Gronlund, 1995; Reynolds et al., 2006; Thorndike, 1997;).

Test

Of the four concepts, test is typically perceived to be the most narrowly defined term (Mehrens & Lehmann, 1991), and one of many forms of measurement (Payne, 1997). According to the most recent edition of *Standards for Educational and Psychological Testing* (American Educational Research Association [AERA] et al., 2014), a "test" is, "a device or procedure in which a sample of an examinee's behavior in a specified domain is obtained and subsequently

evaluated and scored using a standardized process" (p. 2). Being relatively broad, this definition embraces not only what people typically think of a "test" for which responses are "evaluated for their correctness or quality" (p. 2), but also scales and inventories that measure "attitudes, interests, traits, and dispositions" (Salkind & Rasmussen, 2007, p. 948), responses to which are neither right or wrong nor good or bad. These two types of "tests" were originally introduced by Cronbach (1990) who made a distinction between "Tests of Maximum Performance" (p. 38) and "Measures of Typical Response" (p. 41).

Maximum Performance Test. Maximum performance tests measure the "upper limits of the examinee's knowledge and abilities" (Reynolds et al., 2006, p. 5). Numerical values are assigned to test responses to indicate whether they are correct or incorrect (e.g., multiple choice test items), or to indicate level of quality (e.g., essay test items). For example, one of the most well-known and largest maximum performance tests, the Stanford Achievement Test Series (SAT) measures students' academic achievement at various grade levels in spelling, reading, language, mathematics, social science, and listening (Carney & Morse, 2005). Students taking the SAT are expected to achieve the highest numerical value possible by providing responses that are identical, or that correspond well to the predetermined responses. Maximum performance tests, according to Cronbach (1990), can be further classified into achievement tests and aptitude tests. In general terms, an achievement test measures what "the school presumably has taught directly" (p. 40), while an aptitude test quantifies general experience rather than specific instructions for predicting future achievements.

Measures of Typical Response. Typical response measures focus on measuring what a person is, "likely to do under the day-to-day circumstances of living" rather than "what a person is capable of doing, with best effort" (Thorndike, 1997, p. 307). Examples of attributes to be

measured include, but are not limited to, feelings, habits, behaviors, personalities, attitudes, and interests (Cronbach, 1990; Reynolds et al., 2006). Since, "no particular response can be singled out as 'good'" (Cronbach, 1990, p. 41), numerical values are assigned simply to identify patterns. To obtain the values, researchers or measurers may choose to observe typical behaviors or employ various forms of self-reporting to obtain self-descriptions of respondents (Cronbach, 1990).

An example of a typical response measure is the Strong Interest Inventory. Guided by the belief that, "people who are satisfied within a given occupation share a pattern of interests that differentiates them from individuals in other occupations" (Thorndike, 1997, p. 309), the inventory was initially developed by Strong (1927) and has undergone multiple revisions over the years to assist respondents in, "making vocational and educational decisions, confirming occupational choices, suggesting new directions within a career, understanding job dissatisfaction, and developing plans for retirement" (Salkind & Rasmussen, 2007, p. 971). Results from the inventory are numerical values that denote a certain pattern of interest that is neither good nor bad compared to other patterns of interest.

Standard Versus Non-Standardized Tests. In addition to the attributes they measure, tests are often distinguished by other dimensions (AERA et al., 2014). A common distinction is between standardized and non-standardized tests. Typically, most large-scale tests, such as the SAT, are standardized, meaning that the tests are developed from an explicit, rigorous, and systematic process that normally includes test specifications, item development and review, assembling and evaluating test forms, developing procedures and materials for administration and scoring, and test revisions. As the end product of this process, a standardized test consists of a set of fixed items, is administered under the same directions, and yields a numerical value

following an established scoring procedure (Mehrens & Lehmann, 1969). In contrast, non-standardized tests are developed from relatively informal and less rigorous processes. For instance, teachers regularly design, develop, and administer non-standardized tests in and out of the classroom.

Assessment and Evaluation

The literature, to a large extent, agrees that assessment involves methods and procedures that are used to collect evidence in order to draw inferences about the characteristics of entities (AERA et al., 2014; Linn & Miller, 2005; Salvia & Ysseldyke, 2004). Perceived to be a broader term than measurement (AERA et al., 2014; Linn & Miller, 2005; Reynolds et al., 2006), assessment takes a variety of forms that can be informal or formal, formative or summative, and yields quantitative, qualitative, or mixed forms of output. Example assessment methods or procedures include observations, interviews, portfolios, authentic performance, reviewing historical records, tests, scales, etc. The end result of an assessment does not necessarily contain numbers, but can be a qualitative description of an individual's behaviors or traits, e.g., a portfolio. In terms of evaluation that is commonly defined as a process to determine the value, merit, quality, or worth of an entity (Dressel, 1977; Hopkins, 1998; Huitt et al., 2001; Leithwood, 1994; Mehrens & Lehmann, 1991; Russ-Eft & Preskill, 2001; Scriven, 1994), it contains a set of methods similar to those used for assessment.

While it usually implies value judgements, evaluation can be conceptualized in a variety of ways that affect how the connections and differences between assessment and evaluation are viewed. Most notably, with regard to the entities whose characteristics are assessed or evaluated, as suggested in Choppin (1990) and Keeves (1994), assessment is conducted on people, whereas evaluation seeks to determine the merit, quality, or value of abstract non-human entities, such as

programs, interventions, curricula, methods of teaching, etc. In reality, despite that evaluation is often conducted on non-human entities, such as training programs, placing the word "evaluation" or its essence-value judgement-on human beings is commonplace. Teachers often evaluate or judge the value of a student's performance with reference to his or her aptitude (Hopkins, 1998). For example, the same end-of-year reading level for two students can be valued differently based on their distinct reading levels at the beginning of the year (Mehrens & Lehmann, 1991). Likewise, assessment can be conducted on abstract non-human entities, such as assessing the readability of texts in language research. When evaluation targets the characteristics or attributes of people, such as learning achievement and the learning progress of students, some perceive the value judgement to be embedded in (usually at the end of) the assessment process (Linn & Miller, 2005) while others conceptualize it as a separate step following measurement or assessment (Bond et al., 1994; Hopkins, 1998). Evaluation is also believed to be virtually equivalent to assessment when both refer to examining how closely objectives and actual performance match one another (Mehrens & Lehmann, 1991; Suskie, 2009). Additionally, the purposes of the two are believed to be different. It has been argued that while both evaluation and assessment employ a shared selection of varied methods and techniques to collect evidence about certain entities, the former focuses on making judgements about value or quality, while the latter is primarily concerned with improving value or quality.

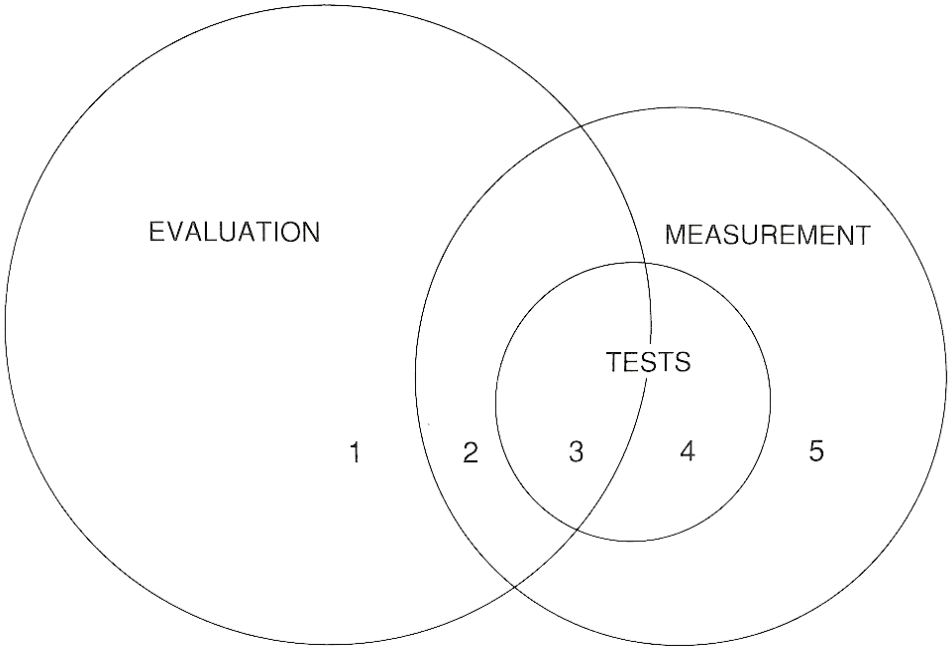
Visualizing the Relationship Between the Concepts

Among the attempts at clarifying what each of these concepts denotes and how they relate to each other, Bachman (1990) and Lynch (2001) proposed two graphic organizers. As seen in Figure 1, Bachman's (1990) contains three circles representing tests, measurement, and evaluation. The devices and techniques are distinguished according to their purpose and whether

quantification is entailed. Area 3 represents tests for evaluation, while area 4 denotes tests for non-evaluation purposes, such as using tests for research. Region 5 indicates non-test measures for non-evaluation purposes. Finally, areas 1 and 2 represent measurement or quantification techniques and non-quantification techniques for evaluation respectively.

Figure 1

Relationships Among Measurement, Tests, and Evaluation



Note. From *Fundamental Considerations in Language Testing*, by L. F. Bachman, 1990, p. 23. Copyright by Oxford University Press (ELT). Reprinted with permission.

Similarly, Lynch (2001, p. 359) employed circles to organize the relationships between the concepts. In their visual organizer, being the umbrella term, assessment implies the "systematic gathering of information for the purpose of making decisions or judgements about individuals" (p. 358). It includes measurement and non-measurement or non-quantification assessment techniques, such as portfolio assessment. Measurement, on the other hand, includes testing.

For the purpose of this review,

- The term, *test,* as used below, refers to a device or procedure that contains a set of questions used to elicit responses from test takers that are quantified following predefined rules. It includes both standardized and non-standardized maximum performance tests as explained above. Individuals taking a test are aware that their knowledge and skills are being tested and quantified, and usually complete the test process in one or two sittings.
- *Measurement*, being a broader concept, includes tests, typical response measures, and many other techniques and methods used to quantify knowledge, skills, and abilities.
- *Assessment,* being even broader in scope, contains all measuring techniques, as well as techniques and processes yielding qualitative depiction of behaviors and traits of individuals, and those that combine numerical and qualitative results.
- *Evaluation* is similar to assessment in that both can employ the same variety of techniques and procedures. However, they are distinctive in the purpose they serve. Assessment highlights improvements, while evaluation emphasizes value judgement.

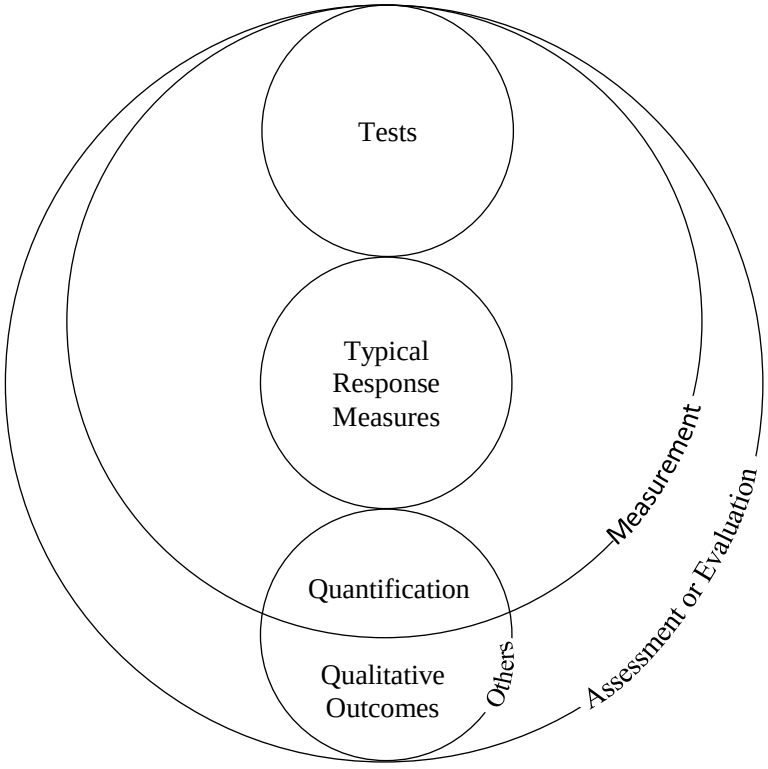
Table 1

Similarities and Differences between Test, Measurement, Assessment, and Evaluation

	Test	Measurement	Assessment	Evaluation
The nature of the description or outcome				
Quantification	✓	✓	✓	✓
Qualitative			✓	✓
Entities described				
Knowledge, skills, abilities	✓	✓	✓	✓
Attitudes & behavior patterns		✓	✓	✓
Characters of groups or inanimate entities		✓	✓	✓
Purpose				
Identify and/or improvement	✓	✓	✓	
Value judgement	✓	✓		✓

Figure 2

The Relationship between Measurement, Test, Assessment, and Evaluation with Reference to the Nature of the Devices and Procedures under Each.



All four of these can be used to obtain a description of some aspect of an individual or other entity, such as knowledge, skills, attitude, and so on. However, as shown in Table 1 above, they differ in the nature of the description or outcome each generates, the entity being described, and the purpose. Figure 2 visualizes the relationship between test, measurement, assessment, and evaluation with reference to the nature of the devices and techniques that each encompasses. As shown, measurement contains tests, typical response measures, and other devices and techniques used for quantifying entities, including combinations of maximum performance tests and typical response measures. Either assessment or evaluation can use any device or procedure for varied purposes. It should be noted that Figure 2 is neither a standard Venn diagram (Venn, 1894) nor a

Concept Circle Diagram (Wandersee, 1987). Blank spaces that are not labeled or named does not indicate any content.

Based on the comparison, clarification, and organization of these assessment concepts, the following section reviews and discusses existing empirical research on visual literacy assessment. By examining the merits of these efforts, difficulties and challenges of building a research agenda for visual literacy assessment are identified.

Visual Literacy Assessment

A look at the empirical assessment research since the commonly cited coinage of the visual literacy concept (Debes, 1970) revealed the achievement in the field as well as challenges and implications to be addressed by future efforts. In general, researchers have employed a variety of assessment techniques and procedures to directly assess visual literacy (e.g., Avgerinou, 2001), or obtain a depiction of an individual's visual literacy competencies as perceived by themselves (e.g., Arslan &Nalinci, 2014). Regarding the audiences assessed, existing empirical studies have assessed populations ranging from elementary school students to college students to educators (Robinson, 1984; Avgerinou, 2001; Turner, 1978). With respect to the assessed content of visual literacy, the majority of the studies have assessed solely or mainly the decoding or reading of visual messages (e.g., Brumberger, 2011). Additionally, the existing assessment efforts were contributed by researchers from a variety of countries, demonstrating an interest on visual literacy assessment research on a global scale.

However, empirical visual literacy assessment research is still in its early stages, as evidenced by the small number of empirical studies and developed assessment products, and the complexity of the challenges that remain to be addressed. A robust and productive research agenda addressing this very concern has yet to be built. For example, although researchers have

used a variety of assessment techniques and procedures, quantification or measurement of visual literacy skills has been the mainstay of existing assessment research. At the same time, the adoption of qualitative research methodologies or techniques that yield qualitative products or performance for assessment has been relatively understudied. This particular challenge has a direct bearing on the finding of a valid, reliable, and fair operational definition that corresponds to both the decoding and encoding dimensions of visual literacy. However, as will be discussed in more detail below, the finding of such an assessment depends on a deeper and more comprehensive understanding of the concept of visual literacy itself, especially the identification of well-defined performance indicators of visual encoding. Additionally, the impact of other sensory skills and language skills on the validity of visual literacy assessments needs to be further investigated.

The following sections will focus on specific visual literacy assessment studies and the challenges and factors that need to be addressed in future assessment efforts.

Visual Literacy Measures

Quantifying concepts is not easy, especially when dealing with an interdisciplinary concept like visual literacy that currently does not have a definition that satisfies all its proponents. However, as commented in Babbie (2013), researchers can adopt a working definition that precludes other possibilities for research inquiries despite disagreement and confusion over what a concept denotes. Thus, findings from the research are applicable to conditions where the exact working definition of the concept applies. Either built upon definitions proposed by earlier scholars or generated by themselves, VL advocates have taken up the challenge of attempting to measure visual literacy across contexts and audiences to justify the existence of VL as a construct and as a field. Some of these efforts derive an individual's VL

performance through tests, while others rely on typical response measures to study the status of visual literacy as perceived by the participants themselves.

Turner's (1978) Visual Literacy Test. According to Avgerinou (2001), the only documented standardized visual literacy test was contributed by Turner (1978). However, this was proven to be inaccurate today, as Avgerinou (2001) has dedicated a dissertation to constructing a standardized VL test as well. Turner (1978) was driven by the development of visual literacy related research in the late 1960s and 1970s (e.g., split-brain research) and the invasion of television into daily life and education, as well as the fact that, "no one as yet has developed a test to determine the expertise or state of visual literacy" (p. 9). Thus, they set out to measure, "the expertise or effective use of visual literacy by educators" (p. 17). Specifically, referencing the third edition of *Standards for Educational and Psychological Tests and Manuals* (AERA et al., 1974), Turner's Visual Literacy Test underwent a rigorous process from developing test specifications to administering the test for standardization.

Conceptually, the "visual literacy" measured in the study conforms to the definition coined by Debes (1970), the "father of visual literacy" (Williams & Debes, 1970, p. ii). Next, five categories of VL content were delineated, including Non-Verbal Communication, Attention Devices, Film/Tapes, Meaning of Elements, and Media Components. Each of these categories contained three visual literacy elements, resulting in a total of 15 components from which the test items were constructed. In terms of the data collection process, a group of 16 classroom teachers participated in a pilot test by taking Form A of the test, comprised of 60 multiple-choice questions. Next, Form B (30 multiple-choice questions) was mailed to a stratified random sample of 150 school supervisors, librarians, and learning resource and media technologists in Missouri, 75 of which were used for data analysis and standardization.

Turner's (1978) study eventually delivered a standardized visual literacy test package that was comprised of the test itself and a detailed manual for administration, which was unquestionably a significant achievement of the first decade (late 1960s to 1970s) of visual literacy research and a starting point for visual literacy testing. Hortin (1983) perceived it as a piece of evidence validating the idea that, "a visual literacy test could be constructed to measure communication skills" (p. 40). Unfortunately, although its momentousness has been recognized in Hortin (1983), Robinson (1984), and Avgerinou (2001), Turner's *Visual Literacy Test* (1978) has not been widely examined and implemented, due in part to its limited availability. As of recently, it appears that the dissertation is only available in physical form and accessible through the Ellis Library at the University of Missouri. The following analysis of the limitations and implications of the test design is based on this author's first-hand experience with both forms of the instrument.

Visual Literacy Skills versus Other Sensory Skills. Overall, visual literacy skills have not been seen as unrelated to other sensory skills. Debes (1970) specified that visual literacy was developed "by seeing and at the same time having and integrating other sensory experiences". In synthesizing the common assumptions of many visual literacy definitions, Avgerinou (2001) pointed out that visual literacy skills were not isolated from other sensory skills (p. 88). However, when it comes to assessment and its validity, it seems appropriate to further examine the role of other sensory skills so that they participate in research as supporting or underpinning skills rather than confounding variables.

In Turner (1978), although the construct measured was *visual* literacy, participants' knowledge of audio techniques and their use in films was tested. Turner (1978) embraced using sound as a cueing device and manipulating audio to achieve certain film effects as components

of visual literacy. Thus questions 10 and 30 in the final form of the test were concerned with sound recording and editing. While it is possible that Turner (1978), or any other researcher, can adopt a working definition of VL that the rest of the world might disagree with, it is essential that the identified sub-components of the concept correspond to the definition of the concept that is assessed. In Turner's (1978) depiction of visual literacy, i.e., "there are essentially three forms of literacy: print, audio and visual. Each medium carries with it the concept or ability to understand and produce messages in that particular mode" (p. 21), audio and visual literacies were conceptually perceived to be separate entities. Still, both visual and audio skills were measured by the test items.

In addition to this inconsistency in Turner's (1978) conceptualization of visual literacy, what appears concerning is that measuring audio competencies may leave one questioning the existence of visual literacy as a concept and field, as it blurs the boundaries between concepts such as media literacy and visual literacy. However, this is not to say that other sensory channels, such as audio, should not be embedded in a visual literacy assessment; rather, knowledge and skills related to audio production, while possibly supporting the encoding and decoding of visuals (e.g., video interpretation and creation), may not be treated as the target content for assessments. Ultimately, further conceptual and operational inquiry into the role of other sensory skills in visual literacy and how they will be addressed in the assessment rests on the shoulders of future researchers.

Explicit Performance Indicators. In social sciences, performance indicators or objectives allow abstract and theoretical constructs to be "seen" by describing them using observable and measurable statements. These statements then serve as groundwork for the subsequent item writing. According to Babbie (2013), indicators signify "the presence or absence of the concept

we're studying" (p. 129). While the categories and sub-categories of visual literacy were presented in Turner (1978), performance indicators or objectives describing a visually literate individual were missing. In other words, it was unclear what the target audience were expected to do with the content identified by the researcher. To some extent, some of the missing performance objectives could be detected subjectively by the readers through active interpretation of the test specification table (e.g., "identification" and "application", p. 78), the limited descriptions similar to performance indicators, and the test items themselves. However, to a large extent, the lack of explicit performance indicators makes it challenging to examine the validity of the instrument.

Verbal Language Use in Visual Literacy Assessment. The lack of performance objectives posed additional challenges to evaluating the merit of the instrument, particularly to examining the alignment between the objectives and the corresponding assessment items. Specifically, contrary to Spitzer and McNerny's (1975) call for limiting verbal use in a visual literacy test, most of the questions in Turner's (1978) test were presented via text even though the author claimed that the items were "graphic, verbal or combination of the same" (p. 77). Of the 60 questions in Form A of the test, only 9 included combinations of verbal statements and visuals. In the final form of the test, 5 out of 30 questions included visuals. However, it is difficult to detangle the impact of the lack of visuals on the validity of the instrument due to missing performance objectives. For instance, regarding the use of camera shots in films, if the indicator was to, "recall what a high-angle shot is," it would not be unacceptable to not include a visual in the assessment question. However, if the indicator was to "recognize a high-angle shot," then a visual would have to be included in the item.

This concern with the use of verbal language in the assessment of visual literacy is also seen in Bratton et al. (1976). One of the questions regarding assessing the behaviors of visual languaging raised by this group of scholars attending the 22nd Lake Okoboji Educational Media Leadership Conference was, "how can the effects of other languaging skills be controlled to obtain a valid measure of visual languaging capabilities?" (p. 124).

Nevertheless, this concern about the use of verbal language in the visual literacy assessment calls for future research to examine its merits. There is no empirical evidence substantiating the elimination of verbal language when assessing visual literacy, nor is there compelling theoretical justification for its necessity. At this point, one could easily challenge the legitimacy of this concern by questioning what makes visual literacy so special that verbal language should be removed when it is used widely and extensively in the assessment of other concepts or competencies across settings and disciplines. Rather than focusing on eliminating the presence of verbal language, researchers may look into the potential threat to the validity of the assessment posed by the lack of visuals and carefully justifying the limited use of verbal language in the assessment items.

***Targeted Assessment Audience*.** Finally, the target audience for the test needs to be clarified. Although Turner (1978) claimed that the test had been designed for high school and college students (both in the test manual (p. 193) as well as in their paper presentation during the Association for Educational Communications and Technology (AECT) annual conference in 1979), it was clear from the complete test design process that educators instead of students were the audience for the study:

> It is the measurement of the acquisition of these skills in the population of educators that is the heart of this study since visual literacy must reside in the educator before it can be

used as a means of teaching an obviously already visually literate generation of students raised with-some would say on-television. (p. 15)

Additionally, the only students involved in the data collection process were the 16 graduate students who participated in the pilot test as, "teachers, school librarians, media specialists, health science and vocational educators" (p. 194) enrolled in a university-level media course. If high school and undergraduate students participated in the pilot test, item difficulty calculated from the dataset could have been different, yielding a final form of the test with different test items. In terms of the main test stage, all 150 participants were selected from a list of school supervisors and media educators whose names were obtained from the Missouri State Department of Education. Therefore, one could question the legitimacy of Turner's (1978) claim that high school and college students were part of the target audience as in reality, the test was designed for and administered to educators. It should be noted that, however, Turner (1978) referred to a limitation of the study as, "the extent to which the sample represents the population from which it was drawn", yet provided no further discussion.

Avgerinou's (2001) Visual Literacy Index. At the turn of the century, Avgerinou (2001), past president of the International Visual Literacy Association (IVLA) and co-Editor in Chief of the *Journal of Visual Literacy* completed a nearly 700-page dissertation study that led to a standardized visual literacy test titled *Visual Literacy Index*. It should be noted that due to the comprehensive and extensive nature of the study, this review does not nearly address all of the topics investigated in the study. It is recommended that individuals interested in exploring more of the fundamental issues revolving around VL refer to the original work where topics such as theoretical foundations of VL, the evolvement of the research in the field, cultures and visual literacy, and political implications of VL measurement are examined. With respect to the test

itself, it is described to be a composite measure that quantifies a set of visual literacy abilities primarily focusing on the decoding dimension of the construct, including "Visualization," "Critical Viewing," "Verbo-Visual Reasoning," "Visual Reconstruction," "Visual Thinking," "Visual Discrimination," "Constructing Meaning," "Re-Constructing Meaning," "Knowledge of Visual Vocabulary & Definitions," "Visual Association," and "Knowledge of Visual Conventions" (Avgerinou, 2001, p. 445). The visual literacy concept, however, encompasses both the decoding and encoding dimensions, as implied in the following definition developed by Avgerinou (2001) from Hortin's (1983):

> In the context of human, intentional visual communication, visual literacy refers to a group of largely acquired abilities, i.e., the abilities to understand (read), and to use (write) images, as well as to think and learn in terms of images. (pp. 410)

Guided by the conceptualization of the VL construct, Debes' *Hierarchy of Visual Skills* (1970), and Gagné's learned capabilities (Gagné & Driscoll, 1988), a list of VL indicators written in the form of behavioral objectives were generated and subsequently used to construct the test items. Compared to the questions in Turner's (1978) test, items contained more visuals that were selected from visual research books, image banks, advertisements, and other resources based on the frequency of their appearance in daily life. Also, in keeping with Spitzer and McNerny's (1975) call for limiting verbal use on a visual test, items making minimal use of verbal or numerical information were considered good items during the item selection stage. Data collection and analysis took place over a period of approximately four years, during which visual literacy experts, educators, and IVLA members participated in four focus group sessions, one pre-pilot test, six pilot tests, and an expert panel.

As a result, the study made a significant contribution to visual literacy measurement research by yielding a post-pilot version, or in the author's words, "most recent version" (p. 428), of the *Visual Literacy Index* comprised of 33 items and 102 questions that can be employed to measure the 11 visual literacy abilities of adults, "who had been educated up to first degree (and beyond), under western-type education systems" (p. 423). For standardization, Avgerinou (2001) defined a fixed set of rules to govern test content, administration, and scoring, yet the norm was out of the scope of the study at the time. Regardless, the establishment of the instrument grants future researchers the opportunity to explore correlations or causal relationships between VL abilities and other factors of interest. It also facilitates the collection of evidence about individuals' visual literacy through which the inclusion of VL in school curricula can be justified. For example, as "the only peer reviewed, publicly available instrument that has a convincing research basis to support its use" (Farrell, 2013, p. 19), the index was adopted by Farrell (2013) in a study to build a baseline of visual literacy among graduate students enrolled in teacher preparation programs. Although the response rate was fairly low, a total number of 1144 students from 10 institutions across the U.S. participated in the study. The implementation of the test led to an identification of the weaknesses in visual literacy abilities among students, which is valuable for advancing teacher education curriculum.

Despite its momentous contribution to the visual literacy assessment research, there is room for further exploration as in the case of most research. With regard to Avgerinou (2001), aside from the relatively small sample size and using only still visuals in test items, the most notable limitation was that the encoding dimension of visual literacy was not fully examined. Acknowledging its difficulty, and that no previous effort had comprehensively dealt with the issue, Avgerinou (2001) suggested that the main task in moving the index forward regarding its

content was not only to integrate the encoding aspect of visual communication, but to measure it using both still and moving images. Nevertheless, to this author's knowledge, the following two challenges are inevitable in any future attempts to measure the encoding aspect of visual literacy.

Creation or Encoding is Theoretically Challenging to Assess. Theoretically, encoding or creating is complex and demanding in nature. Definitions of visual literacy are consistent in that visual literacy is, "a cognitive ability but also draws on the affective domain" (Avgerinou, 2001, p. 89). With respect to the cognitive side of the construct, encoding/creating/writing visuals falls under the *create* category in the revised taxonomy of Bloom's (Anderson & Krathwohl, 2001), a category that ranks at the top of the hierarchy of cognitive complexity. In their dissertation exploring challenges faced by media literacy assessment advocates, Schilder (2014) provided a review of challenges posed by higher-order thinking skills (analyze, evaluate, and create) in assessing media literacy. Referencing several chapters from *Assessment of Higher Order Thinking Skills* (Schraw & Robinson, 2011), Schilder (2014) informed the readers that assessing higher-order thinking skills is often perceived as requiring a range of methods and techniques and an increased use of qualitative techniques (e.g., performance assessment), as well as assessments administered in multiple settings. Interviewing experts in the field of media literacy also suggested that quality higher order thinking assessments "are time consuming, expensive, or complex to develop" (Schilder et al., 2016, p. 41).

Indicators for Visual Creations Are Yet to be Determined. On the other hand, decisions need to be made and justified regarding the indicators of visual creation. In addition, how those indicators can be assessed in a valid, reliable, and fair way should be explored. As indicated in Baca (1990), VL researchers agreed that creating visuals included "mental visualization/conceptualization," "designing the visual," and "making it visible" (p. 67). While

the knowledge, skills, and abilities encompassed by the first component of visual creation are already complex and difficult to measure, measuring what is involved in the second and the third components poses additional challenges. In particular, "making it visible" was thought to include "selecting an appropriate medium," "utilizing the equipment, materials and techniques of the medium," and "using presentation technology." In reality, however, there are thousands of media products for visual creation with a range of simple to complex built-in affordances, some of which have been developed specifically for professionals in fields such as architecture and 3D animation. It is not impossible, but rather unreasonable, to expect individuals to be able to operate a variety of visual media technologies. This reality, therefore, raises the question of what media should be employed to assess visual creation, as well as whether the "making it visible" component should be treated as an indicator of visual creation. If an individual acts as the "brain" and "creates" a visual message through the technology skills or drawing techniques of someone else, during which the vision of the "brain" is as specific and accurate as detailing the boldness of a line, the size of a shape, the RGB code of a color, the hairstyle of a character, etc., would this individual be considered visually literate with regard to the encoding dimension?

Implications of the Visual Literacy Tests. First, Turner's (1978) Visual Literacy Test and Avgerinou's (2001) Visual Literacy Index are unquestionably pivotal to the visual literacy assessment research. Both tests were standardized in the sense that they were designed and developed following a rigorous and systematic process and provided fixed sets of test items, detailed directions on administration, clear scoring instructions, etc. At the same time, they have proved that testing visual literacy could be achieved and laid a solid foundation for future work on measuring or quantifying visual literacy competencies.

From another perspective, it is clear that measuring visual literacy using a rigorous test or obtaining an operational definition of the visual literacy concept is seriously understudied. This reality is, in some ways, understandable given the challenging nature of such an interdisciplinary and complex concept that many of its layers are still under research and development, such as the performance indicators of the visual encoding dimension and the relationship between other sensory skills and language skills and visual literacy. Additionally, it is worth noting that the design, development, and standardization of the tests above involved participation or contribution of varied personnel. Also, they both denoted a long and time-consuming design and development process.

As will be discussed in the following paragraphs, some have taken a different approach to describing the visual literacy competencies as perceived by the target audiences, rather than generating evidence-based assessment results using tests.

Typical Response Measures on Perceived Visual Literacy. As noted in the early sections of this article, typical response measures refer to measuring devices or procedures that do not concern the maximum limits of one's knowledge, skills, or abilities, but rather traits such as attitudes and feelings. For typical response measures, responses do not signify a correct or incorrect answer, but rather patterns of behaviors, attitudes, perceptions, dispositions, etc. In the context of visual literacy research, typical response measures are often developed to examine perceived status, attitudes, beliefs of VL, and self-reported usage of visual technologies. For instance, based on the Visual Literacy Standards published by the Association of College & Research Libraries (ACRL) (The Visual Literacy Standards Task Force, 2012), Arslan and Nalinci (2014) set out to develop a visual literacy scale for students in higher education. Delineating 7 VL standards, 24 performance indicators, and 100 learning outcomes, the

Standards provided a relatively comprehensive list of what a visually literate individual in higher education could do. It encompassed some aspects that was not often recognized by its predecessors, such as visual ethics and image retrieval competencies. Initially, 100 Likert-Scale items were generated in alignment with the 100 learning outcomes specified in the Standards. Inputs from an assessment expert and a linguist resulted in the elimination of 25 items. The instrument was then administered to 414 university students for data collection and analysis, after which 41 items remained in the instrument.

While Arslan and Nalinci's (2014) was one of the only attempts that operationalized the Visual Literacy Standards and administered the instrument to a relatively large number of participants, it is important to note that the instrument measured not "the visual literacy levels of university students" (p. 65), but rather students' perceptions or perceived levels for their visual literacy skills. Specifically, students were asked to indicate to what degree they agreed with each of the visual literacy indicators specified in the standards. For example, item m52 asked students to indicate to what extent they agreed with the statement, "I can change the properties of visuals such as size, resolution and file format when needed" by selecting one of the five options that included "I strongly disagree," "I disagree," "Neither agree nor disagree," "I agree," and "I strongly agree." These responses were worth 1 to 5 points. Thus, higher cumulative scores could only indicate that an individual perceived their visual literacy skills as stronger. The nature of the measure necessitates careful interpretation and use of the results. For example, a claim that a higher score obtained from the instrument indicates that, "the visual literacy skills are high" (p. 65) would call for further research to examine if there was a positive correlation between perceived visual literacy ability and evidence-based visual literacy performance.

Later, a group of scholars from Spain (García-Sánchez et al., 2018) developed another typical response measure for investigating the cultural characteristics of people and their perceived visual literacy through which cross-cultural analysis could be conducted. The instrument derived from the study consisted of three sections. Section one collected demographics (age, gender, nationality, and educational level) as well as internet and image-occupied mobile app usage. Section two included 62 Likert-Scale items for measuring an individual's perceived levels of seven visual literacy constructs adapted from Dondis (1973), including character and content, composition, basic elements of visual communication, the anatomy of the visual message, contrast dynamics, visual techniques: communication strategies, and synthesis of visual style. The third section then examined 6 categories related to the cultural aspects of human beings and society, including individualism vs. collectivism, power distance, uncertainty avoidance, Indulgence vs. Restraint, Long-Term Orientation vs. Short-Term Orientation, and Masculinity vs. Femininity through 30 items. Since the authors had not tested the instrument at the time of publication, future endeavors administering the measure to real audiences are needed to validate the instrument and inquire into its reliability.

Implications of The Typical Response Measures. It needs to be emphasized that, in contrast to tests, typical response measures are concerned with measuring the perceived rather than the evidenced knowledge, skills, or abilities. From the perspective of educational psychology research, perceptions of one's knowledge, skills, or abilities have been extensively studied for decades, resulting in well-established constructs, such as self-efficacy and self-concept, the measurement of which provides implications for teaching and learning. For instance, self-efficacy, referred to as "one's perceived capabilities for learning or performing actions at designated levels" (Schunk & DiBenedetto, 2016, p. 34), is proved to have a positive

correlation with educational outcomes by some correlational studies (Williams & Williams, 2010). However, Schunk and DiBenedetto (2016) indicated that, "there is no automatic relation between self-efficacy and academic ability" (p. 38). Additionally, while "a person knows a great deal about his own behavior" (Cronbach, 1990, p. 43), researchers from various domains have been comparing the two with varying results. For example, Clauss and Geedey (2010) found out that students were better self-assessors at the low and high Bloom's cognitive levels, yet were poor self-assessors at intermediate levels including comprehension and application. Baartman and Ruijs (2011) revealed that while undergraduate students' efficacy was generally consistent with their evidenced social work competencies, there were discrepancies between the two at certain points during their four years in college. Another study (Che Musa et al., 2017) found that students who perceived themselves to be competent in solving statistical problems had difficulty when asked to solve actual problems. The above studies and arguments concerning the relationship between perceived and evidenced performance of students from neighbor social science subjects suggests that while devices measuring perceived visual literacy have their own merits, it is incumbent upon researchers and the reader to keep in mind that there is no definitive data (at least for now), that validates that perceived VL predicts evidenced VL. Therefore, the interpretation and use of results from typical response measures of visual literacy should be done carefully.

Combining Tests with Typical Response Measures for Research. Attempts at measuring visual literacy using tests and typical response measures for research purposes have been seen in some recent publications. Brumberger (2011), for example, attempted to measure visual literacy among post-secondary students as a way to empirically investigate whether millennials or digital natives were more visually literate due to more frequent interaction with

visually-oriented technologies. The visual literacy measured in the study included seven objectives/indicators provided by *21st Century Skills: Literacy in the Digital Age* (North Central Regional Educational Laboratory [NCREL] & Metiri Group, 2003), and concerned both decoding and encoding dimensions. However, since measuring all the aspects was rather ambitious, the instrument focused on, "students' use of and proficiency with visually-oriented technologies, as well as their skills in interpreting images and being informed and critical consumers of visual material" (p. 21). As a result, the instrument employed in the study combined test questions and typical response measurement items. Results from the study suggested that millennials "do not possess a high degree of visual literacy" (p. 44), which empirically invalidated the digital native argument. In terms of limitations for the study, Brumberger (2011) raised questions about the dependence of visual interpretation on knowledge of history, culture, politics, etc., and whether visual literacy could be separated from that knowledge. The author indicated that answers to these questions required a deeper understanding of visual literacy itself.

Culturally Specific versus Culturally Inclusive. An awareness of such issues, namely the dependence of visual literacy on knowledge and experience in a specific area such as American history, has been present in the VL literature for quite some time. As suggested in Baca (1990), it is a shared knowledge that the influence on meanings of visuals lie in viewers, the visuals themselves, the context of presentation, the context of sociological influences, and the interplay between these forces. However, recognizing the inherent subjectivity and influence of other forces in visual interpretation and creation should not be seen as a barrier to VL research. Referring to similar dilemmas encountered at the outset of IQ test research when people

questioned the confounding variables such as sociocultural background, Avgerinou (2001) indicated that this type of issue should not hinder VL measurement research:

> More specifically, there is nothing fundamentally wrong with the measurement of such a culturally bound construct for the reason that different cultures can create their own version of VL tests. Those VL tests would be based on the type of visuals that are closely associated with their producing cultures. Despite the fact that the tests would be designed according to certain specifications set by particular cultural contexts, the test purposes to be achieved would in principle be universally common, that is, over and above any cultural biases. (p. 352)

Over the years, some researchers have taken this approach to VL measurement research in which sociocultural and other forces are identified not as a disadvantage, but rather as specific conditions to which the research applies. For Avgerinou (2001), the target audience was identified as adults educated in a western-type educational system. In a more recent study, Emanuel et al. (2016) developed the *Cultural Image Literacy Assessment-USA* to measure undergraduate students' knowledge of representative images of the U.S. After several trials and revisions, the test consisted of 100 images categorized into general images, personalities, events and landmarks, and art and social movements. Respondents were asked to provide one answer to each image to validate their knowledge of images that were closely associated with the U.S. culture and society. Results from the measurement suggested that while the respondents were more likely to recognize general images and personalities, their overall performance was less than ideal. In terms of future directions for the study and other similar studies, the researchers suggested that images included in the instrument needed to be reevaluated and possibly replaced with those that were more relevant to the culture as times changed. The instrument could also be

customized to measure cultural image literacy in other cultural contexts, thus allowing for comparison of image literacy across cultures.

It should be noted, however, that a clearly delineated definition of cultural image literacy is missing. The "definition" cited in the study was noted to be provided by Messaris in 2004. However, Messaris' (1995) article was presented during the 1994 IVLA conference and published in 1995 along with the other selected readings from the conference. Furthermore, the term "cultural image literacy" was not present in the article. Instead, Messaris (1995) used descriptors such as "an intriguing aspect of visual literacy" (p. 2) and, "type of visual literacy" (p. 6) to label this "knowledge of specific cultural images" (p. 3) or the "familiarity with specific images or sets of images that have played a role in a particular culture's visual heritage" (p. 2). It seems that a more careful investigation needs to be done before one can draw an equal sign between the term, "cultural image literacy," and Messaris' conception of the knowledge of culturally-specific images. This is especially true given that "literacy," as agreed upon by a handful of VL literature, goes beyond recognizing or understanding images to encompass both decoding and encoding visual messages. To avoid unnecessary confusion and controversy, the authors may want to clearly define "cultural image literacy" and its indicators or performance objectives.

From a different perspective, while this author agrees with Avgerinou's (2001) recommendation to carefully select visuals for a VL measure that are designed for a specific culture or society, it should be pointed out that in reality, being a critical consumer and creator of visuals that are closely connected to one's own society or culture is far from enough. This is especially true in today's society where the public frequently decodes and encodes visuals on a global scale. Most recently, in February 2019, the Italian luxury brand Gucci discontinued and

apologized for a sweater whose visual message evoked *blackface*, a visual symbol widely perceived as racist, disrespectful, and hurtful in several countries, and particularly in the U.S. In education, using the U.S. as an example, for the third consecutive year, more than one million international students were studying at higher education institutions for the 2017-2018 academic year (Homeland Security, 2018), forcing educators to be more aware of their visual practices. While it is rather challenging to know all of the visuals in the world, a visually literate person should be an individual who is aware of and acknowledges that there are forces influencing the meaning of visual messages perceived by a diverse audience. The visually literate person should be willing to channel that knowledge, awareness, and respect to their visual decoding and encoding practices.

Qualitative Approach and Mixed Procedures to VL Assessment

In contrast to the aforementioned research that primarily quantify or assign numbers to the perceived or evidenced visual literacy knowledge, skills, or traits of individuals, there is little literature documenting the implementation of qualitative assessment procedures or combining multiple assessment techniques to describe visual literacy. Among the existing studies, Robinson's (1984) was an earlier work employing qualitative techniques, i.e., observations, to obtain a depiction of an individual's VL competencies in addition to quantifying assessment items.

Robinson (1984) adapted Turner's (1978) Visual Literacy Test to examine the narrative and television comprehension of elementary school students. The focus of the research was on the comprehension of television or motion media with respect to narrative components (e.g., plot, character, setting, conflict, mood, etc.), motion media techniques and components (e.g., shot types, lighting, sound effects), viewing habits or preferences, and familiarity with operating

visual media technologies. Similar to many of the empirical assessment studies discussed above, this research highlighted the decoding dimension of visual literacy. At the same time, other sensory skills, i.e., audio elements and their contribution to meaning making, were also the target content of the assessment. However, compared to Turner's (1978), Robinson's procedure expanded the audience of visual literacy assessment from adults to middle school students. Moreover, it explored using dynamic rather than static visuals as the medium of assessment. Most notably, this assessment research was an early effort in assessing relatively higher-order visual decoding skills, employing a naturalistic inquiry approach that yielded qualitative assessment results. Participant observation was reportedly involved in the collection of data, which, according to Robinson (1984), echoed the call for using naturalistic inquiry methods to investigate individual meaning derived from visuals.

A more recent effort was contributed by Yeh & Lohr (2010). Taking a qualitative approach, these researchers employed techniques such as observation and interview to obtain a rich depiction of pre-service teachers' perceptions of visual literacy and their ability to extract the intended meanings from instructional visuals. During the study, eight pre-service teachers were asked to discuss aloud about their definitions of visual literacy, the meanings of the four instructional visuals prepared by the researchers, how they interpreted the images to obtain the meanings, how the CARP design principles (Contrast, Alignment, Repetition, Proximity) were employed in the visuals, and to sketch out how the visuals could be improved. The four visuals used in the study included a Venn Diagram, an algebraic equation, a bar chart, and a map. Results from the study suggested that the participants were able to define visual literacy, extract the intended meanings from the instructional visuals, and propose improvements to the visuals based on the CARP principles. The researchers then pointed out that, "perhaps the most

important result of this research lies in its promotion of new ways to test visual competencies" (p. 195).

Naturalistic or Experimental Approach to Visual Literacy Assessment. While not specifically targeting the issue of assessment, arguments have been made by advocates for either quantitative or qualitative paradigm approaches and techniques for general visual literacy research. Without going into too many details, Cochran et al. (1980) criticized that, being reductionist, classical experimental types of research are concerned with cause-effect and correlational inquiries that describe states of entities and investigate factors or conditions leading to changes in state. This type of research is not appropriate for studying visual literacy, a "cultural phenomenon" (p. 243) that operates on a rather complex system that concerns the internal cognitive structure of an individual and the external visual environment. In Baca (1990), while recommending both quantitative and qualitative methods, the VL scholars indicated that qualitative, naturalistic inquiries were more appropriate to VL research. However, later, Braden (1996), in his chapter for the *Handbook of Research for Educational Communications and Technology*, claimed that quantitative methods should be adopted due to the fact that research in the visual literacy field has been criticized for its lack of rigor. When it comes to assessment, Avgerinou (2001) pointed out that developing an operational definition, or measuring VL through a test, "clearly called for an experimental-type research design which would primarily rely on quantitative data, and seek to explore -possibly explain- all identified connections between variables" (p. 364).

Considering that an operational definition of visual literacy encompassing both the decoding and encoding dimensions is yet to be born, and that the placement of VL in educational curriculum has yet to be secured, Braden's (1996) and Avgerinou's (2001) arguments are

unquestionably valid. Nevertheless, conducting assessment research within the quantitative framework does not necessarily preclude the embedding of techniques and procedures that yield qualitative outcomes as long as numerical values are assigned as guided by detailed, valid, reliable, and fair scoring rubrics or other quantification techniques or procedures. This particular approach also echoes scholars' recommendations for assessing higher-order thinking skills through a variety of techniques, including those that are qualitative in nature (Schilder, 2014).

With respect to Cochran et al.'s (1980) criticism on employing quantitative methods to study visual literacy, a complex cultural phenomenon, it certainly holds true but only to a certain degree. Taking another complex cultural phenomenon, language, as an example, both qualitative and quantitative techniques and procedures have been employed individually and collectively for decades to assess the acquisition of it. Not only that, but the results have provided a wealth of insights for language learners, language educators, researchers, education strategies, the design of language environments, etc. Although there are a vast number of resources invested in designing and developing such complex assessments, the implementation of one type of technique does not seem to impede the employment of the contrasting one. For example, *Test of English as a Foreign Language* (TOEFL), an exam that reports quantitative results but employs qualitative techniques such as speaking and essay tasks, is a successful test accepted by more than 11,000 institutions in over 150 countries (Educational Testing Service [ETS], n.d.). Therefore, those interested in establishing an operational definition of visual literacy should consider employing both quantitative and qualitative assessment techniques within a quantitative framework, especially when considering the reality that there is an absence of valid and reliable measures for both the decoding and encoding dimensions of visual literacy.

Summary and Recommendations for Establishing a Research Agenda for VL Assessment

Evidently, attempts at developing and implementing valid and reliable devices or procedures to assess visual literacy have fallen far short, raising the question of whether visual literacy measurement has moved beyond the "primitive" stage, a phase described in Avgerinou nearly 20 years ago (2001, p. xxix). At the same time, the following difficulties remain to be addressed in establishing a robust research agenda for visual literacy assessment.

In examining existing empirical VL assessment research, a variety of techniques and procedures have been developed and administered to a range of audiences, although measuring or quantifying participants' visual literacy appears to dominate this branch of research compared to depicting an individual's VL status qualitatively. Specifically, despite the challenges of quantifying an abstract entity such as visual literacy, some tests have been developed to elicit participants' VL knowledge and skills, the scoring of which was then operated in quantitative data analysis to yield test statistics and to make inferences about test takers. While these attempts are undeniably critical contributions to the visual literacy assessment literature, a number of issues have arisen that require further study.

First, these tests unanimously focused on the decoding dimension of visual literacy. As previously noted, encoding or creating visuals is challenging to measure because the nature of being a higher-order thinking skill demands a variety of methods and multiple occasions for measurement. Additionally, there are external factors and forces that make the visual creation process more difficult for translation into clearly defined and measurable indicators. For example, measuring visual creation requires a careful consideration of the technologies that will be available to the assessees as they should contain sufficient, yet not overwhelming affordances to ensure that the visual created will be a relatively accurate reflection of test takers' intentions.

However, it should be emphasized that the root issue is to research what exactly the creation dimension of visual literacy entails, or even, as some may argue, whether visual creation is a component of visual literacy.

Second, the visuals employed in the existing instruments are primarily static or still, which according to Farrell (2013), is a logical choice as variables associated with images in motion present additional measurement challenges. Regardless, Avgerinou (2001) did suggest that future visual literacy assessment studies not only measure the decoding dimension but measure through "a variety of ways (still and moving images)" (p. 513).

Furthermore, conversations about test takers' cultural backgrounds led previous test designers to intentionally select visuals that were closely associated with a certain culture, and to clearly define the cultural background of the target audience. Nonetheless, as discussed earlier, further discussion should take place regarding whether restricting visuals that are particularly familiar to one culture is consistent with today's reality where online visual communication brings together visual consumers and composers from around the world. In either case, cultural factors certainly should be kept in the dialogue of visual literacy assessment research.

Some of the other issues discussed in the article above are relatively uncommon but should be carefully addressed in future research, such as the lack of visuals in test items, excessive use of verbal information, targeting audio competencies on a visual test, etc.

In addition to tests where numerical values are assigned referencing the correctness or quality of participants' responses, a small number of researchers have contributed typical response measures to investigate individuals' attitudes, self-reported behaviors, and perceived competencies in relation to visual literacy. While items in the two instruments reviewed in this article (Arslan & Nalinci, 2014; García-Sánchez et al., 2018) were constructed based on two

different sets of visual literacy performance statements or indicators, they were formulated on a similar 5-point Likert scale, which the participants used to report the degree to which they agreed with the statements. Compared to those visual literacy tests that centered on visual decoding abilities, the two self-reported VL measures incorporated statements about both visual decoding and encoding. However, as noted above, any inferences or decisions made about the assessees taking this type of instrument should be preceded by an awareness and acknowledgement that results from typical response measures are only indicative of perceived VL abilities. To date, there is no definitive data substantiating a positive or negative correlation between perceived and evidenced VL performances. Future research is recommended to study this topic across populations and contexts, yet accomplishing this task appears to be dependent upon the availability of an evidence-based, valid, and reliable VL measure. Nevertheless, even if a positive correlation between perceived and evidenced visual literacy is validated in the future, the generalizability of the findings should always be approached with caution before making any decisions or inferences.

Moreover, assessing visual literacy within the qualitative research paradigm is relatively understudied. This review, based on the above arguments and research evidence, advocates for quantitatively operationalizing the visual literacy concept as a result of the current state of visual literacy assessment research. However, assessment studies adopting qualitative research methodologies are likely to facilitate the embedding of qualitative techniques in the quantitative framework, where numerical values will be assigned to outcomes from those qualitative techniques in adherence to explicit scoring rubrics or other valid and reliable quantification techniques or procedures. Again, while this approach is consistent with the complex and

multidimensional nature of the visual literacy construct, the qualitative assessment component necessitates more resources and is time-consuming to develop.

Finally, it is recommended that researchers make more attempts to assess visual literacy while carefully considering the above issues and challenges in the assessment process. Only then will visual literacy be more likely to establish a robust and productive research agenda and earn its place in the educational curriculum across contexts.

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Manuscript II: Creating a Product for Instructional Designers to Assess Their Knowledge of a Fundamental Vocabulary of Visual Literacy: A Design and Development Study

As one of the earliest forms of human expression and communication, visuals have a profound impact on the advancement of human society. From Renaissance paintings to the augmented reality programs on smartphones that project virtual images into reality, visuals have served human activities indefinitely with their versatility and ubiquity. In the world of instructional design, visuals saturate daily and professional communications. Visuals and mixed forms of meaning-making involving visuals have supported many aspects of learning and training, such as stimulating motivation, directing attention, managing cognitive load, facilitating information processing, etc. Visual artifacts frequently seen in learning and training materials include, but are not limited to infographics, concept maps, visual organizers, animations, interactive 3D objects, virtual realities, augmented realities, and so on. While instructional designers are not typically expected to replace graphic artists and other professionals alike, they are still expected to be able to decode and encode visuals and to be visually literate due to the role of visuals in learning and in the ID workplace (Chen, 2020; Klein & Kelly, 2018; Sugar et al., 2011).

Nevertheless, in reviewing visual literacy initiatives in higher education from 1999 to 2015, Blummer (2015) noted that many of those efforts have remained at the pilot stage, and the effects have been debatable. Within instructional design, although there is considerable research on visual techniques for teaching and learning, such as instructional message design research (Bishop, 2014), studies examining visual literacy abilities in instructional designers or effective strategies for nurturing visual skills in novice ID professionals are rare. The lack of research validating instructional designers' visual literacy conflicts with the reality that ID job analysis

studies have indicated that employers expect visual skills in applicants (Chen, 2020; Klein & Kelly, 2018). In addition to this, ID competency standards, such as *Instructional Designer Competencies: The Standards* (Koszalka et al., 2013), have labeled communicating using visual forms as essential for instructional design professionals across contexts. In the realm of visual literacy, Robinson et al. (2018) noted that the focus of this area of interest should remain on the assessment of visual abilities to increase the likelihood of it finding its place in the curriculum. Nevertheless, an extensive search of literature revealed that there were a limited number of evidence-based instruments for assessing visual literacy, and even more limited access to some of these products.

Therefore, drawing on existing research related to visual literacy assessment, and to address the need of validating visual literacy in instructional designers, this study initiated an effort to design and develop a product for instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, to assess their knowledge of a fundamental vocabulary of visual literacy. As later discussed in the article, knowledge of the fundamental vocabulary of visual literacy was identified by many as the basis for any visual communication. Additionally, it was noted in Metros and Woolsey (2006) that teaching a basic visual vocabulary was the first step to adopting a systematic institutional approach to debate about and embed visual literacy in the educational curriculum. Therefore, by focusing on the very foundation of visual literacy, the targeted product assisted instructional designers in identifying the terms and concepts in the fundamental vocabulary of VL that they have mastered and have yet to master. From this, the results can inform directed future visual literacy learning and training.

Using a design and development research (Richey & Klein, 2009) approach, this study attempts to answer the following questions:

1. What terms and concepts have been identified as comprising a fundamental vocabulary of visual literacy?
2. What factors can be identified as important in the design and development of a product for assessing knowledge of the fundamental vocabulary of visual literacy?
3. How might the factors of such a product be operationalized in the context of this study?
4. How do instructional designers and experts perceive the effectiveness of the product?

Literature Review

Visual Literacy and Instructional Design

Historically, visual literacy has commonly been an integral component of the field of instructional design. As documented in Fransecky and Debes (1972), an interest in visual literacy "began tentatively in 1965 and 1966" among members of the Association for Educational Communications and Technology (AECT), some of whose "exploratory efforts" were published in *Visuals Are a Language*, a magazine founded by Debes at Eastman Kodak Company (p. 32). As the interest developed, there was a collective voice calling for, "some kind of exploratory get-together" during the 1968 AECT, which was then named the *Department of Audiovisual Instruction*, annual meeting (Fransecky & Debes, 1972, p. 32). That voice then led to a meeting later that year attended by a small group of scholars of diverse disciplines sharing an interest in visual literacy, which then resulted in the very first national conference on visual literacy where the term, *visual literacy*, was coined by Debes (1970). More than fifty years later, the ties between the two fields remain strong. *The International Visual Literacy Association* (IVLA), an interdisciplinary association of educators, researchers, and practitioners dedicated to the concepts

and principles related to visual literacy, is currently an organizational affiliate of AECT (AECT, n.d.).

This interconnection between the two is rather natural since visual literacy concerns what is often inevitable for instructional design professionals, decoding and encoding visuals. As commented in Richey et al. (2010), instructional designers are "heavily" dependent upon the strengths of visuals as communication and ultimately as learning devices (p. 42). This statement can be substantiated by decades of research on the impact of visuals on learning, such as Paivio's (1986) dual-coding theory and Mayer's (2009) principles of multimedia learning where the role of visuals in human cognitive information processing was heavily examined. Instructional message design, which concerns all the senses, highlights designing visual messages for learning (Larson & Lockee, 2019). From another perspective, visuals that are often referred to as "cosmetic" or "decorative" by some have also been studied and are proven to shape the learning effect, such as the arrangement of an instructional interface and the overall aesthetics of a learning experience (Hamdani et al., 2012; Hancock, 2004; Lohr, 2000). Detailed guidelines and best practices for designing visual messages and multimodal communications for learning can be found in books such as *Graphics for Learning* (Clark & Lyons, 2011) and *Creating Graphics for Learning and Performance* (Lohr, 2008).

The impact of visuals on learning and training makes it understandable that many instructional design competence standards encompass visual literacy skills. For example, adopted by the International Board of Standards for Training, Performance and Instruction (ibstpi), *Instructional Designer Competencies: The Standards* (Koszalka et al., 2013) labels communicating effectively in visual form and the ability to, "use appropriate message and visual design principles" (p. 27) as essential to instructional designers. In the workplace, an analysis of

nearly 400 online ID job postings in May 2015 indicated that more than half of the jobs expect prospective designers to be able to effectively communicate visually (Klein & Kelly, 2018). More recently, Chen (2020), in a study identifying competencies required by ID jobs using content analysis and text mining, noted that visual design skills were one of the 23 skills identified from the ID jobs posted on EdTechRecruiting from 2015 to 2019. In addition, this expectation for visual literacy skills is also evidenced from the perspective of working ID professionals. A qualitative interview with working instructional designers indicated that a designer "often performs multiple roles depending on a project needs" (Liu et al., 2002, p. 6), including the role of instructional visual creator. Moreover, using a Delphi technique, Sugar et al. (2018) reported that the eleven working professionals came to a consensus that visual design principles were considered essential for entry-level designers in higher education. Additionally, documenting the yearlong instructional practices of a practicing instructional designer in higher education verified a need for visual literacy abilities to perform tasks such as redesigning existing e-learning models to make them visually appealing, graphic design activities, video production, and image production (Sugar & Moore, 2015). The authors (Sugar & Moore, 2015) called for an evaluation of current ID programs to see if students are being prepared to play different roles.

Visual Literacy in Instructional Design Professionals

In spite of the necessity for visual literacy in ID professionals as evidenced above, a search of literature in both the fields of visual literacy and instructional design suggests that visual abilities in instructional designers have mainly been reported indirectly, and that the results vary.

Specifically, concerns were raised about the status of visual skills in instructional designers and the presence of visual education in ID programs. For instance, in examining ID program descriptions and ID textbooks that are considered fundamental, Goldfarb and Kondratova (2004) commented that instructional designers were generally not well equipped with the knowledge and skills to perform media design tasks, "because typically they are insufficiently trained in the art of multimedia, and, especially, in the art of visual presentation." More recently, citing literature on the non-intuitive connection between an exposure to visual messages and the acquisition of visual literacy as well as the lack of visual literacy programs in higher education, Ervine (2016) called for research on the status of visual literacy in instructional design programs. In teaching practices, driven by an observation of the lack of visual aesthetics in student-generated technology integration solutions and compromised user experience thereof, Sosa (2009) implemented a visual literacy intervention. Sosa (2009) reported that the post-intervention student projects were more user friendly, arguing that visual literacy was the missing piece within technology integration courses. In the context of Turkey, it was reported that instructional design students scored lower on the visual-related qualities of their infographic designs (Nuhoğlu Kibar & Akkoyunlu, 2014). From the perspective of employers, over half of the nearly 200 potential ID employers surveyed in Villachica et al. (2010) indicated that they expected entry-level instructional designers to be able to select appropriate media and develop instructional materials using appropriate media. However, many reported that entry-level designers, "could not perform to expectations in spite of assistance, or performed to expectations with a lot of assistance" (p. 33). Douglas (2003), in an effort to explore the development of novice instructional designers, noted that novice designers, "were primarily interested in

mastering the design of Instructional Objectives and Instructional Problems as opposed to Message Design."

By contrast, as reported by some, instructional design students and novice instructional designers appear to perceive themselves as proficient in visual communication. In a study by Dabbagh and English (2015), students enrolled in an instructional design graduate program were asked to rate their ID competencies in various categories, results of which suggested that the students perceived themselves to be proficient in communicating effectively through visual forms. More recently, Olson and Eadens (2019) investigated novice instructional designers' comfort levels with demonstrating the ibstpi competencies. The data analysis suggested that the ability to "communicate effectively in visual, oral, and written form" (p. 191) was one of the top two competencies that novice designers were most comfortable with.

Nevertheless, these attempts and others alike are only valid to a certain extent. First, there are no empirical data substantiating a correlation between perceived visual communication abilities and evidenced performance. Second, visual competence descriptors were typically embedded in statements that also described other competencies, such as written communication skills, leading one to question how much of the rating could be attributed to a student's perception of their ability to communicate using visuals.

Evidently, there is a mismatch between the asserted need for visual literacy in instructional designers and the number of evidence-based studies validating the status of visual literacy abilities in instructional designers.

A Fundamental Vocabulary of Visual Literacy

Vocabulary can be the body of words used in a language (e.g., English), in a particular subject (e.g., law), or a collection of non-verbal artistic forms and techniques (e.g., dance

movement) (Stevenson, 2010). As visual media continue to pervade human society, scholars in visual literacy and its related fields, such as visual language, visual intelligence, and visual communication, have been exploring and identifying a fundamental vocabulary to assist students in purposefully interpreting and composing visual messages.

Among the earliest writings on visual literacy, Dondis' *A Primer of Visual Literacy* (1973) attempted to provide "a basic handbook for all visual communication and expression" (p. x). While acknowledging that a visual language can never be "a clear-cut logical system" as in the case of verbal language, Dondis (1973) proposed that knowledge of basic visual elements and manipulative techniques can be learned by all visual media consumers, leading to the creation and comprehension of clear visual messages. Specifically, basic visual elements comprise the "tool box of all visual communications," from which the raw materials of all visual objects, statements, and experiences are drawn, planned, and expressed (p. 15). In Dondis (1973), being "the basic substance of what we see" (p. 39) and "the irreducible components of the visual media" (p. 65), visual elements encompass "the dot, line, shape, direction, tone, color, texture, dimension, scale, movement." (p. 39). Visual composition begins with the selection of appropriate visual elements which are then employed through purposeful visual techniques that manipulate the elements. Visual techniques, known as "the agents in the visual communication process" (Dondis, 1973, p. 17), control the meaning of a visual statement, therefore serving most effectively as connectors between the intention of a visual problem solver and the result obtained. Although it is impossible to identify and define every visual technique, Dondis (1973) introduced a selection of contrasting pairs of techniques, such as balance vs. instability, symmetry vs. asymmetry, consistency vs. variation, etc. In addition to fundamental visual elements and techniques, Dondis (1973) also introduced several more complex and advanced

terms and concepts. For example, they discussed some concepts known collectively as style, i.e., a visual synthesis of elements, techniques, culture, history, etc., such as Gothic, Byzantine, expressionism, and primitivism. Concepts commonly known as visual contexts or visual media are also included, such as sculpture and painting.

Later, Curtiss (1987), an artist, art educator, and past board member of the International Visual Literacy Association, proposed that there were two vocabularies that were basic to becoming visually literate. These included, "the marks, symbols, and visual elements" for composing visual statements and "the words that are used to describe our perceptions and efforts" (p. 1) or, "the verbal vocabulary that is used to discuss visual experience" (p. vii). Therefore, terms and concepts in Curtiss (1987) include both verbal vocabularies with visual equivalents (such as the verbal word, line, and its equivalence in visual form), and others that are not necessarily represented by actual visuals, such as "intent" (p. 4). For those that do have visual equivalences, similar to Dondis (1973), they include basic visual elements, principles of visual composition (referred to as visual techniques in Dondis, 1973), visual styles, and visual media or contexts (Curtiss, 1987). However, some of demonstrations by Curtiss' (1987) contain more visual examples and detailed sub-terms and -concepts. The basic elements are described to be "constituents that are given and irreducible" and applicable to visual statements created in any medium (p. 13). The elements include point, line, shape, mass, texture, space, time, movement, color, and value. The techniques are known as "processes and principles by which visual statements are organized" (Curtiss, 1987), and include unity, scale, orientation, balance, and more. At the same time, while their work targeted college students, Curtiss (1987) believed the concepts and vocabularies introduced in the book should be made available to younger learners. They believed the elements of visual statements should be introduced "at the same time as the

letters of the alphabet" (p. viii), and that the composition principles should be introduced along with grammar.

According to Leborg (2006), knowledge of visual concepts is applied during creation without verbal language, but verbal language is important in the underlying processes before and after the creation of visual messages where creators reflect on what to create and what has been created. In providing a primer on visual language and a visual dictionary of the fundamentals of visual communication, Leborg (2006) classified 61 basic visual objects into four categories, including abstract objects and structures, concrete objects and structures, activities, and relations. Among the four, concepts under the categories of concrete and abstract objects and structures were similar to the design elements identified in Dondis (1973) and Curtiss (1987). The concepts in the other two categories resembled the ones labeled as techniques or arrangements in other books. It should be noted that while Leborg (2006) did not specify the context for the application of these concepts, several of them are especially relevant to visual creation in a digital environment since the way the visuals to be manipulated is relatively easily achieved in computer programs. These include concepts such as *rotation, displacement, overlapping, compound, subtraction*, and *modification*.

Helmers (2006) highlighted the decoding dimension of visual literacy, and was driven by the fact that students in language, literature, and rhetoric continually encountered visual messages without supportive response from the education system. Helmers (2006) provided students with a vocabulary that helped them to conduct visual analysis by describing visuals in detail. Through this process, a visual is put together piece by piece, and can be better understood. This vocabulary contains two categories of terms and concepts based on the elements and principles of design. Elements, or literal elements, include color, value, line, shape, form, texture,

and space. The principles of design, or arrangement, provide meaning by arranging literal elements to serve different purposes including proportion, balance, contrast, and more. Students were encouraged to inventory the literal elements in a visual, and to then discuss the arrangement. In order to address the encoding dimension of visual literacy, it is a shared pattern in books on design basics to address visual elements that encompass the most fundamental ingredients of any form of visual message, and the visual techniques that manipulate those elements (Evans & Thomas, 2013; Gatto et al., 2011; Lauer & Pentak, 2005; Peterson, 2003).

Moreover, Curtiss (1987) pointed out, visual creation is one of areas that is most significantly impacted by computer technology. Powered by the World Wide Web and the rise of social media, visual consumption and creation has become a daily routine for many. For example, half a billion users interact with Instagram Stories each day, where there are multiple forms of visuals to decode and encode, such as static photos, illustrations, stickers, video, and so on (Facebook IQ, 2019). According to Curtiss (1987), computer graphics offer a new vocabulary and "new modes for visual expression" (p. 200). Similarly, Wong and Wong (2001) emphasized that those living in the information age need to deal with a new visual language due to advances in computers and general technology. In response to the need, a few works have been published dealing with fundamental terms and concepts for visual communication in the digital environment. Examples include Wong and Wong's (2001) on general computer graphics creation, Jackson's (2015a) on digital image fundamentals, and Jackson's (2015b) on digital illustration fundamentals. Nevertheless, it should be noted that some of the terms and concepts featured in these books are not exclusive to digital visual communication. Rather, in many cases, the digital environment makes it easy to display and manipulate the visual equivalents of these terms and concepts.

Thus, although there are different views on the specific categories of terms and concepts that constitute the vocabulary of visual literacy, it is recognized that the fundamental vocabulary of visual literacy encompasses basic visual elements and visual techniques. These terms and concepts typically include both verbal methods (i.e., the words) for describing visual content and for other communication purposes, and visual counterparts that compose the visuals in varied media. Additionally, as the use of fundamental terms in digital visual creation is inevitable for a visually literate individual in today's society (and especially for instructional design professionals dealing with digital learning content), they are included as an important component of a fundamental vocabulary of visual literacy for this product. Specifically, the terms and concepts were gleaned from the literature listed in Table 2. Table 3 presents the detailed terms and concepts that make up the fundamental vocabulary of visual literacy in the context of this study.

Table 2

Literature on the Fundamental Vocabulary of Visual Literacy

Literature	Author & Year of Publication
A primer of visual literacy	Dondis, 1973
Introduction to visual literacy: A guide to the visual arts and communication	Curtiss, 1987
Visual design on the computer (2nd ed.)	Wong & Wong, 2001
The elements of visual analysis	Helmers, 2006
A visual language: elements of design	Cohen & Anderson, 2006
Visual grammar	Leborg, 2006
Visual communication: Integrating media, art and science	Williams & Newton, 2007
Creating graphics for learning and performance: Lessons in visual literacy (2nd ed.)	Lohr, 2008
Exploring visual design: the elements and principles (4th ed.)	Gatto, Porter, & Selleck, 2011
Exploring the elements of design (3rd ed.)	Evans & Thomas, 2013
Digital image compositing fundamentals	Jackson, 2015
Digital illustration fundamentals.	Jackson, 2015

Table 3

The Categories of Terms and Concepts Comprising the Fundamental Vocabulary of Visual Literacy

Category 1: Visual Elements & Selected Supporting Terms	Category 2: Visual Actions/Techniques/Arrangement	Category 3: Foundational terms for Digital Visual Communication
Dot/Point	Alignment	Serif
Line	Contrast	Sans Serif
Shape	Repetition	Resolution
Color	Similarity/Repetition/Consistency	Aspect Ratio
Texture	Proximity	RGB
Space	Perspective	CMYK
Motion/movement	Golden Mean/Ratio/Section	Raster Graphics
Value	Rule of Thirds	Vector Graphics
Complementary Colors	Scale	Kerning
Analogous Colors	Symmetry	Leading
Monochromatic Colors		
Tint		
Shade		
Warm Colors		
Cold Colors		
Primary Colors		

Factors to Consider when Designing and Developing a Product to Assess VL

To facilitate the design and development of a product for instructional design students or instructional design professionals, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, to assess their knowledge of the fundamental vocabulary of visual literacy, literature on visual literacy assessment and general assessment of performance indicators were examined to identify important factors for consideration.

Types of Assessment in Relation to the Instructional Process. Based on its relative positioning in the instructional process, assessment can be distinguished into various types to serve distinctive purposes. Specifically, some (e.g., Bloom et al., 1981; Swearingen, 2002)

highlighted diagnostic, formative, and summative assessments. Of these three types of assessments, diagnostic assessments are implemented prior to the instruction to identify the strengths and weaknesses in learners' knowledge and skills, the results of which then inform the adjustment of the instruction. Then, during the instructional process, instructors often use formative assessments, or an "ongoing diagnostic tool" (Swearingen, 2002, p. 3), to advise their teaching practice to echo the learning progress of their students. Finally, summative assessment is administered at the end of the instruction to determine mastery of the intended learning outcomes.

From a different perspective, some associate diagnostic assessment with addressing learning problems and deficiencies, although Bloom et al. (1981) emphasized that "diagnosis" in education was not exclusive for this purpose (p. 116). According to Bloom et al. (1981), diagnostic assessment can assume several roles, such as examining the presence of prerequisite skills, determining students' mastery of specific objectives, and classifying learners according to their traits. In Gronlund (1998), however, "placement assessment" is similar to the diagnostic assessment in Bloom et al. (1981) and Swearingen (2002). Gronlund (1998) noted that diagnostic assessment was reserved for examining persistent learning problems identified from the output of formative assessments.

The planned assessment product, as evidenced throughout this manuscript, leans toward the *diagnostic* assessment as described in Bloom et al. (1981) and Swearingen (2002). It targets the audience who have not received formal education or training in visual literacy or a related area of study, such as visual communication. By assessing or diagnosing the strengths and weaknesses in their knowledge of the visual literacy terms and concepts, the planned product will help point the audience in the direction of future learning in visual literacy.

The Nature of an Assessment: Norm-Referenced vs. Criterion-Referenced.

Assessments of student achievement can be norm-referenced or criterion referenced, depending on the primary purposes they serve and the manner in which the results are interpreted. A norm-referenced assessment reports the relative standing of a student among other students (Gronlund, 1998) and is used to "compare the relative performance of learners" (Dick et al., 2015, p. 139). On the contrary, criterion-referenced assessments, also referred to as, "learner-centered" or "objective-referenced" assessments (Dick et al., 2015, p. 137), shift the focus from the relative performance of an individual to their achievement of specific objectives in a given content area (p. 138). Because it indicates the extent to which students have achieved individual objectives, criterion-referenced assessment allows students to reflect on their strengths and weaknesses in the given content area, which "aids learners in ultimately becoming responsible for the quality of their work." (Dick et al., 2015, p. 137). On the other hand, criterion-referenced assessments are of particular value for instructional purposes, because the results can be used to evaluate the effectiveness of specific portions of the instruction package (Dick et al., 2015; Gronlund, 1998). Additionally, the distinctive purpose of an assessment determines the way it is designed and developed. For instance, as indicated in Gronlund (1998), the item selection procedure of a norm-referenced assessment involves eliminating items that are relatively less discriminatory, such as easy items. In contrast, designers of criterion-referenced assessments do not eliminate easy items or alter item difficulty to spread out the scores, but rather ensure that the items are sufficient to describe performance. Because of the differences between the two, which one to develop or use is a decision that researchers and educators should "make carefully and well before the assessment is actually conducted" (Tanner, 2001, p. 8).

The Assessment Context. The nature and impact of computer-assisted assessments have expanded as computers continue to evolve and become more affordable for K-12 and college students (Frey, 2018). In general, assessments developed using digital technology offer multiple advantages over paper-and-pencil assessments. One of the most notable advantages of assessments in a digital environment is the ability to employ a variety of innovative item types that allow for new and varied response possibilities, response actions (e.g., touching the screen, typing, talking into a microphone, etc.), more multimedia inclusion, and a higher level of interactivity between the assessment and assessment takers (e.g., branching). Moreover, assessments in a digital environment offer more accessibility features such as text-to-speech, zooming-in, and others. Additionally, facilitated by the Internet, computer-based assessments liberate users from the constraints of physical space. In many cases, the use of mobile devices also allows users to participate in assessments when and where it is convenient.

Nonetheless, assessments conducted in a digital environment have their limitations. For example, more time and resources are often needed to design and develop an assessment taken using a digital device (Frey, 2018). Despite their limitations, computer-assisted assessments are of particular value for unique situations when most face-to-face activities are prohibited due to factors such as COVID-19.

Types of Assessment Items. Although there are a variety of assessment items that correspond to many types of learning outcomes, selection-type items and supply-type items are frequently found in assessment instruments for various subject matters. According to Gronlund (1998), selection-type items generally include multiple-choice items, true-false questions, matching items, and interpretive exercise. Supply-type items, on the other hand, entail short answer questions, essay questions (restricted response), and essay items (extended response).

The selection of a specific item type is often determined by the learning outcome the item is intended to assess, although sometimes other factors can influence this decision, such as the difficulty involved in judging or scoring.

As discussed in Gronlund (1998), multiple-choice items are versatile because they can be used to assess a wide range of learning outcomes, from simple to complex, such as knowledge, comprehension, and application. Multiple-choice items typically consist of a stem and alternatives. A stem is usually a question or statement that presents the problem situation. In contrast, alternatives provide a potential solution to the stem, while containing plausible distractors. A notable advantage of multiple-choice items is that they are easy to score. However, constructing such items is time-consuming because it is often difficult to find plausible distractors.

Short-answer items, while being similar to multiple-choice items in that both can assess a variety of learning outcomes, is unique in that the assessees are required to supply a response instead of selecting an option from the available. Therefore, guessing is relatively less likely in short-answer items. At the same time, however, constructing short answer questions is challenging due to the difficulty of phrasing the questions, particularly ensuring that the wording points to one correct answer. Furthermore, the spelling skill of the assessees could introduce confounding variables into the scoring of the provided responses, thus generating an assessment result that could be challenged regarding its validity. Gronlund (1998) continued to emphasize that due to its weaknesses, short-answer items should be reserved for occasions, "where supplying the answer is a necessary part of the learning outcome to be measured." (p. 79) Along with this reminder, a list of guidelines in writing quality short-answer items were provided in Gronlund (1998), including but not limited to, phrasing the item that leads to one answer,

"placing the blanks at the end of the statement", and avoiding extraneous cues (e.g., varied lengths of the blanks) (p. 98).

Quality of the Assessment Items. According to Dick et al. (2015), there are four categories related to item quality that should be considered when creating assessment items or tasks, including goal-centered criteria, learner-centered criteria, context-centered criteria, and assessment-centered criteria. The content of the *Standards for Educational and Psychological Testing* (AERA et al., 2014) also identifies expert review as one of the possible actions for item review. The goal-centered criteria highlight the alignment between the test item and the performance objectives. In general, item format is not chosen arbitrarily. Instead, assessment designers should verify that the response generated from the test item is consistent with the exact behavior described in the objective. Learner-centered criteria suggest that the assessment should be customized to the characteristics of the target audience. Specifically, factors related to cognitive ability, mental condition, and sometimes physical needs should be considered, such as, "vocabulary and language levels, developmental levels for setting appropriate task complexity, motivational and interest levels, experiences and backgrounds, special needs, and freedom from bias (e.g., cultural, racial, gender)" (Dick et al., 2015, p. 144). Definitions for unfamiliar terms should be provided when necessary. It is also recommended that learners not be asked to take the assessment in an unfamiliar context or experience an unfamiliar item format. If necessary, there should be a detailed direction on the item format. In addition, gender, diversity, and other ethical issues should be considered to avoid biases. Context-centered criteria emphasize the alignment between the assessment context and the performance context. The last criteria, the assessment-centered criteria, concern the anxiety and emotional state of the learners as influenced by the test-writing qualities. Assessment designers should pay attention to, "correct grammar, spelling,

and punctuation, as well as clearly written and parsimonious directions, resource materials, and questions" (p. 145).

Considerations Derived from Existing VL Assessment Research. Despite the paucity of documented products for assessing visual literacy, a number of factors and considerations have been extracted from existing research to guide this new attempt to design and develop a visual literacy assessment product. Specifically, considering the purpose and target audience of the product, the factors examined here include the methods and channels for accessing the product, the writing of well-defined performance objectives, and the use of verbal versus visual language.

Access to the Assessment Product. As noted earlier, although assessing visual literacy has been periodically mentioned over the years, the number of studies that have developed or used devices to assess the attainment of visual literacy is limited. In addition, access to some of the earlier work has been limited due to various factors, such as the technology available at the time, which posed a challenge to those interested in studying the historical development of visual literacy assessment or examining the merits of the assessment products and procedures. For example, the only recorded standardized VL test prior to the 21st century, Turner's *Visual Literacy Test* (1978), is only available in printed and acquired through the interlibrary loan service. In this study, because the purpose is to provide instructional design students and professionals, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, with a product for them to assess their knowledge of a fundamental vocabulary of visual literacy, consideration should be given to how to make the product easily accessible to the target audience.

Well-Defined Performance Objectives. The lack of explicit performance objectives in Turner's (1978) test has made it difficult for other researchers to determine whether there is consistency between what is to be assessed and what is assessed through the test items. Performance objectives, also referred to as indicators (Babbie, 2013), make the "invisible" constructs visible and measurable. As indicated in various works on the design and develop of assessment devices (Gronlund, 1998; McMillan, 2014; Reynolds et al., 2006; Tanner, 2001), visual literacy assessment (Avgerinou, 2001), and classic instructional design literature (e.g., Dick et al., 2015), delineating the performance objectives is one of the significant early steps in the process of assessment design and development. Therefore, future research on assessing visual literacy should identify well-defined performance objectives and design test items or assessment tasks that match the performance objectives.

Use of Visuals in an Assessment of Visual Abilities. Spitzer and McNerny (1975) called for a limited use of verbal information in a visual literacy assessment. While there is merit to this argument, the extent to which it is justified should be determined on a case-by-case basis. Specifically, because visual literacy is a fairly broad concept that encompasses several different aspects, such as visual decoding, visual encoding, and in some cases, visual ethics (The Visual Literacy Standards Task Force, 2012), verbal information could be inevitable in item writing when certain knowledge and skills are to be assessed. For example, students may be prompted to explain what intellectual property is by providing a written response, which may be a way to demonstrate their comprehension of visual ethics. In general, it seems rather unreasonable and unfeasible to eliminate the presence of verbal language in the items and response of a visual literacy assessment. One could easily question the legitimacy of not using verbal language, as it is used in assessments in many other subjects or areas of study. Therefore, rather than focusing

on omitting the use of verbal language, it is meaningful to examine when and there the use of verbal language should be controlled and to justify this design decision. It is also important to analyze the knowledge or skills detailed in each performance objective to ensure that the presence or absence of visuals does not diminish the validity or the reliability of the interpretation of the assessment results.

Assessment Directions. In general, assessment directions should be clear and concise (Dick et al., 2015; Gronlund, 1998). However, this expectation is sometimes challenging to achieve because, "what is clear to you may be confusing to others" (Dick et al., 2015, p. 148). Nevertheless, there are strategies and best practices that assist assessment designers in providing valuable and adequate guidance to those being assessed. For example, a common practice is to include an introductory direction prior to the presentation of assessment items to ease the anxiety of those taking the assessment (Dick et al., 2015; Gronlund, 1998). Introductory directions may include the purpose of the assessment, the performance objectives, whether it encourages guessing of answers, and other relevant information. When multiple item formats are included in the assessment, subordinate or sectional directions can be introduced. Furthermore, additional or special assessment directions should be considered depending on the specific circumstances that arise in the assessment.

Assessment Feedback. As Brown (2018) states, the purpose of instructors giving assessments and students taking them is to gain insights into the deficits and strengths in student performance. By determining the detailed status of student performance, "possible actions that could be taken to further improve the work" can be implemented (p. 73). These insights are "key to learning gains" (p. 73). Typically, assessment feedback can take a variety of forms and be given to students at different times. Students sometimes receive feedback on their performance

immediately, or they may receive formal written feedback at a later time. Gronlund (1998) pointed out that an effective assessment should provide students with the kind of feedback that informs them of "strengths of performance and weaknesses to be corrected" (p. 21). The following criteria discussed in Gronlund (1998) can be considered and implemented to construct effective assessment feedback,

A. Should be given immediately following or during the assessment.

B. Should be detailed and understandable to students.

C. Should focus on successful elements of the performance and the errors to be corrected.

D. Should provide remedial suggestions for correcting errors.

E. Should be positive and provide a guide for improving both performance and self assessment. (p. 21).

In particular, to develop self-learners, Gronlund (1998) suggests that assessments should help the assessed develop self-assessment skills. To achieve this goal, in the assessment feedback, assessment designers may consider informing the assessed not only how to modify the performance, but also how to assess those modifications. From another perspective, Brown (2018) suggests that feedback should "be conducted in a warm and supportive manner" (p. 79).

Validity and Reliability. Validity and Reliability are two of the most emphasized factors in the design and development of student achievement assessments (Gronlund, 1998; McMillan, 2014; Reynolds et al., 2006; Tanner, 2001). Validity concerns the extent to which evidence supports the interpretation and use of the assessment results (Gronlund, 1998) and is dependent of various types of evidence. For example, content-related evidence is assured by aligning the test content with the learning domain. Other types of evidence include criterion-related evidence, construct-related evidence, and the consequences of using the assessment results. Reliability, on

the other hand, refers to the consistency of the assessment results (Reynolds et al., 2006). Methods to improve the reliability of assessment results include the use of a variety of methods to control internal and external factors that may lead to assessment error. Internal error, as specified in McMillan (2014), entails factors internal to the students, such as anxiety and fatigue. External errors, on the other hand, are influenced by factors such as scoring or judgement, item quality, test interruptions, and assessment length (Frey, 2018; McMillan, 2014).

Methodology

To provide instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, with a product to assess their knowledge of the fundamental vocabulary of visual literacy, this study adopted the design and development research methodology (Richey & Klein, 2009). Also referred to as developmental or development research, this type of research denotes, "the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development" (Richey & Klein, 2009, p. 1). As definition indicates, design and development research primarily denotes research conducted "during the design and development of a product or tool" (p. 9) and related to the "development, validation, and use of design and development models" (p. 10). With respect to tool and product research, while some studies adopting this type of methodology feature a particular aspect of the design and development process, others document the entire lifecycle of the end product or tool. In general, product design and development research aims to design and develop an instructional or non-instructional product or program following the main stages of a typical instructional systematic design model, while studying the process.

Adopting the product design and development research method, this study implemented the main stages of the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) (Branch, 2008) to document and study the processes of analysis, design and development, and formative evaluation. The implementation phase was omitted as it went beyond the scope of this study.

Participants

Two groups of participants were recruited during the formative evaluation phase of the study using a nonprobability sampling technique. Specifically, purposive or judgmental sampling was implemented as this technique echoed the purpose of the study. This strategy denoted sampling participants based on specific traits such as knowledge and experience. The first group of participants consisted of expert reviewers who had taught visual literacy courses or conducted visual literacy research, visual literacy assessment research, or media literacy assessment research. They were first contacted via email to be invited to participate in this study (see Appendix A). After agreeing to review the product, an evaluation package (see Appendix B) was shared with the reviewers. As part of the formative evaluation phase, a pilot test was also conducted to obtain initial reactions and perceptions of instructional design students and professionals about the product itself and its use, and to identify issues related to the usability of the product. For this component, a small group of instructional design students and practicing instructional designers were purposefully selected to provide rich feedback to inform revisions to the product. Similarly, a recruitment letter was first sent to the designers (see Appendix C). Next, a pilot test package was shared with those who agreed to participate in the study (see Appendix D). Ultimately, two of the nine invited expert reviewers, as well as all six invited instructional designers, completed the review process and the pilot test.

Procedure

Phase I: Analysis. A literature review was conducted to answer the first two questions while laying the groundwork for the design and development phase of the study. The questions answered in the first phase were 1) what terms and concepts have been identified as comprising a fundamental vocabulary of visual literacy, and 2) What factors can be identified as important in the design and development of a product for assessing knowledge of the fundamental vocabulary of visual literacy?

As indicated in the literature review, the terms and concepts have been identified from a collection of books (n=12) published from the outset of the visual literacy movement to recent years that delineated the fundamentals of visual literacy and related concepts. As a result, three categories of terms and concepts were identified as comprising a fundamental vocabulary of visual literacy, including *Visual Elements & Selected Supporting Terms*, *Visual Actions/Techniques/Arrangement*, and *Foundational terms for Digital Visual Communication*. The detailed terms included in each category can be found in Table 3. With respect to the second question (i.e., the factors to be considered during the design and development of the product), general guidelines for designing and developing assessment products and existing visual literacy assessment research were visited, through which a set of factors were identified as important for the purpose of this study.

Phase II: Design and Development. Informed by the factors and considerations identified from the literature review in Phase I, the design and development phase of the study addressed question three: how might the factors of such a product be operationalized in the context of this study? Guided by the purpose of the study, this phase followed the assessment

development procedures outlined in Gronlund's (1998) *Assessment of Student Achievement* and Dick et al.'s (2015) *The Systematic Design of Instruction*, which included,

- Determining the nature and context of the assessment
- Describing the intended learning outcomes in performance objectives
- Constructing Test Items
- Sequencing Test Items
- Preparing Directions
- Developing Reporting and Feedback Strategies

The factors and considerations identified as important for the purposes of this study were operationalized in the design and development of the product, as detailed below.

Determining the Nature and Context of the Assessment. As reviewed earlier, the nature of an assessment is primarily determined by the purpose of assessing and how the assessment results are interpreted. In short, a norm-referenced assessment compares the relative performance of an individual in a given group, whereas a criterion-referenced assessment informs the degree to which one has achieved specific objectives of a given domain (Dick et al., 2015; Gronlund, 1998). Because this effort aims at assisting instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, in identifying the terms and concepts of visual literacy that they are familiar and relatively less familiar with, rather than allowing the audience to compare achievement, the product is criterion-referenced in nature. By identifying weaknesses in their knowledge of this vocabulary, the product guides the audience in their efforts to reach the objectives. In other words, this product is consistent with Bloom et al.'s (1981) discussion of *diagnostic* assessment. Specifically, this assessment is not intended to be used by the target audience during or at the end of a visual

literacy course; rather, it serves those who have a limited understanding of visual literacy terms and concepts as a result of their general education or life experiences. From another perspective, results of a criterion-referenced assessment can help evaluate specific instructional units and program curricula (Dick et al., 2015; Gronlund, 1998). In generating evidence that substantiates the state of fundamental knowledge of visual literacy in instructional designers, the product could potentially be used to gain insights into the effectiveness of instructional design curricula in preparing their students for the visual literacy expectations of the job market. The product could also serve as a front-end analysis tool for instructors to build prior knowledge for a course or section of a course that emphasizes visual decoding and encoding.

In terms of the assessment context, it was determined that this product would be positioned in an online digital environment instead of in a paper-and-pencil context. This decision was driven by several factors and existing visual literacy assessment research. Among the features and advantages of computer-assisted assessment discussed in Frey (2018), the multimedia possibilities, the variety of interactions, and the expanded access particularly satisfy the purpose of this product and serve its audience. In response to the call to embed visuals in a visual literacy assessment (Spitzer & McNerny, 1975) and to consider both static and moving visuals (Avgerinou, 2001), multiple factors related to assessment validity and reliability, such as the performance objectives themselves, many aspects of item writing, and the alignment between the objectives and the assessment items, were carefully considered before deciding to use or control visual and verbal language. Compared to the paper-and-pencil mode, in addition to allowing the use of multimedia elements, the digital environment is an economical and eco-friendly choice, considering the number of images and colors involved. In terms of interactions, although paper-and-pencil assessments have their own methods of generating interaction

between the product and the assessees, assessment in a digital environment has distinctive advantages. For example, by simply interacting with a few buttons, one can jump back and forth between many slides or pages. Additionally, the digital environment allows responses to assessment items to be instantly recognized and judged by the machine. Most importantly, the digital environment allows instructional designers to access the product anytime, anywhere using any digital device with internet access. This feature addresses the reality that some existing visual literacy assessment products cannot be easily accessed by other researchers or other interested parties. This digital environment also removes potential limitations of uncontrollable and unpredictable factors, such as the COVID-19 Pandemic, during which accessing educational resources remotely became a daily routine for many educators and students.

Therefore, the product was first designed and developed in *Articulate Storyline*, an e-learning authoring software with built-in quiz or knowledge-check function that allows for customization (Articulate Community Team, n.d.). The product was exported as a package and hosted on *Github.com*, an internet hosting service provider (GitHub, n.d.). The product can be accessed here or by scanning the following QR code (see Figure 3).

Figure 3

QR code of the product

Describing the Intended Learning Outcomes in Performance Objectives. Gagné's (Gagné,1977; Gagné & Driscoll, 1988) taxonomy of learning outcomes and Dick et al.'s (2015)

instructions on writing performance objectives were consulted in this step. Gagné's taxonomy includes learning outcomes that fall within the cognitive domain, psychomotor domain, and affective domain (Driscoll, 2005). The cognitive domain is grounded in psychological and neurological evidence that substantiates the distinction between declarative and procedural knowledge (Driscoll, 2005). Regardless of the type of knowledge, it "must be inferred from some behavior that is observable" (Driscoll, 2005, p. 355). Gagné (1977) proposed five categories of learning outcomes, "in no particular order of complexity or importance" (Gagné & Driscoll, 1988, p. 44). These categories include verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills.

Referred to as declarative knowledge or *knowing that*, verbal information is described as, "the organized bodies of knowledge" that is acquired from school, radio, television, and many other sources (Gagné & Driscoll, 1988, p. 45). It is what people recall and "state in propositional form what was learned," and could be categorized into names, facts, principles, and generalizations (Gagné & Driscoll, 1988, p. 45). Verbal information can be stored in mind and cued in non-verbal forms. Driscoll (2005) indicated that the verbal information in Gagné's conception "appears incorporate the first two levels of Bloom's taxonomy," which include the level of knowledge (remembering) and comprehension (understanding). Therefore, acquiring verbal information means that an individual can recall and state something, but they may not necessarily fully comprehend the meaning of the information. For instance, verbal information is what players need to recall during trivia games. Players may or may not comprehend the meaning of their statements or the answers that they give. However, comprehension is often the goal for verbal information learning (Driscoll, 2005). As indicated in Table 4 below, several

terms in the digital visual category are classified as verbal information as they are labels or names of objects.

A second category of learning outcomes contains intellectual skills that emphasize *knowing how*, or procedural knowledge. This category can be further divided into discriminations, concrete concepts, defined concepts, rules, and higher-order rules with reference to "the complexity of mental operations they imply" (Gagné & Driscoll, 1988, p. 47). Individuals at the discrimination level are able to tell the difference between objects, but cannot necessarily name or explain the differences. An example given in Gagné and Driscoll (1988) is when children can tell the difference between two colors or textures without being able to name the different stimuli. Once discrimination is achieved, "concept learning may occur" (Gagné & Driscoll, 1988, p. 49).

According to Gagné (1977), there are two types of concept learning, including learning of concrete concepts and defined concepts. Concrete concepts are common objects (e.g., cat and chair) and object qualities (e.g., color and shape) that "can be denoted by being pointed out," and are "concepts by observation" (Gagné, 1977, p. 111). Some concrete concepts are learned at a young age, whereas more advanced concrete concepts are learned later in life as individuals enter more advanced schools and different careers. The second type of concept learning concerns defined concepts that "cannot be identified by pointing them out" but must be defined (Gagné & Driscoll, 1988, p. 50). Gagné (1977) indicated that defined concepts may be composed of other concrete concept(s) and/or defined concepts that involve relations. In a sense, defined concepts can be viewed as the simplest rules for classifying objects and events (Gagné, 1977). However, notably, some concepts can be learned as concrete concepts first and later as defined concepts, while some concepts can only be learned as defined concepts.

As indicated in Table 4, several concepts in category 1 are concrete concepts, as they are qualities of objects or objects themselves that can be easily pointed out. The rest of the concepts rely on definitions to be classified. Although many of the concrete concepts in Table 4 can be treated as defined concepts, it is not necessary for the purposes of this study. The entire category of visual actions/techniques/arrangement includes defined concepts as they are learned by definitions or descriptions and contain relationships or connections between other concrete or defined concepts.

Next, performance objectives were written as recommended by Dick et al. (2015) to serve as "statements from which test items and tasks are derived" (p. 120). A complete performance objective typically includes the behavior, or what students will be able to do, the condition, or what needs to be provided or present for students to demonstrate the behavior, and the criteria for judging the level of mastery. In some cases, criteria can be omitted or implied, such as when the criteria refer to the learner providing the correct response. Gagné and Driscoll (1988) indicated that the acquisition of verbal information means that students can state the information in propositional form. Also, verbal information can be stored in the mind as images, the retrieval of which can be prompted by non-verbal means. In this study, since the terms in the verbal information category are labels and names that correspond to certain visuals, the assessment of them should include images when necessary. Therefore, for terms that fall into the category of verbal information in Table 4, the performance objective reads, "Given a combination of written and visual descriptions for the term, students will name the term."

Table 4

Cross Categorization of the Terms and Concepts Referencing Gagné's Learning Outcomes and the Visual Literacy Literature

Categories of the terms and concepts	Gagné's learning outcomes		
	Verbal Information	Concrete Concepts	Defined concepts
Category 1: Visual Elements & Selected Supporting Terms		Dot/Point Line Shape Texture Space/White Space Motion/movement Value/Tone	Complementary Colors Analogous Colors Monochromatic Colors Warm Colors Cold/Cool Colors
Category 2: Visual Actions/Techniques/Arrangement			Alignment Contrast Repetition/Similarity/Consistency Proximity Perspective Rule of Thirds Symmetry/Mirroring
Category 3: Foundational terms for Digital Visual Communication	Resolution RGB CMYK Kerning Leading Raster Graphics Vector Graphics Orientation		Fill Font Serif Sans serif Gradient

Typically, whether the concept is concrete or defined, there is no need for an individual to state the definition in order to demonstrate that they have learned the concept (Gagné, 1977). Instead, an indication of concept learning might be that an individual classifies instances of the concept or names the concept when being presented with its variants (Gagné & Driscoll, 1988). Furthermore, according to Dick et al. (2015), students can be asked to identify actual objects or the visual or verbal depiction of the objects that match the concept. For the purpose of this study, the assessed were expected to name a concrete concept prompted by a representative set of visual variants. Because the defined concepts featured in this study were relatively more abstract in nature and encompassed relationships or connections between other concrete or defined concepts, additional but carefully selected verbal cues were provided in the assessment items for the assessees. Specifically, these objectives were,

Concrete Concept: Given at least three varied visual instances of the concept, students will name the concept.

Defined Concept: Given at least three varied visual instances of the concept and minimum verbal cues, students will name the concept.

***Constructing and Sequencing Test Items*.** Factors that were operationalized in constructing the assessment items included determining the type of items (Gronlund, 1998) and implementing the item quality criteria (AERA et al., 2014; Dick et al. 2015).

Regarding the item types, while both multiple-choice items and short answer items were appropriate for the learning outcomes described above, the latter was considered to serve the purpose and the target audience of the product. Specifically, the expectation to accurately name the term or concepts depicted in the images is a natural consequence of aligning the assessment context with the performance context. In real life, the precise use of these terms allows

instructional design professionals to communicate effectively with media specialists or graphic artists. Short answer items satisfy this focus because that it avoids the ambiguity of "I seem to know" or "I know it, but I don't know it by that name". For those who individually create or edit learning materials that entail visual messages, knowing the exact term will allow them to effectively articulate and search for the desired image or other visual media.

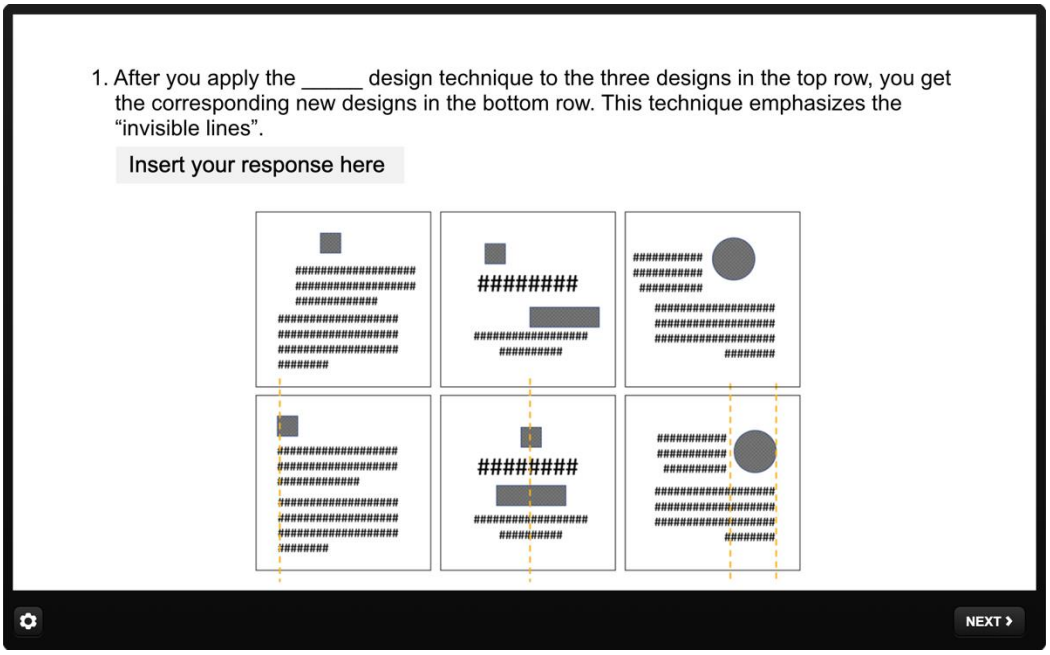
Several of the guidelines discussed in Gronlund (1998) have also been operationalized in the construction of the short answer questions for this product. For example, visuals and verbal language were carefully constructed and balanced to ensure that the assessees could detect the desired responses to the items. In addition, most of the blanks were placed at the end of the verbal portion of the items, so that the reading of the verbal statements was rarely disrupted by the blanks. Another aspect was to keep the length of the blanks fairly consistent to control for extraneous clues. An additional detail involved in the item development was the control over the threat to validity posed by spelling skills. The product automatically places a red curve under any potential misspelled word inserted by the target audience.

Furthermore, the criteria for item qualities discussed in Dick et al. (2015), *Standards for Educational and Psychological Testing* (AERA et al., 2014), and lessons learned from existing visual literacy research have been implemented. First, the goal-entered criteria emphasized the alignment between the assessment items and the performance objectives. When constructing the items, attention and consideration were given to ensure that the conditions (i.e., the tools and materials needed to demonstrate the desired behavior) and the desired behavior specified in the assessment items match that of the performance objectives. For example, the design technique or action, *alignment*, is a defined concept that emphasizes that objects in a design should be organized so as to form one or more invisible lines for easy reading of the designed content. As

described earlier, the performance objective for a defined concept is, “Given at least three varied visual instances of the concept and minimum verbal cues, students will name the concept.” Accordingly, the conditions or materials available for the assessees were, “at least three varied visual instances” of the concept and minimum verbal cues. As seen in Figure 4, three visual variants depicting the implementation of this visual principle to three different designs are provided along with carefully constructed textual cues. The assessees were instructed to insert their responses (i.e., name the concept), which matched the behavior of “name” designated in the objective. Therefore, in contrast to multiple-choice items, the short-answer item type corresponds to the need to verify that the target audience can precisely name the term. This concern for the alignment between the assessment items and the performance objectives was present throughout the entire item construction process.

Figure 4

Item Example (Alignment, Defined Concept)



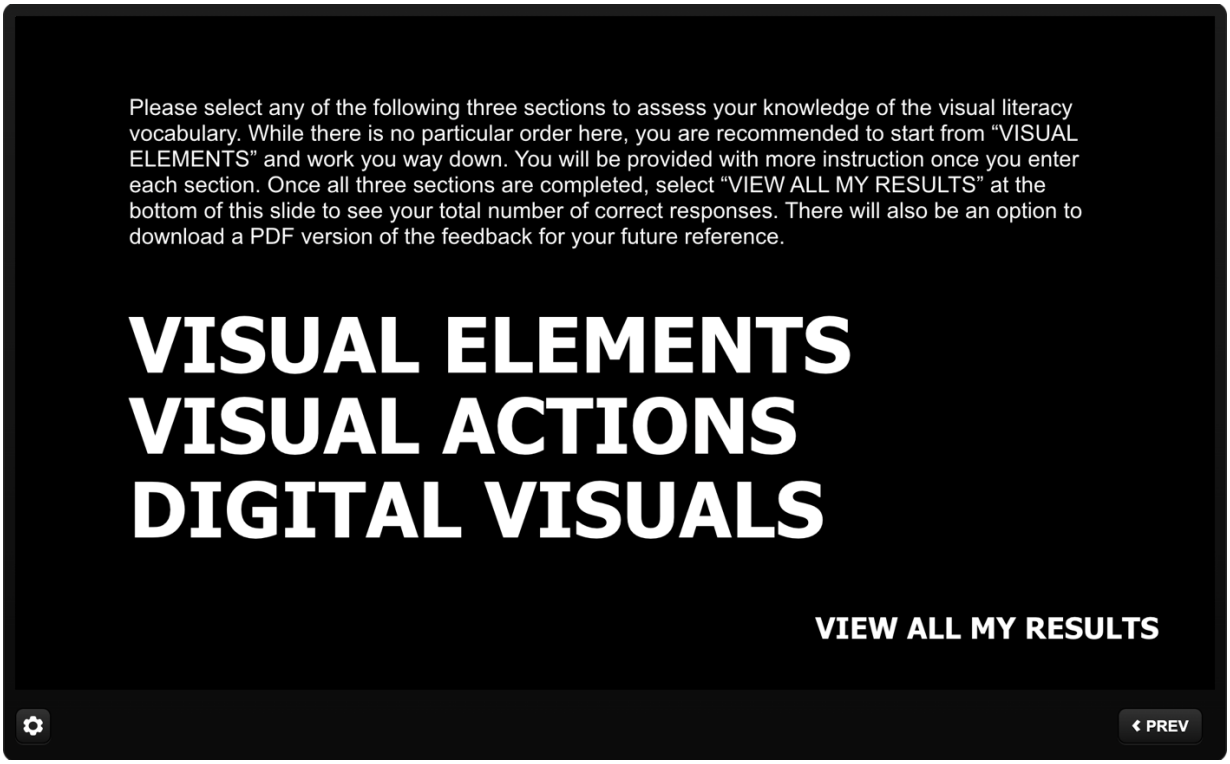
Other item quality criteria operationalized in the item construction process mainly concerned the needs and characteristics of the assessees, such as the language used in the assessment, the motivation level of the assessees, and their familiarity with certain terms used in the assessment directions. A number of strategies have been implemented to address these factors. For example, to alleviate the anxiety of being assessed, the introduction page of the product informed the audience that their responses and assessment results would only be available to the individual being assessed. To motivate the audience, elements targeting audience empowerment and illustrating the usefulness of the assessment were built into the assessment product (see the *MUSIC* motivation model by Jones, 2015). Additionally, in accordance with the recommendation of the *Standards for Educational and Psychological Testing* (AERA et al., 2014) regarding item quality, questions about several aspects of item quality were included in the evaluation survey, which was shared with the expert reviewers involved in the formative evaluation stage of the study and the instructional designers participated in the pilot test.

With regard to item sequencing, Dick et al. (2015) indicated that there were no fixed rules that fit all situations. Rather, decisions usually depend on specific assessment situations and the content of the assessment. In this product, items were grouped into three sections that corresponded to the three categories of visual literacy terms and concepts. Although there was no particular order between the categories, assessees were advised to visit the categories from top to bottom, as indicated in Figure 5. The grouping of items with reference to the inherent connections between the terms and concepts was primarily intended to facilitate the appropriate cueing of prior knowledge, which helps to control the level of difficulty of the assessment. Specifically, assessees were informed that the assessment contained three categories of terms and concepts of visual literacy. This information was presented at the beginning of the assessment

when the assessees visited the introduction page (see Appendix E for a copy of the introduction section of the product. Note that the introduction in the product was placed on a scrollable digital page). When a section on the main sections slide (Figure 5) was selected, the assessees would be taken to the opening slide of that section where a detailed description of the category, or the terms and concepts involved, was provided (See Figure 6). This description informed the assessees of what the category means in the context of the product and helped to activate their relevant prior knowledge.

Figure 5

The Main Sections



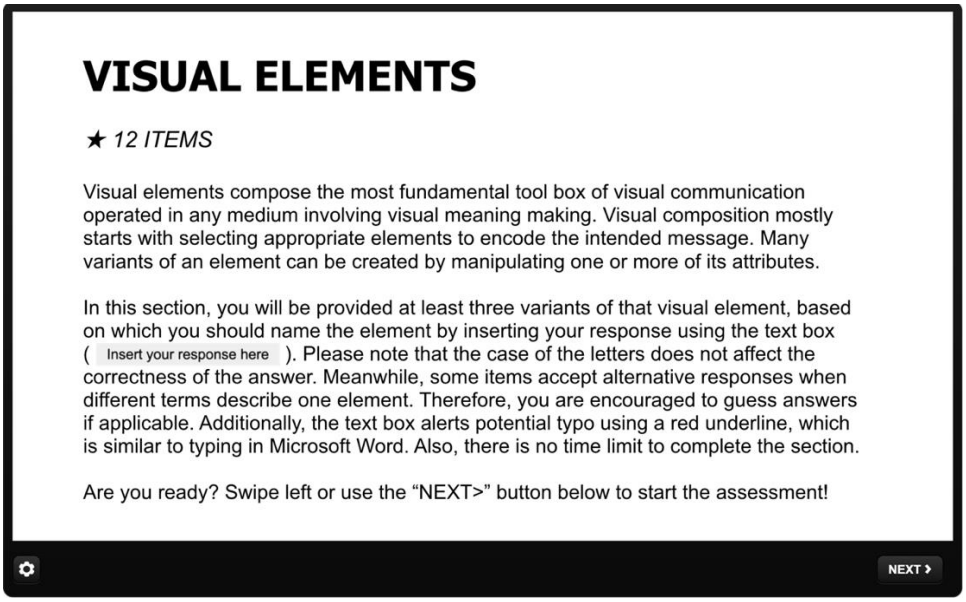
***Preparing Directions*.** Writing assessment directions is not necessarily a convenient task for assessment developers, despite their familiarity with the assessment, because the ones preparing the directions are typically not the audience who need them. Many factors and elements have been suggested as critical when writing assessment directions, such as information

about the time limit, tools that should be available when taking the assessment, the item format, and so on (Dick et al., 2015). In addition to these considerations, the need for unique directions may arise when dealing with specific assessment situations. In this product, the assessment directions emphasized both the assessment content and the technology aspects of the product.

Regarding the assessment content, the product operationalized Dick et al.'s (2015) recommendations for preparing an overall introductory direction and sub-sectional directions. In addition to informing the audience of the three categories of terms and concepts as discussed above, the introduction (see Appendix E) presented an overview of the assessment, a description of the target audience, the purpose, and then a combination of text and screen captures showing the key pages of the product. Moreover, sub-sectional directions (see Figure 6) were presented at the beginning of each of the three sections. These offered details about each particular section and the terms and concepts included, such as the number of items, time limit, item format, and the meaning of the headings of the sections or categories.

Figure 6

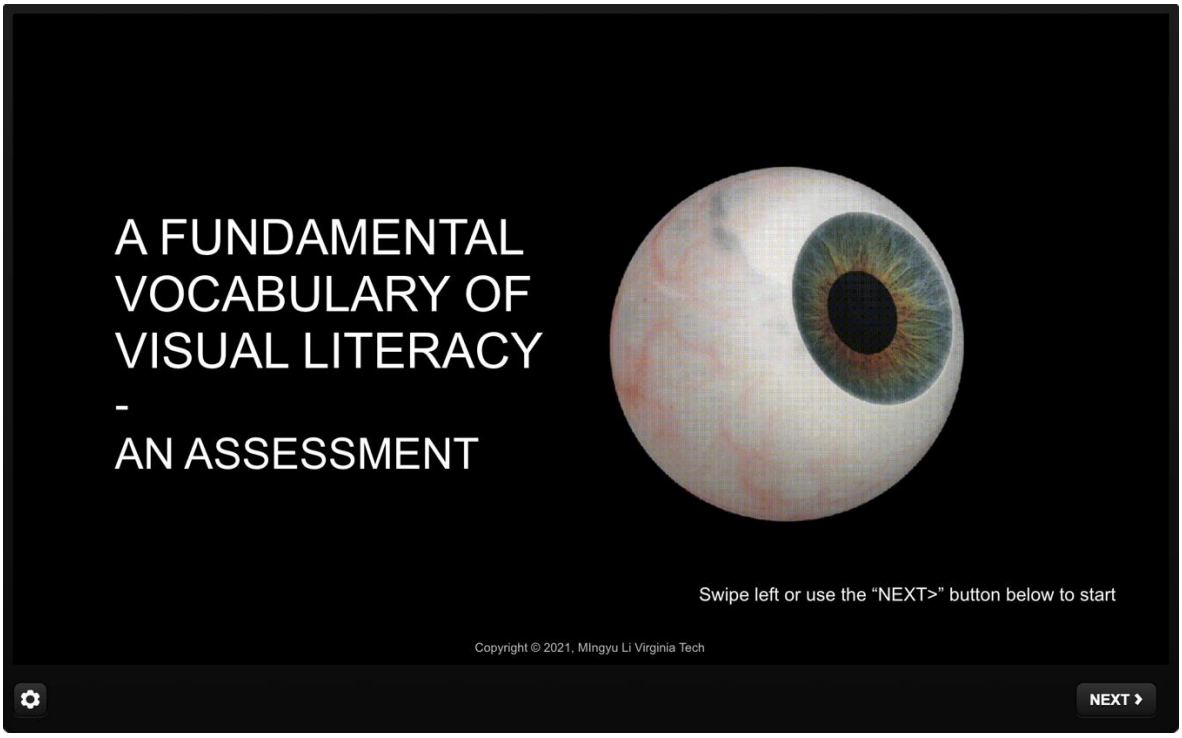
Example Sectional Direction



In terms of navigating the technology aspects of the product, the directions were precise and strategically placed throughout the product. For example, when users first accessed the product, directions on how to advance through the slides were provided at the bottom of the cover slide (see Figure 7). This instruction was written with the device that the subject might use to access the product in mind (e.g., computer, tablet, and smartphone). Immediately after the audience proceeded to the second or the introductory page, they were instructed to scroll down for more content. This particular direction was included wherever there was a scrollable page. Other similar detailed directions were strategically distributed throughout the product.

Figure 7

The Cover



In addition to the careful and strategic placement of the directions in the product, questions about the adequacy of the assessment directions were included in the

evaluation survey shared with expert reviewers and in the user test survey sent to the pilot testers.

Reporting and Feedback. As reviewed above, reporting and feedback are pivotal to an assessment as they inform the assessees of specific strengths and weaknesses in their performance compared to that described by the performance objectives. Several factors and criteria were operationalized when writing feedback and embedding it into the product.

Gronlund (1998) recommended that feedback should be provided "immediately following or during the assessment" (p. 21). One type of feedback in this product was immediate feedback that informed the assessees of how many items they answered correctly in each section (see Figure 8). Moreover, Brown (2018) indicated that feedback could vary in form and given times. When the assessees visited "Review & Feedback", they were given another set of immediate feedback showing the results of individual items (see Figure 9). On the same page, as seen in Figure 9, additional feedback featuring detailed explanations of the term or concept (see Figure 10) could be accessed through the "SEE MORE FEEDBACK" button. Nevertheless, assessees were notified that they could choose to view the detailed explanation/feedback immediately or after they had completed all three sections. Once the assessees have completed all three sections, they could access the "View All Results" option to view all three results. From there, they would be able to review in detail the results of each section of individual items and the corresponding additional feedback. A compilation of explanations of all terms (see Appendix F) would also be available for the assessees to view online or download to their device.

Figure 8

Example Immediate Feedback (Sectional Results)

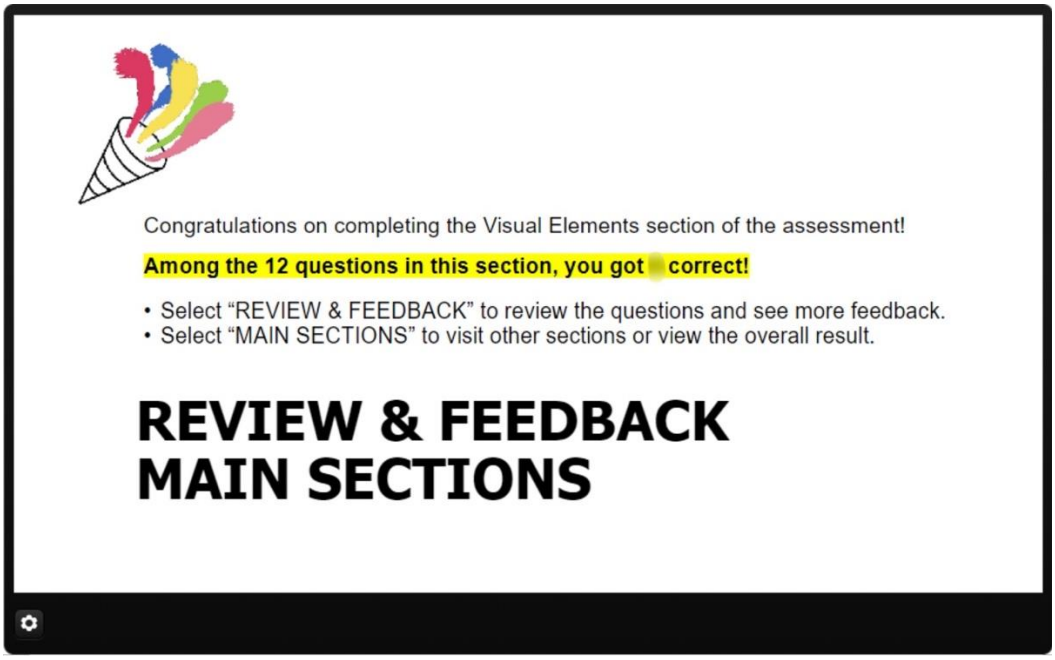


Figure 9

Example Immediate Feedback (Individual Item Result)

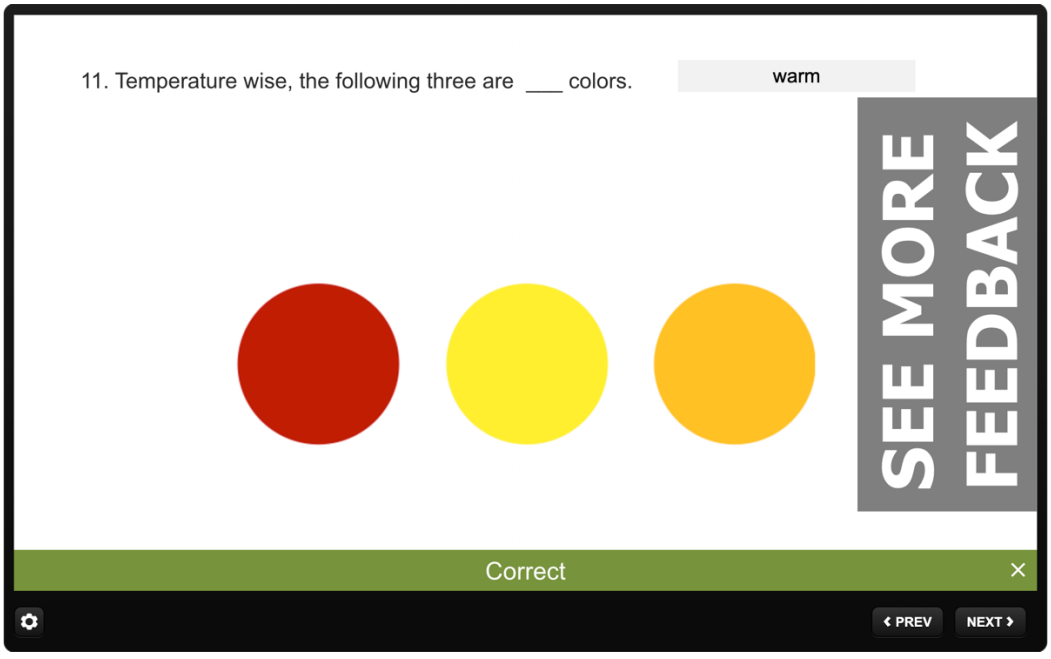
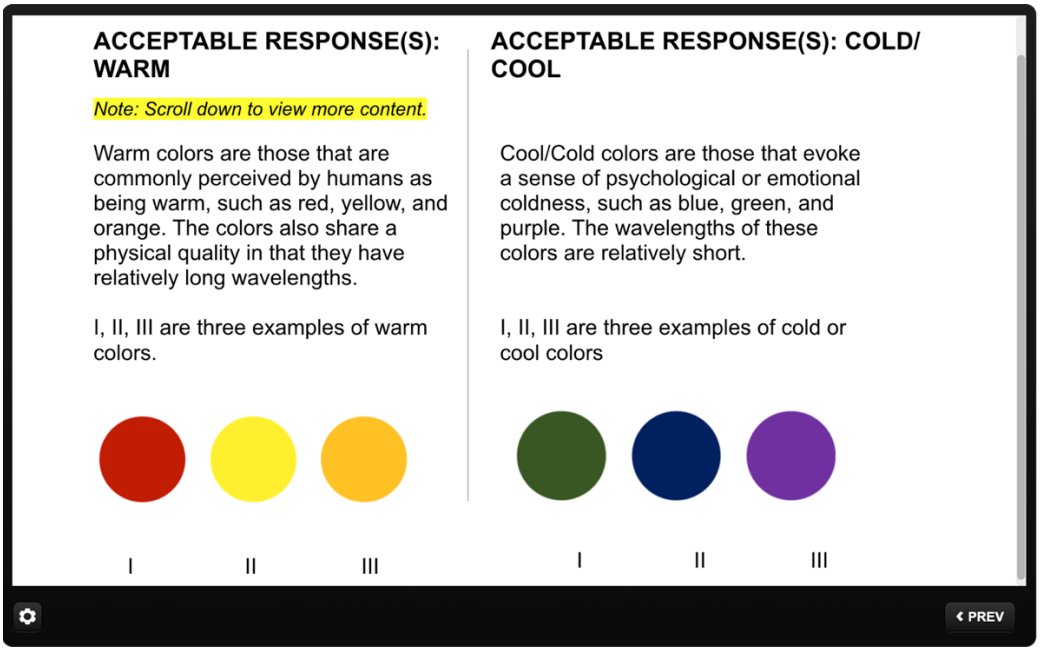


Figure 10

Example Additional Feedback



Another factor operationalized in the product development emphasized the interpretation of the assessment results and the recommendations for remediation of the identified weaknesses, as suggested in Brown (2018) and Gronlund (1998). Specifically, when the audience visited the overall results page, they were presented with the option to proceed to the final page of the product (see Appendix G). As seen in Appendix G, the product discussed short-term directions that the assessees could follow to address the weaknesses revealed by the assessment results. Long-term goals and objectives were also shared with the assessees. Additionally, external resources on visual literacy training and learning were listed on the page.

Validity and Reliability. Validity concerns the degree to which the interpretation and use of the assessment results are valid (Gronlund, 1998), and is dependent of various types of evidence. The validation of an assessment refers to the collection of these varied pieces of evidence. According to Brown and Hudson (2002), the type of evidence that supports the validity

of a criterion-referenced assessment is often content validity. This type of evidence emphasizes that the assessment content or item pool is representative of the domain or criterion the assessment intended (Gronlund, 1998; Salkind, 2010). As noted in Salkind (2010), content-related evidence draws heavily from the process of assessment design and development, during which the researcher carefully documents evidence related to the representativeness of assessment items. An additional method for providing content validity is to seek inputs of those with expertise in the content domain (Salkind, 2010).

The content validity of this assessment product was substantiated by both the analysis or literature review phase of the study and the formative evaluation. First, regarding the representativeness of the assessment items or content, the identification of the categories that comprised the fundamental vocabulary of visual literacy was informed by a comprehensive review of the literature. This review examined the foundations of visual literacy, visual design, visual language, and visual communication by consulting books and articles published over the years (N=12). The same process was applied to identify the specific terms and concepts that constituted each category. Second, review questions addressing the representativeness of the categories and the terms and concepts included were shared with the expert reviewers during the formative evaluation phase to obtain evidence to validate the representativeness of the content of the assessment (see Appendix H for a copy of the expert review survey).

The Reliability of the assessment was also carefully addressed throughout the design and development of the product. Specifically, this product employed several strategies to mitigate potential assessment errors that could be introduced by factors that were internal and external to the assessees.

Internal factors, as discussed in McMillan (2014), concern the internal state of the assessees, such as stress and motivation. An example strategy applied to alleviate audience stress and anxiety in the product was to inform them that neither the product designer nor anyone else would have access to the assessment results unless the assessed individual chose to share the results themselves. They were also reminded that the product would alert them to potential spelling errors and that the case of letters would not affect the judgement of answer. In addition to these strategies, the assessment is not timed. Assessees could also leave and return to the assessment at any time, as long as they would be using the same device and browser. In terms of motivation, the usefulness of the product and the user empowerment were considered during the design and development process (see the *MUSIC* motivation model by Jones, 2015). Example external factors are objectivity of judgment and unnecessary interruptions (Frey, 2018; McMillan, 2014). To ensure objectivity in judgment, the acceptable assessment answers for the short-answer items were those commonly used across disciplines and interests as suggested by the books reviewed during the analysis phase of the study. Several other strategies previously discussed also contribute to the objectivity of judgements, such as alerting to spelling errors and not judging letter case. To control unnecessary interruptions, product users were recommended to complete the assessment in a single session in a quiet environment free from distractions.

Phase III: Formative Evaluation. An evaluation phase was recommended in Richey and Klein (2009) for product and tool design and development research to address potential issues concerning the merit of product or the tool, such as its usefulness, impact, and effectiveness in solving the intended problem. Common evaluation techniques include formative evaluation, summative evaluation, and field evaluation. Of these evaluation methods, formative evaluation was considered most relevant to this study as it emphasized the use of evaluation data

"as a basis for further development" (Seels & Richey, 1994, p. 128). Because this study is an early effort to design and develop a product for instructional designers to assess their knowledge of a fundamental vocabulary of visual literacy, it calls for a formative evaluation from which data could be collected and analyzed to guide potential revisions.

Specifically, a small number of expert reviewers and pilot testers participated in this stage of the research. The expert review segment focused on expert insights into the validity of the assessment product and perceptions of the effectiveness of it. On the other hand, the pilot test segment, in addition to generating detailed feedback about the usability of the product, collected the initial reactions of a small number of target users regarding the usefulness of the product. As the two segments served different purposes and their outputs each emphasized unique aspects about the product and product design, it was not necessary to arrange the two in a particular order; therefore, the expert review and the pilot test were conducted simultaneously.

Since the results of the study were not intended to be generalizable and the focus of the research was to gain insight into the merits of the product, this study was determined by the Virginia Tech IRB to not meet the definition of *human subject research* as defined by the *Federal Policy for the Protections of Human Subjects* (see Appendix J). The consent process was therefore omitted. Instead, participation invitation letters were sent separately to nine expert reviewers and six pilot testers (see Appendixes A and C). The expert reviewers were selected based on their scholarship in visual literacy, visual literacy assessment, visual literacy education, media literacy, or media literacy assessment. The pilot testers were also purposefully selected. They were practicing instructional designers and instructional design graduate students. Since the product could be used by both native and non-native English-speaking instructional designers, the participants were selected to fit this profile. Eventually, all six invited pilot testers and two of

the nine invited expert reviewers agreed to participate in the research, and have completed the assigned tasks. An evaluation package for the expert reviewers (see Appendix B) and a pilot test package (see appendix D) for pilot testers were shared with the participants. The evaluation package contained an introduction to the study and the product, product specifications or an abbreviated version of the analysis and design and development phases of the study, a flow map of the product, a link to the product with instructions, and a link to the electronic review survey. The pilot test package contained an introduction to the product, a link to the product itself with instructions, and a link to the pilot test survey. Both electronic surveys (see Appendix H and I) were created using Qualtrics and encompassed Likert-scaled questions and open-ended questions.

Specifically, the pilot test survey addressed the usability and overall user experience of the product, such as the language, technology affordances, sufficiency of the directions, etc. It also recorded pilot testers' perceptions of the effectiveness of the product in helping them identify the strengths and the weaknesses in their knowledge of the fundamental vocabulary of visual literacy. The expert review survey, on the other hand, focused on the design and development process. Notably, each Likert-scale question in both surveys was accompanied by an additional open-ended question asking the designers to explain the reasoning behind their responses. These open-ended questions automatically appear once a respondents select any of "strongly disagree," "disagree," or "Neither agree or disagree." This particular design decision allows the researcher to accurately identify the issues in the product that led to relatively negative reactions from the pilot testers or the expert reviewers, on the basis of which modifications can be evaluated, performed, or reserved for future development in a more focused manner.

Both the expert reviewers and the instructional designers were asked to complete the survey in ten business days, with the possibility of extensions if necessary. The data collected from the surveys are analyzed and discussed below. The modifications made to the product and the directions for future development are also described in detail.

Results and Discussion

All six practicing instructional designers and instructional design graduate students responded to the anonymous pilot survey as requested. The two expert reviewers who agreed to participate in the study also completed the review survey. Their input regarding the usability and effectiveness of the product and the validity of the design and development processes and the product, along with a depiction of the revisions made to the product based on the feedback and future development, is analyzed and discussed as follows.

The Pilot Test

All six invited instructional designers agreed to experience the product and respond to the pilot test survey. These participants included practicing instructional designers and in-training instructional design graduate students or aspiring instructional designers who were native English speakers and non-native English speakers. The designers were given ten business days to complete the pilot test process upon agreeing to participate in the study, and all six completed the anonymous survey.

To facilitate the analysis of the results while ensuring anonymity, the respondents were labeled “A” to “F” alphabetically based on the date they completed the survey. Specifically, “instructional designer A,” “designer A,” or “respondent A” in the following content was the first pilot tester who completed the survey, while “instructional designer F,” “designer F,” or “respondent F” refers to the respondent who completed the survey last.

Language. Language use is one of the factors that influence the item and assessment quality. As revealed by the survey results, the pilot testers perceived the assessment language to be clear, grammatically-sound, and free from bias. However, designer F reported that the term, "technology advances" in the statement for the Digital Visuals section that reads, "some say technology advances has brought us this new visual language" could confuse the users. In responding to this observation, the sentence was revised to read, "some say advancement in technology has brought us this new visual language."

Additionally, instructional designer B pointed out that the tone used in some sentences in the "What's Next" section of the product was rather strong. Designer B said, "While I appreciated the intent of the 'What's Next' section to be helpful, I felt a little put off by the language of what I 'should' do. In an ideal world, I would love to explore visual literacy concepts, but realistically, there are obstacles that may slow my ability to do so." As part of the goal for this product was to encourage instructional designers to conduct further visual literacy learning based on the results they received, the tone of the language, especially in the "What's Next" slide should have been more welcoming and encouraging. Therefore, the researcher reviewed the content on that particular page carefully and deleted words that could be perceived as unnecessarily strong, such as "should.'

Technology Affordances. According to the survey results, all of the pilot testers used a laptop to access the product. Five of them used Google Chrome and one used Firefox. The instructional designers took roughly 30 mins to one hour to complete the assessment. In general, most of the respondents did not encounter technology issues or experience lagging while loading the product. Nevertheless, as indicated in Table 5, some detailed suggestions or observations regarding the technology affordances or functions were reported by the pilot testers.

Table 5

Issues Concerning the Technology Affordances of the Product and Corresponding Modification

Reported observations or suggestions	Modifications made to the product
Additional feedback for item 12 of the Visual Elements section does not load normally.	The "See more Feedback" button for item 12 of the Visual Elements section now directs to the correct additional feedback slide.
The "<PREV" button of item 5 of the Digital Visual section did not work.	The "<PREV" button of item 5 of the Digital Visual section now functions normally.
Some respondents suggested adding a link to the main sections to the slides when users review the detailed assessment results and feedback.	A hyperlinked "BACK TO THE RESULTS" that directs to the sectional results where users can access a button to go back to the main sections slides has been added to all of the review slides.

Directions. The assessment directions available in the product highlighted both the technology aspects and the assessment itself, including an overall introduction to the product, sectional directions provided at the beginning of each section, and detailed prompts or cues strategically placed throughout the product. The pilot survey sought feedback from the designers regarding the adequacy of these directions. Overall, as the following table suggests (see Table 6), the six pilot testers responded positively to the effectiveness of the directions regarding both the technology and assessment aspects of the product.

When it came to pilot testers' perceptions of the detailed forms of the instructions, such as the three sectional directions presented at the beginning of each section or category of the items, most participants perceived them to be effective. Specifically, instructional designer B shared that the titles of the sections "were helpful in providing parameters for the questions to come." Designer C indicated that the directions prompted them to know what was coming next. Similarly, designer F said, "I agree that the descriptions of the sections served as cues for me. They helped me understand the lens I needed to read the questions with. For example, the

description in the visual elements section helped me understand that I was going to be presented with variations on a particular visual element. I was going to need to identify the primary visual element."

Table 6

Pilot Testers' Perception of the Adequacy of the Assessment Directions

Q7 - Please indicate the degree to which you agree that the directions provided in the product regarding the following aspects are clear and sufficient.		
	Directions related to the technology aspect of the product, such as where to click/press and how to advance through the product.	Directions related to the assessment itself, such as the number of items in each section, the overall introduction to the assessment, directions on what to do next, etc.
Strongly disagree		
Disagree		
Neither agree or disagree		
Agree	2	1
Strongly agree	4	5
Total	6	6

On the other hand, some, while acknowledging the effectiveness of the sectional directions, shared suggestions and considerations for future development. For example, both instructional designers D and E indicated that although the sectional directions were helpful and clear, there was a large number of sentences within each of the three sectional directions, which could be tiring for assessment takers. In proposing directions for modifying the longer content, a designer suggested using bulleted points to separate and organize the content. The other respondent indicated that they would find it helpful if some portions of the directions were translated to a visual format, such as video. In responding to the suggestions discussed above, the sectional directions were categorized and organized using subtitles, spaces, and bullet points. In

addition, visualizing the long directions when appropriate was recognized as a direction for future development.

Feedback and Report. The pilot testers shared their perceptions of the effectiveness of the product by responding to the survey questions that focused on the adequacy of the individual item results, the additional feedback (where each term was explained in detail with visual examples), the sectional results, and the page that delineated next steps pointing to the directions for the visual literacy learning of the assessees.

Table 7

Pilot Testers' Perception of the Effectiveness of the Assessment

	Q9 - Please indicate the degree to which you agree with the following statements regarding the assessment results you received.	
	The results reflect fairly accurately my knowledge of the fundamental vocabulary of visual literacy.	The results direct future visual literacy training and learning for me.
Strongly disagree		
Disagree	2	
Neither agree or disagree		
Agree		4
Strongly agree	4	2
Total	6	6
	Q10 - Please indicate the degree to which you agree that the additional feedback explaining the terms or concepts in detail, i.e., the feedback shown on the screen when you press "See More Feedback", helps you learn the terms and concepts that you did not answer correctly.	
Strongly disagree		
Disagree		
Neither agree or disagree		
Agree	1	
Strongly agree	4	
Total	5	

Overall, as indicated in Table 7 and Table 9, the majority of the instructional designers agreed that the results of the assessment fairly accurately represented their knowledge of the

fundamental vocabulary of visual literacy and directed their future visual literacy learning. Moreover, they unanimously perceived the additional feedback illustrating the terms and concepts accompanied by visual examples to be helpful in addressing the weaknesses in their knowledge of the visual literacy vocabulary. Additionally, most of them also found the content on the "What's Next" slides to be valuable for them to identify short-term and long-term goals regarding their visual studies. Finally, according to Table 9, all of the participants were motivated by the product to learn more about visual literacy using the external resources provided at the end of the product.

Potential areas for improvement were also reported by some. To obtain valuable and detailed feedback that could guide the modifications made to the product, each Likert-scale question was accompanied by an additional open-ended question that invited the respondent to provide an explanation for their selection of "strongly disagree," "disagree," or "neither agree or disagree." One suggestion that stood out, and was mentioned by at least two pilot testers was to consider more inclusive acceptable answers for certain items. Specifically, the two instructional designers pointed out that some of their answers were marked by the product as "incorrect" due to differences in singular or plural forms or missing the addition of a "-," which led to them responding "disagree" to the first statement in Q9 (see Table 7).

It is worth noting here that the inclusivity of the item answers was considered and operationalized during the design and development phase of the product. For example, "space" and "white space" are both acceptable for item 5 of the Visual Elements section. Similarly, "similarity," "repetition," and "consistency" are all acceptable answers for item 3 of the Visual Actions section. Additionally, assessees were informed that the case of the letters did not impact the judgement of the answers. Nevertheless, as revealed by the survey results, some factors

regarding the inclusivity of the assessment answers were overlooked. Since the goal of this study was to provide instructional designers with valid and reliable assessment results, this feedback is pivotal. To address it, the following changes regarding the inclusivity of the item answers were made (see Table 8).

Table 8

Changes Made to Enhance the Inclusiveness of the Assessment Answers

Items & Sections	Previous acceptable answers	Revised acceptable answers
Item 1, Visual Elements	Dot/Point	Dot/Dots/Point/Points
Item 2, Visual Elements	Line	Line/Lines/Stroke/Strokes
Item 3, Visual Elements	Shape	Shape/Shapes
Item 4, Visual Elements	Texture	Texture/Textures
Item 5, Visual Elements	Space/White Space	Space/White Space/White-Space
Item 5, Visual Actions	Rule of Thirds	Rule of Thirds/Rule-of-Thirds
Item 6, Visual Actions	Symmetry/Mirroring	Symmetry/Mirroring/Mirror
Item 5, Digital Visuals	Gradient	Gradient/Gradients
Item 6, Digital Visuals	Font	Font/Type
Item 9, Digital Visuals	Sans Serif	Sans Serif/Sans-Serif
Item 10, Digital Visuals	Leading/Line Space/Line Spacing	Leading/Line Space/Line Spacing/Line-Space/Line-Spacing

With respect to the effectiveness of the "What's Next" page that discussed short-term and long-term directions for the assessees, as seen in Table 9, most of the pilot testers perceived it to be helpful for identifying short- and long-term visual literacy learning goals and objectives. They also expressed a willingness to learn more about visual literacy in the future by accessing the visual literacy resources listed on the page. Nevertheless, instructional designer D, who selected "disagree" as a response to the statement about the effectiveness of the "What's Next" slide for identifying long-term study goals, indicated, "what's next session was helpful to find resources related to visual literacy and to know what I can learn about it. However, I didn't think about long-term plans about it." In responding to this particular feedback, the researcher reviewed the language used on the "What's Next" page. Although suggestions for long-term goals were

provided, further considerations should be given to make the long-term goals more explicit and applicable.

Table 9

Pilot Testers' Perception of the "What's Next" Page.

Q11 - Please indicate the degree to which you agree with the following statements regarding the content of the "What's Next" slide.			
	It helps me identify short-term visual literacy learning goals and objectives.	It helps me identify long-term visual literacy learning goals and objectives.	I plan to access some of the external resources provided on that slide.
Strongly disagree			
Disagree		1	
Neither agree or disagree	2	1	
Agree	3	4	5
Strongly agree	1		1
Total	6	6	6

The Expert Review

Nine expert reviewers were identified and invited via email to review the product and its design and development. These experts were researchers and/or educators who specialized in visual literacy, visual literacy assessment, media literacy, or media literacy assessment. The reviewers were given at least ten days to complete the review process after receiving the expert review package, which included an introduction to the study and the product, the product specifications, a flow map of the organization of the product, the product itself, and the review survey. Ultimately, two of the invited experts completed the review process and were labeled as "expert A" and "expert B" in the following content. Expert A has developed and taught graduate level visual literacy courses and is an accomplished researcher in media literacy education and assessment. Expert B, coming from a library information and science background, has published

a number of works on visual literacy and been actively involved in several significant initiatives of the International Visual Literacy Association.

Overall, both experts agreed that the product was effective and useful to its target audience. According to expert A, the product offered, "a building block for assessment for instructional designers that need to understand these concepts for designing online instructional objects." On the other hand, the reviewers discussed several of the design and development decisions that could mitigate the effectiveness of the product and pose a threat to the validity of the assessment. The following section highlights several aspects of the experts' feedback and discussed their implications for future development of the product. In addition, the corresponding modifications made to the product are outlined below.

Representativeness of the assessment content. As discussed earlier, the content validity of an assessment emphasizes that the content or the items assessed are representative of the targeted domain. In this study, the content validity of the product was examined by conducting a comprehensive review of the literature and collecting input from content experts. In general, expert A believed the three categories identified from the literature were a good representation of a fundamental vocabulary of visual literacy. They also indicated that the specific terms and concepts were good representations of the corresponding categories they constituted. Expert B, on the other hand, while acknowledging the representativeness of the terms that made up the visual elements and visual actions categories, raised concerns about the category of digital visuals. Specifically, they indicated that many of the terms in this category were not exclusive to digital visuals, such as "orientation" (i.e., the general direction of a design).

In response to this feedback, while some of the terms in this category are indeed not exclusive to digital visual communication, they were grouped in the assessment because they shared the quality of being easily manipulated in a digital environment, and were essential to many of the digital visual creation and editing tools, such as Microsoft Office programs and Adobe Creative Suite. Additionally, as described in phase II, the grouping of the terms facilitated the provision of cues to promote the recall of relevant prior knowledge by the assessees. Therefore, instead of regrouping the terms or reconsidering the categories, the following modification was made to the sectional introduction to the category of digital visuals to avoid possible confusion and provide clearer cues.

Previous: "This section contains terms and concepts that are frequently seen and practiced in digital visual communication. They are often available in a variety of digital visual creation tools. Some say that technological advance has brought us this new visual language."

Revised: "This section contains terms and concepts that are frequently seen and practiced in digital visual communication. They are often easy to manipulate in a digital environment and compose the essential settings of a variety of digital visual creation and editing tools, such as Microsoft Office programs, Adobe Creative Suite, and many web-based image editing programs. Some say that advancement in technology has brought us this new visual language, although some of these terms have also been seen and practiced in non- digital environments."

Item Quality. Expert input targeting the many factors related to the quality of the assessment items was also surveyed and analyzed.

***The Exclusive Nature of the Assessment Answers*.** Regarding the alignment between the objectives or indicators and the assessment items, expert B considered the objectives to be good, but questioned whether the corresponding assessment items would yield valid

assessment results due to the exclusive nature of the assessment answers. A similar observation was reported by expert A. This issue echoed, to some extent, the feedback of the pilot testers discussed above. It was therefore suggested that more inclusive answers be built into the product to mitigate threats to the validity of the assessment, and to avoid potential fatigue and frustration. As discussed above, to yield valid assessment results, modifications were made to enhance the inclusiveness of the assessment answers (see Table 8). Nonetheless, it is worth noting that the terms and concepts, or the acceptable assessment answers, were collected from 12 books published over the years on visual literacy, visual communications, visual grammar, and visual design (see Table 2). In contrast to some alternative names or even descriptions, these terms compose the typical vocabulary adopted by the professionals. Therefore, when making the changes, consideration was given to balancing the inclusiveness of the assessment answers with the generality of the terminology. Ultimately, precisely naming the terms is the intended learning outcome assessed by the product.

The item Format. Another suggestion proposed was to consider changing the item format from short answer to multiple-choice, which, as noted by the reviewer, would require a change of objectives. While this proposed modification would address the exclusivity of the assessment answers, it does not fully meet the purpose of the product or serve the target audience. The focus of the assessment is not only to allow instructional designers to diagnose whether they could recognize the visual counterparts of the terms or concepts, but to emphasize whether the audience can accurately name the terms or concepts. This emphasis is of notable value for instructional design professionals who often work in teams that include graphic artists and multimedia specialists. Using the vocabulary that the professionals use helps avoid unnecessary miscommunications and facilitates workflow. For those who independently

create or research instructions that require visuals and visual media, knowing the vocabulary facilitates articulating and searching for the needed images or other visual media. As explained in the early sections of the article, despite the limitations, short-answer items are used for occasions, "where supplying the answer is a necessary part of the learning outcome to be measured." (Gronlund, 1998, p. 79)

The Adequacy and Accuracy of Visual and Verbal Cues. With respect to the adequacy and accuracy of the verbal and visual cues provided in the assessment items, expert A agreed that the cues described their corresponding terms or concepts as intended. According to expert B, "some are actually very clear and do a great job at measuring what you intend to measure. Some others perform a bit less well." The inadequacy of the cues in some assessment items, as commented by the reviewer, makes it challenging to prompt the behavior (i.e., accurately naming the term or concept).

Specific considerations were given to the adequacy of the cues, including limiting the use of verbal language when necessary and planning the cues based on the varying complexity of the concepts. As a result, assessees were expected to name some of the terms based on visual cues only and others with the addition of verbal cues or descriptions. Nevertheless, as indicated by the feedback from the experts, further research is needed to examine the adequacy and accuracy of the visual and verbal cues in the assessment items on a case-by-case basis. For example, additional iterations of user tests could be conducted to examine whether and how the verbal and visual cues contribute to users' inability to correctly name the terms or concepts in spite of them indicating prior to the assessment that they have learned the terms.

Assessment Directions and Feedback. Both experts found the assessment directions to be effective regarding explaining the assessment to the audience and how the product could be

used by the audience. In terms of the detailed feedback on the many forms of the feedback provided throughout the assessment, expert A perceived the additional feedback explaining the terms and concepts to be adequate. Expert B, while acknowledging that the feedback was "great and very useful," suggested adding more targeted feedback and examples to emphasize how to apply the terms and concepts to help people learn or other topics that are more relevant to the role of instructional designers. In response, while considerations have been given to this particular aspect during the design and development phase of the product (see the feedback for "contrast," "movement/motion," and several other items for examples), some of the examples could be more specific as revealed by the expert. However, this potential modification could make the feedback lengthy and more complex, therefore demanding a longer attention span from the assessees. With this in mind, further rounds of user tests are needed to determine where in the assessment process to embed the additional feedback and how to make the feedback more relevant to instructional designers without being overwhelmingly complex or lengthy.

Summary of the Results and Discussion

The instructional designers, or the invited pilot testers, responded generally positively to the merits of many aspects of the product, including the technology affordances, the language used in the assessment, the directions, and the various forms of feedback and reports. Most respondents found the product effective in helping them identify the strengths and weaknesses in their knowledge of visual literacy. The participants also indicated that they were motivated to learn more about visual literacy in the future. Below are some quotes from the designers reflecting on the effectiveness of the product.

Instructional Designer F: "I was really surprised by how many terms I didn't know or remember. This assessment was a valuable tool to help me realize my weaker areas in visual

literacy. The feedback for each question was very helpful because it defined the terms and provided readable and visual examples. I really appreciated the side-by-side feedback for warm and cool colors and for raster and vector images. Those concepts certainly benefit from a comparison between the pairs."

Instructional Designer E: "In all, you did an excellent job creating the assessment. You included details of what needed to be done and what to expect every step of the way."

Instructional Designer D: "This product was very helpful to assess my knowledge about visual literacy and have valuable information. It was also well-designed and easy to use. The handout I could download was very helpful to learn visual literacy."

Instructional Designer C: "This is a very useful tool. I discovered just how much I need to learn about visual literacy."

The expert reviewers generally acknowledged the effectiveness and usefulness of the product, but also noted several areas that could pose a threat to the validity of the assessment. Some of their concerns echoed the experience of the pilot testers. As indicated above, a few modifications have been made to the product. However, the following suggestions and observations from the pilot testers and the expert reviewers have not been implemented due to limited resources and the timeline available for the study. Nevertheless, the feedback provided future directions for development and research.

First, it is recommended that some of the longer and text-heavy assessment directions (such as the overall introduction and the sectional instructions) be converted to a combination of alternative multimedia artifacts to prevent fatigue and frustration, such as videos, avatars, images, and audio. Second, further iterations of user testing are needed to examine the adequacy and accuracy of the verbal and visual cues provided in the assessment items on a case-by-case

basis. At the same time, more rounds of expert reviews could be implemented to evaluate the accuracy of the cues. Third, additional feedback that explains the terms or concepts needs to be revisited and potentially edited to make them more relevant to the roles and responsibilities of instructional design professionals. Nonetheless, consideration should be given to ensuring that the feedback is not overwhelmingly lengthy or complex.

To some extent, the interpretation and analysis of the expert feedback demonstrates the eclectic nature of visual literacy and the potential differences between the researcher's and expert reviewers' conceptions of visual literacy. As has been discussed, no definition of the concept of visual literacy has been found that satisfies researchers from different disciplines. Jonassen and Fork (1975) commented that visual literacy was "eclectic in origin" (p. 7), and Braden and Baca (1991) interpreted this statement to mean that visual literacy "has drawn on the theory and practice of many other fields, melding parts of this and parts of that into an amalgamated (thus eclectic) set of interlocking ideas" (p. 152). For example, according to Thompson and Beene (2020), librarianship's interest in visual literacy is closely linked to information literacy. This connection is evidenced by the fact that the Visual Literacy Standards were developed in the context of the *Information Literacy Standards for Higher Education* and highlighted topics that were relatively more relevant to the interests and practice of librarians, such as ethical and legal issues revolving around visual use (The Visual Literacy Standards Task Force, 2012).

Ultimately, the concept of visual literacy is under development and debate, which poses many challenges for conducting assessment research. Interestingly, an article published in March 2021 titled "The Lost Years of Visual Literacy" (Peña & Dobson, 2021) revealed a period of approximately 30 years of visual literacy history that preceded the visual literacy movement of the late 1960s and the 1970s. These missing years, the authors argued, "have interesting

implications for current understandings of visual literacy" (p. 10). Regardless, it is clear that the concept and field of visual literacy is relatively young and evolving. To some extent, while this fact does not completely hinder research in this area, as mentioned above, it does pose various challenges, as different conceptions held by the researchers can influence how they think and act on the concept and its related research.

Conclusion

Employing the design and development research methodology, this study provided instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, with an assessment product to assess or diagnose their knowledge of a fundamental vocabulary of visual literacy. In designing and developing such a product, a comprehensive literature review was first conducted to identify the terms and concepts that comprise this vocabulary. During this phase, literature on the fundamentals of visual literacy and related fields were consulted. Factors to consider for the design and development of visual literacy assessment as discussed in existing research and general assessment development research were also identified. After these factors have been operationalized and the product has been developed, the formative evaluation (i.e., a pilot test and an expert review) was implemented to solicit input from the target audience and experts in the field. This input has been used to modify the product and to identify areas for future research and development.

Overall, the assessment product was perceived by the instructional designers to be useful and effective as intended. The expert reviewers, while acknowledging the value and effectiveness of the product, identified specific aspects of the design and development that could potentially pose a threat to the validity of the assessment. Feedback from participants in both groups has been employed to guide modifications to the product. Nonetheless, due to the scale

and the nature of some of the recommended modifications, the resources required, and the timeline for the study, some feedbacks were not implemented but identified as directions to advance the product and the research for the future. For example, operationalizing the design of the product involved selecting the technology to develop a functional product and placing it in an online environment that was easily accessible to its audience. Although this study managed to achieve the operationalization of such a digital product, a potential collaboration between the researcher and a computer scientist may help to control the compromises made in terms of the validity and reliability of the assessment.

Another factor that could be considered a limitation of this study and a direction for future development concerns the nature of the objectives or indicators assessed by the product. While the objectives and corresponding assessment items serve the intended purpose of the design and the targeted audience, in reality, a variety of relatively more complex and higher-order visual literacy competencies are often expected of instructional design professionals. Therefore, in addition to addressing the directions and challenges raised by the expert reviewers and pilot testers that are specific to this product, further research may consider exploring valid and reliable methods to assess the visual literacy competencies of instructional designers at the more complex end of the visual literacy spectrum in a digital environment.

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Conclusion to the Dissertation

The assessment of visual literacy has long been recognized as critical to the research on this concept and the promotion of its embedding in educational curricula across academic disciplines. Nevertheless, in reality, research efforts to address this issue have been far from adequate. A robust and productive research agenda addressing this research interest has yet to be established. In the field of instructional design, although the role of visuals for learning and learning design has been extensively researched and that instructional design professionals are expected to have some degree of visual skills, there is little evidence-based research on the state of visual literacy among instructional design students and professionals. Additional research that builds on a valid and reliable description of the visual literacy in instructional design students or professionals, such as identifying strategies or factors that facilitate or hinder the development of visual literacy competencies, is even rarer.

Therefore, driven by the lack of research on visual literacy assessment and the limited availability of procedures, instruments, or products for assessing visual literacy, particularly in the context of instructional design, this dissertation has contributed two manuscripts that are distinctive in their research methodologies but connected in nature. The first manuscript explored how visual literacy had been assessed over the years and identified challenges in establishing a robust and productive research agenda from the existing research. In completing the second manuscript, the output of the first manuscript directly guided the design and development of the assessment product. By contextualizing the assessment and highlighting the foundation of visual literacy, the second manuscript yielded an evidence-based assessment that served a well-defined purpose and a specific target audience. The formative evaluation of the product revealed that

while there were areas for future research and development, the instructional designers and visual literacy experts generally found the product to be useful and effective as intended.

Implications

Despite the many empirical efforts by researchers around the globe to assess visual literacy, it is doubtful that we have left the early stages of visual literacy assessment research, especially given the challenges that remain to be studied. Such challenges have posed difficulties in building a robust and productive research agenda for visual literacy assessment. Many of these factors relate to the concept of visual literacy itself, such as what it entails to create, write, compose, or encode visuals. This question, concerning the nature and scope of the encoding dimension of the visual literacy concept, has a direct bearing on how this dimension can be assessed in a valid and reliable way.

Furthermore, although the assessment product developed from the second manuscript is an early attempt that requires further modification and research, it extends the approach to assessing visual literacy by modeling the design and development of an evidence-based visual literacy assessment in a digital environment. The developed product is easily accessible and provides immediate results and feedback to its target audience. This digital technology-assisted assessment was perceived by the instructional design students and practicing instructional designers as helping them identify the strengths and weaknesses in their knowledge of the fundamental vocabulary of visual literacy and motivating them to engage in targeted learning to remediate their visual literacy. To some extent, although further modifications and research are needed, the product implies that this context- and audience-specific approach to visual literacy assessment, with its emphasis on self-paced assessment or diagnosis combined with

corresponding remedial feedback and built-in interactions, is a possible direction for advancing visual literacy assessment research.

Directions for future research

A number of challenges and directions emerged from the dissertation regarding future research on visual literacy assessment and visual literacy assessment in the context of instructional design.

First, regarding visual literacy assessment techniques and procedures, future research is recommended to consider employing techniques that yield artifacts that are qualitative in nature. This direction implies that more research is needed to address the assessment of higher-order visual literacy competencies. This aspect is critical because visual literacy is a complex concept that encompasses many higher-order thinking skills and ultimately necessitates qualitative procedures and techniques to assess its full spectrum. Emphasis may also be placed on valid and reliable methods for quantifying the output of those qualitative techniques, on the basis of which an operational definition of the concept can truly be justified and validated. Another major challenge that needs to be addressed by future research concerns the encoding dimension of the visual literacy concept. As indicated in manuscript one, some have delineated the indicators or objectives targeting this dimension. However, further discussion is still needed to determine the scope and the adequacy of the indicators. It is yet another challenge to assess these indicators in a fair, valid, and reliable manner. From another perspective, future studies that plan to implement the developed measures or design new measures of perceived visual literacy should carefully consider the implications and uses of the assessment results. More research should be in place to examine the correlation between the perceived visual literacy and evidence-based visual literacy competencies.

With regard to assessing visual literacy in instructional design, the following recommendations for future research should be considered in addition to the feedback emphasizing the future development for this particular product. The design and development of this product suggests that developing such a digitally-assisted assessment product calls for collaboration among the researchers, information technologists, digital visual artists, and other roles as needed. This collaboration may help mitigate the likelihood that the validity and reliability of the assessment and the user experience it provides will be compromised by the skills of the researchers. Additionally, the assessment product developed from this study targeted the foundational vocabulary of visual literacy, which was primarily concerned with lower-level visual literacy knowledge. Future research is recommended to identify techniques and procedures to assess higher-order and complex visual literacy competencies, such as using the foundational terms and concepts for specific problem-solving tasks. Additional research is also needed to examine the relevance of specific visual literacy competencies to the shared practices of instructional design professionals, or whether there is a difference between the competencies needed for instructional designers working in different contexts, the results of which will inform the design and development of visual literacy assessments that truly serve their target audiences. These assessments may be further adopted by other researchers to identify strategies or factors that assist instructional design professionals in developing these competencies effectively.

Appendix A: Expert Reviewer Recruitment Letter

Mingyu Li
Ph.D. Candidate,
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Dear Dr. xxx,

I hope this email finds you well.

My name is Mingyu Li, a doctoral candidate in the Instructional Design and Technology program at Virginia Polytechnic Institute and State University. I am currently completing two manuscripts that comprise my doctoral dissertation. The first manuscript, a comprehensive literature review, offers insights into how visual literacy has been assessed over the years and the challenges of assessing this concept as revealed by existing research and practice. The second manuscript, taking the design and development research methodology, aims at designing and developing a product for instructional designers, particularly those new to visual literacy or who have not intentionally developed their visual skills, to assess their knowledge of a fundamental vocabulary of visual literacy. In seeking expert input regarding the adequacy of the product and possible areas of improvement, I am writing to invite you to review this product.

For your reference, in designing and developing such a product, this study echoes the call for visual literacy assessment research and addresses the reality that there is a lack of evidence validating instructional designers' visual literacy abilities despite them being expected to be visually literate by the job market. Following the typical three-phase structure of design and development research, this effort has identified three categories of terms and concepts comprising a fundamental vocabulary of visual literacy and located factors to be considered when designing and developing such a product in phase I, analysis. Phase II, design and development, emphasized the operationalization of the factors in the design and development of the product. The third phase concerns the collection of formative evaluation data.

As one of the scholars with expert knowledge in visual literacy, visual literacy education, or practical experience in visual literacy assessment, you were identified as an expert reviewer. Please note that your participation will be voluntary and anonymous. If you would like to know more about the study or are interested in participating as an expert reviewer, please feel free to reply to this email. Reviewers who agree to participate in the study will receive an evaluation package that includes an introduction, product specifications, a flow map of the product, a link to the product with instructions, and a link to an electronic review survey. The review process should take less than two hours. Your responses to the assessment product and the assessment results will be displayed by the product only to yourself. Participants' responses to the survey questions will be analyzed, reported in the dissertation, and guide the revision of the product. Meanwhile, demographic data or identifiers will not be collected by the review survey.

Thank you in advance for your time and consideration.

Sincerely,
Mingyu Li

Appendix B: Expert Review Evaluation Package

Evaluation Package for Expert Reviewers

Mingyu Li

Virginia Polytechnic Institute and State University

Note. This package complements *Creating a Product for Instructional Designers to Assess Their Knowledge of a Fundamental Vocabulary of Visual Literacy: A Design and Development Study* by Mingyu Li. It shall only be used by invited expert reviewers who have agreed to participate in the research study.

Documents Enclosed

Introduction

Overview

This evaluation package complements a research study by Mingyu Li, a doctoral candidate in the program of Instructional Design and Technology at Virginia Polytechnic Institute and State University. Being one of the two manuscripts comprising my doctoral dissertation, *Creating a Product for Instructional Designers to Assess Their Knowledge of a Fundamental Vocabulary of Visual Literacy: A Design and Development Study* echoes the call for visual literacy assessment research (Robinson, Avgerinou, Curtiss, DeVaney & Pettersson, 2018) and addresses the reality that there is a lack of evidence validating instructional designers' visual literacy despite them being expected to be visually literate by the job market (see Chen, 2020; Klein & Kelly, 2018; Liu, Gibby, Quiros, & Demps, 2002). By allowing instructional designers, especially those new to visual literacy or who have not intentionally developed their visual skills, to assess their knowledge of a fundamental vocabulary of visual literacy, this product assists its audience in identifying specific terms and concepts that they are not familiar with, which directs future visual literacy learning and training.

Following the design and development research methodology (Richey & Klein, 2009), the study employed a three-phase model, including analysis, design and development, and formative evaluation. The analysis phase encompassed a literature review, through which terms and concepts comprising the fundamental vocabulary of visual literacy and factors to be considered when designing and developing the assessment product were identified. The product was then designed and developed during the second phase where the factors identified in the analysis phase were operationalized. Then, this package was created to be used in phase III where the formative evaluation would be performed. The evaluation phase entails expert review and a pilot test. For the pilot test, a small number of instructional designers are invited to provide feedback regarding the usability and effectiveness of the product from the perspective of target users. In terms of the expert review, this package was created and distributed to a small sample of scholars who possess expert knowledge in visual literacy and practical experience in conducting assessment research. Their feedback will be reported in the dissertation and guide the revision of the product. Meanwhile, their insights will contribute content-related evidence to substantiate the validity of the product.

Navigate the Package

As you have noticed, there are a few items in this package. The instruction provides reviewers with background information on the study and the package itself. Then, the product specifications present details regarding both the analysis and design and development phases of the study. Next, a flow map of the product delineates the overarching structure of the product. The following section contains a link to the product itself with instructions. The last document presents a link to the electronic evaluation survey and briefly explains what to expect in the survey. Reviewers are recommended to review this introduction and the product specifications in the following document before accessing the product for the purpose of providing quality feedback regarding the alignment between the design thoughts and the product.

Product Specifications

The product, *A fundamental Vocabulary of Visual Literacy: An Assessment*, is a self-paced online assessment product that allows instructional designers, especially those new to visual literacy or who have not intentionally developed their visual skills, to assess their knowledge of a fundamental vocabulary of visual literacy. The assessment results not only help the designers identify specific terms and concepts of visual literacy they are not familiar with but based on which, direct visual literacy learning and training.

Under the umbrella of the design and development research methodology (Richey & Klein, 2009), the product was developed from a three-phase model, including analysis, design and development, and formative evaluation.

Phase I-Analysis

A literature review was conducted during this phase to identify 1) the terms and concepts comprising a fundamental vocabulary of visual literacy, and 2) factors identified as important when designing and developing a product for the target audience to assess their knowledge of a fundamental vocabulary of visual literacy.

In short, the terms and concepts were identified from a collection of books published between the outset of visual literacy movement and more recent years that delineate fundamentals of visual literacy and visual communication (see Table 1 below). As a result, three categories of terms and concepts were identified as comprising a fundamental vocabulary of visual literacy, including Visual Elements & Selected Supporting Terms, Visual Actions/Techniques/Arrangement, and Foundational Terms for Digital Visual Communication.

- Visual elements compose the most fundamental toolbox of visual communication that is operated in any medium involving visual meaning-making. Visual composition mostly starts with selecting appropriate elements to encode the intended message. Variants of an element can be created by manipulating one or more of its attributes.

- Visual actions/techniques/arrangements describe the arrangement and manipulation of visual elements in a visual composition to communicate meanings and serve different purposes. There are possibly countless techniques, but the ones encompassed in this section are frequently seen in practice.

- The third category concerns terms and concepts that are frequently seen and practiced in digital visual communication. They are often available in a variety of digital visual creation tools. Some say that technological advance has brought us this new visual language.

Specific terms and concepts encompassed by each category are presented in Table 2 of this package. Meanwhile, factors to be considered during the design and development of the product were identified from literature on designing and developing general assessment products and

Note. The *Product Specifications* section of this evaluation package is an abbreviated and adapted version of the original research paper, the purpose of which is to provide reviewers with key information regarding the analysis, design and development of the product.

existing visual literacy assessment research. A quick summary of the factors is available in Table 3.

Table 1

Literature on terms and concepts comprising a fundamental vocabulary of visual literacy

Literature	Authors	Years of Publication
A primer of visual literacy	Dondis	1973
Introduction to visual literacy: A guide to the visual arts and communication	Curtiss	1987
Visual design on the computer (2nd ed.).	Wong & Wong	2001
The elements of visual analysis	Helmers	2006
A visual language: elements of design	Cohen & Anderson	2006
Visual grammar	Leborg	2006
Visual communication: Integrating media, art and science	Williams & Newton	2007
Creating graphics for learning and performance: Lessons in visual literacy (2nd ed.)	Lohr	2008
Exploring visual design: The elements and principles (4th ed.).	Gatto, Porter, & Selleck	2011
Exploring the elements of design (3rd ed.).	Evans & Thomas	2013
Digital image compositing fundamentals	Jackson	2015
Digital illustration fundamentals.	Jackson	2015

Table 2

Categories of terms and concepts comprising the fundamental vocabulary of visual literacy

Category 1: Visual Elements & Selected Supporting Terms.	Category 2: Visual Actions/Techniques/Arrangement	Category 3: Foundational terms for Digital Visual Communication
Dot/Point	Alignment	Orientation
Line	Contrast	Fill
Shape	Similarity/Repetition/Consistency	Font
Texture	Proximity	Serif
Space/White Space	Perspective	Sans Serif
Motion/Movement	Rule of Thirds	Resolution
Value/Tone	Symmetry	RGB
Complementary Colors		CMYK
Analogous Colors		Raster/Bitmap Graphics
Monochromatic Colors		Vector Graphics
Warm Colors		Kerning
Cold Colors		Leading
		Gradient

Table 3

Factors identified as important for the designing and developing of the product

Factors	What to consider
The nature of an assessment	• Criterion-referenced: Focuses on the achievement of specific objectives • Norm-referenced: Compares relative performances between the assessees (Dick, Carey, & Carey, 2015; Gronlund, 1998)
The assessment context	• Paper-pencil assessment: Usually saves time and some types of resources • Digital & online assessment: multimedia possibilities, innovative item types, various interactions, expanded access, etc. (Frey, 2018)
Quality of the assessment items	• The alignment between the assessment items and the performance objectives • Specific to criterion-referenced quality: items are representative of the designated domain • Learner characteristics (e.g., language level, interest, motivation, gender, etc.) • Specific item-writing qualities (e.g., grammar, spelling, directions, etc.) (AERA, APA, & NCME, 2014; Dick, Carey, & Carey, 2015)
Availability of the product	• Some of the existing assessment products cannot be easily accessed by researchers interested in studying visual literacy assessment, e.g., the original product in Turner (1978) is only available in print and can be accessed through interlibrary loan. How to ensure the target audience can relatively easily access a product expected to be used by instructional designers to assess their knowledge of a fundamental vocabulary of visual literacy?
Clearly stated performance objectives	• Some existing visual literacy assessment research did not clearly state the performance objective or indicator that the assessment assessed (e.g., Turner, 1978), making it challenging for the readers to examine the merits of the products and the research.
Use of visuals	• Some visual literacy scholars called for using visuals and carefully limiting the use of verbal language in the assessment items of a visual assessment (see Spitzer & McNerny, 1975) • Some called for including moving images in visual literacy assessment research (see Avgerinou, 2001)
Assessment directions	• Clear and concise • Introductory vs. sectional directions • Preparing directions based on specific assessment situations (Dick, Carey, & Carey, 2015; Gronlund, 1998)
Assessment feedback	• The time the feedback is given; immediate or not?

	• The feedback should inform the assessees of the weaknesses and strengths in their performance • Consider providing remedial suggestions and how to assess progress (Brown, 2018; Gronlund, 1998)
Validity and Reliability	• What type of evidence can be collected to substantiate the validity and reliability of the assessment? (Brown & Hudson, 2002; Gronlund, 1998; McMillan, 2014; Reynolds, Livingston, & Willson, 2006; Salkind, 2010)

Phase II: Design & Development

Phase II of the study described the operationalization of the factors and considerations identified in Phase I (see Table 3) while designing and developing the product. Overall, this phase was guided by the assessment design and development procedures delineated in Gronlund's *Assessment of Student Achievement* (1998) and Dick, Carey, & Carey's *The Systematic Design of Instruction* (2015), including,

- Determining the nature and context of the assessment
- Describing the intended learning outcomes in performance objectives
- Constructing test items
- Sequencing test items
- Preparing directions
- Developing reporting and feedback strategies

Determining the nature and context of the assessment

As this effort aimed at providing instructional designers with an assessment product to identify specific terms and concepts of visual literacy that they were unfamiliar with rather than comparing performances between the designers, the nature of the product was therefore criterion-referenced. Next, it was determined that this product would be hosted in an online digital instead of paper-pencil environment, a decision informed by many factors and existing visual literacy assessment research. For example, an online digital environment allows various forms of visuals to be easily embedded in the product while saving resources required for excessive color printing. An online context also enables instructional designers to access the product anytime and anywhere using any digital device as long as the internet is available.

Describing the intended learning outcomes in performance objectives.

Gagné's (Gagné,1977; Gagné & Driscoll, 1988) taxonomy of learning outcomes and Dick, Carey, and Carey's (2015) instructions on writing performance objectives were visited this stage. Specifically, Gagné's categorizations of verbal information, concrete concept, and defined concept were identified as most relevant to describing the terms and concepts identified in Phase I of this study. Acquiring verbal information denotes that an individual can recall and state certain information without necessarily fully comprehending the meaning of the information although the goal is usually comprehending (Gagné,1977; Gagné & Driscoll, 1988; Driscoll, 2005). Concrete concepts are common objects (e.g., cat and chair) and object qualities (e.g.,

color and shape) that "can be denoted by being pointed out" and are "concepts by observation" (Gagné, 1977, p. 111). The second type of concept learning concerns defined concepts, which "cannot be identified by pointing them out" but must be defined (Gagné & Driscoll, 1988, p. 50). Gagné (1977) indicated defined concepts could be composed of other concrete concept(s) and/or defined concepts with certain relations in between. Some concepts are learned as concrete and then become defined as individuals develop, whereas others can only be learned as defined concepts. Based on the above discussion, the terms and concepts identified in Table 2 were categorized as seen in Table 4 on page 10 of this package.

Performance objectives were then written based on Gagné (1977) and Dick, Carey, and Carey (2015)'s discussions on how to assess verbal information, concrete concepts, and defined concepts. Specially, the learning of verbal information can be assessed by asking the individual to state the information in propositional forms or, on some occasions, cued using non-verbal forms (Gagné & Driscoll, 1988). The learning of concrete and defined concepts can be validated by classifying instances of the concept or naming the concept when being presented with instances of the concept (Gagné & Driscoll, 1988). Meanwhile, assesses should be able to judge whether an object fits a learned concept through a visual or verbal depiction of the object. Additionally, Dick, Carey, and Carey's (2015) instruction on specifying the condition and behavior in a performance objective was also considered.

Therefore, the performance objectives that this product addresses include,

Verbal information: Given a combination of written and visual description of the term, students will name the term.
Concrete Concept: Given at least three varied visual instances of the concept, students will name the concept.
Defined Concept: Given at least three varied visual instances of the concept and minimum verbal cues, students will name the concept.

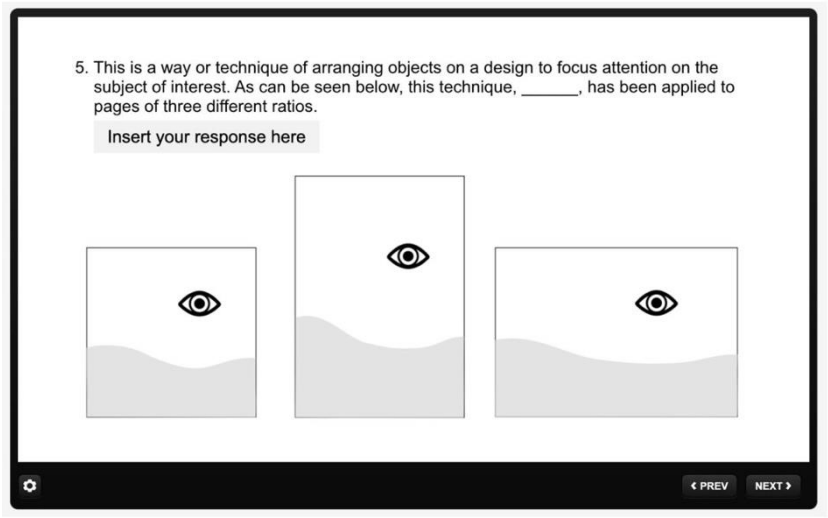
Constructing and Sequencing Test Items

The items were developed in Articulate Storyline, an e-learning authoring software with a built-in quiz or knowledge-check function that allows various customizations (Articulate Community Team, n.d.). Then, the product was exported and hosted on Github.com, an internet hosting service provider (GitHub, n.d.). The factors operationalized in this stage highlighted the various aspects of item quality control. One of the most notable factors was the alignment between the assessment items and the performance objectives. For example, the defined concept assessed in Figure 1 (on page 9 of this package) is the *Rule of Thirds*, a design action denoting placing the focal point of a design on or near the intersections of the imaginary horizontal and vertical lines that divide a frame into nine equal pieces. As indicated by the performance objective for defined concepts, condition or materials available for the assessees to perform the behavior is "at least three varied visual instances" of the concept and minimum verbal cues, which can be substantiated by the three image examples and the limited use of text in this item. Meanwhile, the behavior described in the objective is "name". As seen in Figure 1, assessees are instructed to insert their response to the item using the textbox, i.e., name the concept. This attention to the alignment between the assessment items and the performance objectives is

evidenced in all three categories of the terms and concepts. Please refer to the product for more examples.

The product clustered items that featured terms and concepts under the same category in terms of item sequencing, which facilitated providing sectional directions to the target audience before the items were presented. Meanwhile, while there is no particular order between the three clusters/sections, assessees are recommended to visit visual elements first, then visual actions, and finally digital visuals.

Figure 1
The Screen Capture of an Example Item, the Rule of Thirds



Preparing Directions.

Directions provided for the assessees concern the assessment itself and the technology aspect of the product. Content wise, the product presents an overall introduction to the assessment product and sectional introductions to the clusters/sections. With respect to navigating the technology aspect of the product, the directions are precise and placed throughout the product strategically, such as instructions on where to press or click on the screen, how to advance in the product, and when scrolling is expected. Meanwhile, directions were written with the various devices that designers could be using to access the product in mind.

Table 4

Cross Categorization of the Terms and Concepts with Reference to Gagné's learning outcomes and the Visual Literacy Literature

Categories of the terms and concepts	Gagné's learning outcomes		
	Verbal Information	Concrete Concepts	Defined concepts
Category 1: Visual Elements & Selected Supporting Terms		Dot/Point	Complementary Colors
		Line	Analogous Colors
		Shape	Monochromatic Colors
		Texture	Warm Colors
		Space/White Space	Cold Colors
		Motion/movement	
		Value/Tone	
Category 2: Visual Actions/Techniques/Arrangement			Alignment
			Contrast
			Repetition/Similarity/Consistency
			Proximity
			Perspective
			Rule of Thirds
			Symmetry
Category 3: Foundational terms for Digital Visual Communication	Resolution		Fill
	RGB		Font
	CMYK		Serif
	Kerning		Sans serif
	Leading		Gradient
	Raster/Bitmap Graphics		
	Vector Graphics		
	Orientation		

Reporting and Feedback

Many forms of report and feedback are presented to the audience at various times. One type of immediate feedback is the sectional results provided at the end of each section. From there, one can choose to review individual items or continue answering the items in the other sections. If they choose to review individual items, in addition to being informed of whether that item is correct, they can press a "See More Feedback" button to view a detailed explanation of that term or concept. When all three clusters/sections are completed, assessees can access a slide displaying all three sectional results and choose to review individual items from there. A downloadable PDF compilation of all the terms and concepts is also available on that slide. Additionally, feedback on how to use the assessment results, what to do next based on the results, and external resources for future visual literacy learning are provided.

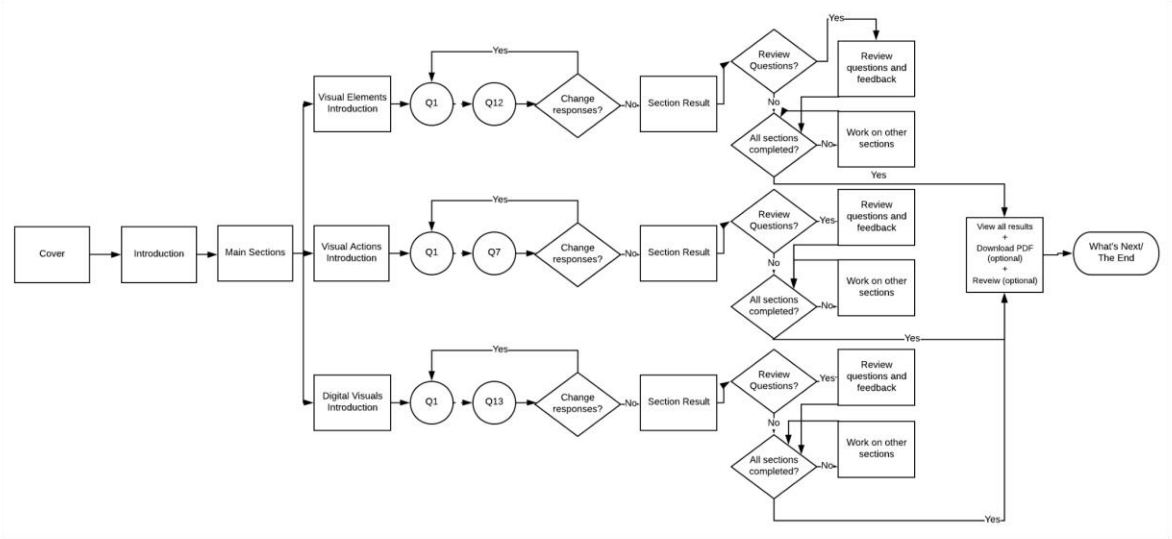
Validity and Reliability.

The Validity of a criterion-referenced assessment is often substantiated by content-related evidence (Brown & Hudson, 2002). This type of evidence emphasizes that the assessment content or items are representative of the intended domain or criterion (Gronlund, 1998; Salkind, 2010). In this study, validity evidence is collected from two channels, including the literature review and expert review. First, regarding the representativeness of the items, as denoted in the literature review, the identification of the categories comprising the fundamental vocabulary of visual literacy was informed by a comprehensive review of literature that delineated foundations of visual communication, visual design, visual language, and visual literacy and published across ages. The same process applies to the specific terms and concepts under each category. Second, review questions about the representativeness of the categories and the terms and concepts enclosed are shared with expert reviewers during the formative evaluation phase of the study.

With respect to reliability, this product adopted strategies mitigating assessment errors that could be introduced by factors internal and external to the assessees. Internal factors, as discussed in McMillan (2014), concern the internal state of the assessees, such as stress and motivation. An example strategy to ease the stress and anxiety of the audience in the product is to inform them that their assessment results are not recorded or shared in any form by the product. For motivation, the usefulness of the product and learner empowerment are considered during the design and development process (see the MUSIC motivation model by Jones, 2015). Example external factors are objectivity of judgment, interruptions, etc. (Frey, 2018; McMillan, 2014). The objectivity of judgment is secured by the machine-assisted nature of the assessment and the many visual literacy books reviewed in Phase I. Meanwhile, product users are recommended to complete the assessment in one sitting in a quiet environment free from distractions.

A Flow Map of the Product

Figure 2
A Flow Map of the Product from the Perspective of the Assessment Designer



The Product

If you have not reviewed the *Introduction*, *Product Specifications,* or the flow map, you are recommended to scan through them first. The first two segments of this package present a general introduction to the study and the product and then a delineation of the theoretical and practical considerations underpinning the design and development of the product. The map displayed on the earlier page assists reviewers in comprehending the organization of the product from the perspective of the researcher.

If you have reviewed the previous documents of this package, please use this link or scan the QR code below to review the product. While reviewers have their preferred review process, printing out the tables and figures presented in the previous sections or displaying them on the side of the screen while reviewing the product might facilitate evaluating the alignment between the design process and the resulted product. Meanwhile, paper and a pencil or other forms of notetaking should be available so that any immediate responses, observations, comments, or suggestions can be easily recorded as the reviewer is reviewing the product.

Figure 3
A QR Code of the Product

Upon completing reviewing the product, reviewers should access the electronic survey linked on the next page of this package. This survey only records your responses to the questions but not any information related to your identity. Your responses will be analyzed and reported in the research paper. They will also guide the revision of the product.

The Review Survey

As previously stated, this review survey will only record your responses to the questions. Any information related to your identity will not be documented, meaning the researcher himself will not be able to identify the respondent. Reviewers are encouraged to provide authentic responses to the questions. In general, the survey collects your perception of the effectiveness of the product in assisting its target audience in identifying weaknesses in their knowledge of a fundamental vocabulary of visual literacy. By contributing to the potential revision of the product, the insights of the reviewers benefit the target audience of the product, the field of instructional design, and visual literacy assessment research.

Once your feedback is submitted through the survey, it will be analyzed by the researcher, guide the revision of the product, and reported in the research paper.

The review survey can be found here. The password has been shared with the reviewers.

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Appendix C: Pilot Tester Recruitment Letter

Mingyu Li
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Blacksburg, VA 24060
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Dear xxx,

I hope this email finds you well.

My name is Mingyu Li, a doctoral candidate in the Instructional Design and Technology program at Virginia Polytechnic Institute and State University. In completing one of the two manuscripts for my doctoral dissertation, I am writing to invite you to test or experience a product designed and developed for instructional designers, particularly those new to visual literacy or who have not intentionally developed their visual skills, to assess their knowledge of a fundamental vocabulary of visual literacy. In designing and developing such a product, this study echoes the call for visual literacy assessment research and addresses the reality that there is a lack of evidence validating instructional designers' visual literacy abilities despite them being expected to be visually literate by the job market.

As a member of the audience the product targets, you are invited to test or experience the product. Your participation will be voluntary and anonymous. If you would like to know more about the study or are interested in participating as a pilot tester, please feel free to reply to this email. Pilot testers who agree to participate in the study will receive a pilot test package that includes an introduction, a link to the product, a link to an electronic pilot test survey, and other materials. **The review process should take around one hour.** Your responses to the assessment product and the assessment results will be displayed by the product only to yourself. Participants' responses to the survey questions will be analyzed, reported in the dissertation, and guide the revision of the product. Meanwhile, demographic data or identifiers will not be collected by the review survey. Please also note that your participation in this study does not count as credit hours or credit points towards any course you are or will be taking at any institution.

Thank you in advance for your time and consideration.

Sincerely,
Mingyu Li

Appendix D: Pilot Test Package

Pilot Test Package

Mingyu Li

Virginia Polytechnic Institute and State University

Note. This package complements *Creating a Product for Instructional Designers to Assess Their Knowledge of a Fundamental Vocabulary of Visual Literacy: A Design and Development Study* by Mingyu Li. It shall only be used by pilot testers who have agreed to participate in the research study.

Documents Enclosed

Introduction

Overview

This pilot test package supplements the second manuscript of a dissertation effort by Mingyu Li, a doctoral candidate in the program of Instructional Design and Technology at Virginia Polytechnic Institute and State University. The manuscript, *Creating a Product for Instructional Designers to Assess Their Knowledge of a Fundamental Vocabulary of Visual Literacy: A Design and Development Study*, echoes the call for visual literacy assessment research and addresses the reality that there is a lack of evidence validating instructional designers' visual literacy despite them being expected to be visually literate by the job market. By allowing instructional designers, especially those new to visual literacy or who have not intentionally developed their visual skills, to assess their knowledge of a fundamental vocabulary of visual literacy, this product assists its audience in identifying specific terms and concepts that they are not familiar with, which directs future visual literacy learning and training.

Navigate the Package

As you have noticed, there are a few items in this package. This instruction provides you with brief background information on the study and the package itself. The following section contains a link to the product itself with instructions. Then, a link that directs to an electronic survey is provided. The package finally presents a flow map of the product delineates the overarching structure of the product, which can be used as a reference as you provide feedback using the survey.

The Product

If you have not reviewed the *Introduction* on the previous page, you are recommended to scan through it first. It presents a general introduction to the study and the product and instructions on navigating this package.

If you have reviewed the earlier content, please use this link or scan the QR code below to experience the product. Please note that you are recommended to experience the product in one sitting and a quiet environment free from distractions. You might also want to document the time you spent on completing the assessment. Meanwhile, paper and a pencil or other forms of notetaking should be available so that any immediate responses, observations, comments, or suggestions can be easily recorded as you experience the product.

Figure 1
A QR Code of the Product

Upon completing experiencing the product, you should access the electronic survey linked on the following page of this package. This survey will only record your responses to the questions but not any information related to your identity. Your responses will be analyzed and reported in the research paper. They will also guide the revision of the product.

The Pilot Test Survey

As previously stated, this survey will only record your responses to the questions. Any information related to your identity will not be documented, meaning the researcher himself will not be able to identify the respondent. You are encouraged to provide authentic responses to the questions. In general, the survey collects your perception of the usability and effectiveness of the product in assisting its target audience in identifying weaknesses in their knowledge of a fundamental vocabulary of visual literacy. You may use the flow map on the following page as a reference when answering the survey questions. By experiencing the product as one of the target users and based on which contributing feedback regarding the usability and effectiveness of the product, you assist the researcher in revising the product and therefore benefiting fellow instructional designers.

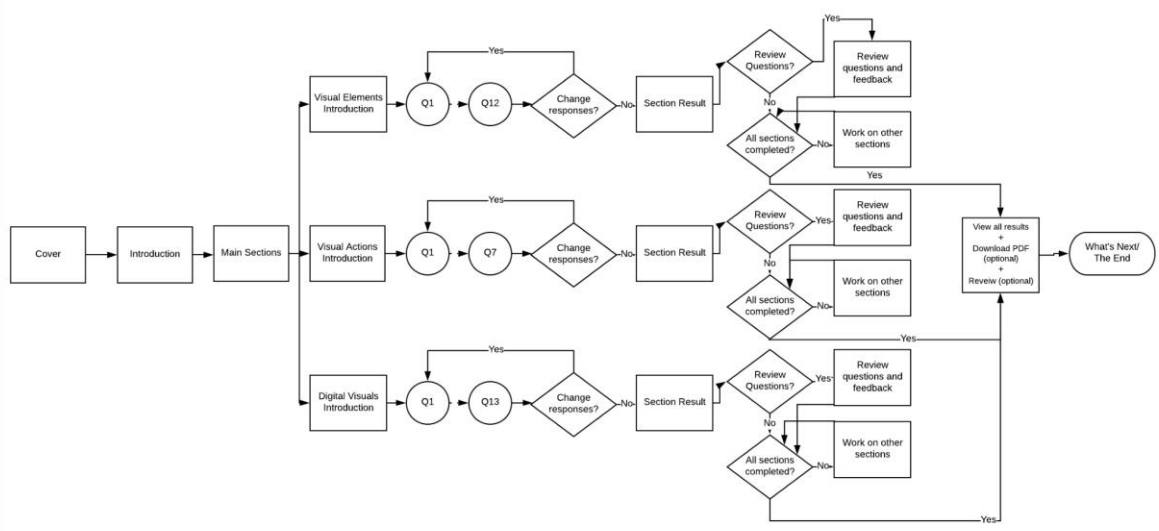
Once your feedback is submitted through the survey, it will be analyzed by the researcher, guide the revision of the product, and reported in the research paper.

The pilot test survey can be found here. The password has been shared with the participants.

A Flow Map of the Product

You may use the following flow map as a reference when answering questions in the survey linked on the previous page.

Figure 2
A Flow Map of the Product from the Perspective of the Assessment Designer



Appendix E: Product Introduction Page

(Note. The following content is displayed on the second slide of the product.)

INTRODUCTION

Note: scroll down to view more content.

What is this assessment?

This product, A Fundamental Vocabulary of Visual Literacy: An Assessment, was designed and developed by Mingyu Li as part of his doctoral dissertation study on visual literacy assessment. It assesses the knowledge of a fundamental vocabulary of visual literacy. The terms and concepts included here were identified from several books on visual communication and visual literacy and categorized into three groups, visual elements, visual actions, and digital media.

Who is it for?

The assessment targets instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, to assess their knowledge of a fundamental vocabulary of visual literacy.

What is the purpose of this product?

According to Instructional Design job studies and reports from practicing instructional designers, instructional designers are expected to have a certain level of visual literacy. However, some evidence suggested that their visual skills were not particularly strong, although some perceived themselves to be proficient in communicating using visuals. Additionally, questions remain about how and how well visual literacy related instructions are being implemented in instructional design programs. Therefore, this product is provided for designers to assess or diagnose their knowledge of the most fundamental aspect of visual literacy, i.e., knowledge of a fundamental vocabulary of visual literacy. After identifying specific terms and concepts that you are relatively unfamiliar with, we recommend further directed study to strengthen your visual literacy and become a more effective visual decoder and encoder. efficient visual decoder and encoder.

How to navigate this product?

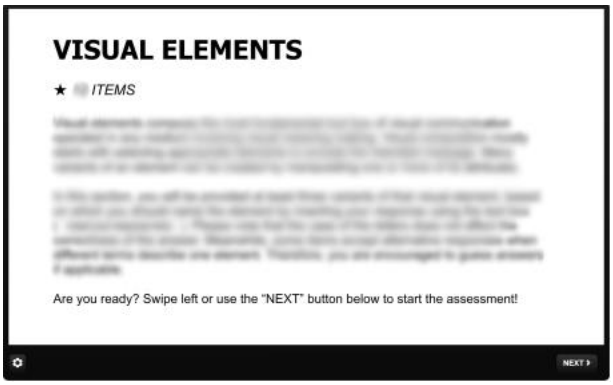
You may choose to skip the content below, as these directions will be provided throughout the assessment as needed. However, reviewing them now helps you grasp the flow of the assessment.

Mostly, you should use the “<PREV” and “NEXT>” buttons located at the bottom of this player (iPad and certain mobile devices users may use the “<” and “>” buttons either on the side or at the bottom of the player) to navigate the assessment. When the buttons are hidden, instructions for navigation will be provided on the main screen. Additionally, whenever you see a scroll bar

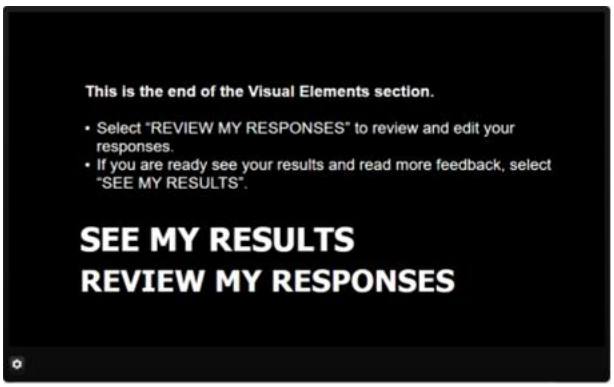
to the right side of the screen (see the scroll bar on the right), you can scroll down and up to view more content.

You are now on the Introduction slide of this product. By swiping left on a touch screen or pressing the “NEXT>” below, you will be directed to the main sections slide where the three sections of assessment items are linked (see the image below).

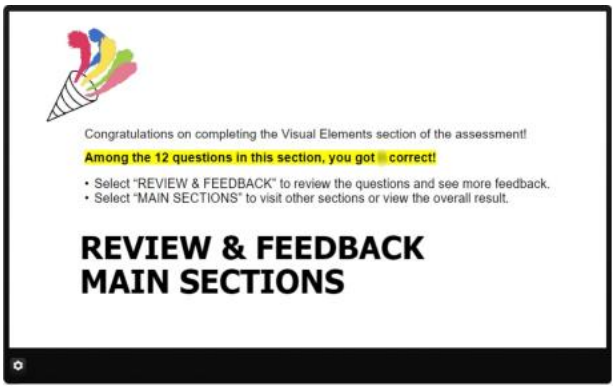
While there is no particular order, you are recommended to start from ”VISUAL ELEMENTS” and work your way down. After completing all three sections, the ”VIEW ALL MY RESULTS” will show you your total number of correct responses. A PDF compilation explaining the terms will also be available.



You will provide a response to each item in that section by inserting your answer into the text box that looks like this “ Insert your response here ”. Please note that the case of the letters won’t affect the correctness of your response. Also, the text box alerts potential typos using a red underline, which is similar to typing in Microsoft Word. Also, there is no time limit to complete the sections.

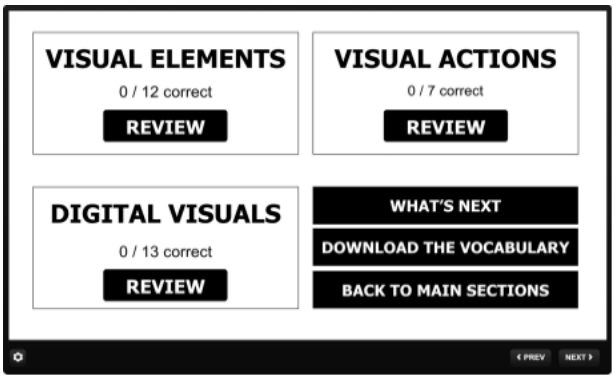


Once all the items in a section are completed, you will see the end-of-section slide where you can choose to see your results or go back to change your answers.



Then, after selecting "SEE MY RESULTS", you will see the congratulations page where the number of correct responses is provided. "REVIEW & FEEDBACK" will allow you to review individual items and see a more detailed explanation of the concepts. However, you can select "MAIN SECTIONS" to go to other sections for now. Once you complete all the sections, you have the option to review each section as well.

When reviewing your results, you will see whether an individual response is correct or not as well as an option to see more feedback that will take you to a new slide where the term is explained. Then, you can use the "<PREV" button to go back to the question and advance to the rest of the questions to review the results.



Once all three sections are completed, click on "VIEW ALL MY RESULTS" from the main sections slide to see a summary of all your results. A PDF compilation of all the terms and concepts assessed by this product will be available for downloading there. Additionally, another button named "What's Next" will provide information on what to do with the assessment results, recommendations for the future, and external resources on visual literacy learning.

This is the end of the introduction slide. Are you ready to get to know more about the fundamental vocabulary of visual literacy? Swipe left or use the "NEXT>" button below to see the main sections slide.

Appendix F: A Downloadable Compilation of the Vocabulary

A Compilation of the Terms and Concepts Comprising

the Fundamental Vocabulary of Visual Literacy

Mingyu Li

Virginia Polytechnic Institute and Sate University

Note: This document complements "A Fundamental Vocabulary of Visual Literacy: An Assessment" by Mingyu Li. The content in this document, including the images, the text, and everything else shall not be reprinted without permission. Questions and comments should be directed to Mingyu Li, minggbt@vt.edu.

Visual Elements & Selected Supporting Terms

Dot/Point

It is the smallest, simplest, irreducible unit of any visual. A dot is usually circular in shape, but not necessarily perfectly round. Dots can suggest other visuals, such as shapes, textures, and many other complex visuals. Dots also have personalities. For example, fuzzy dots tend to indicate excitement, whereas perfectly rounded dots are calm and stable.

I-A typical perfectly rounded dot. II-Variances of a fuzzy dot. III-A triangle (shape) suggested by a group of dots.

I II III

Line

A line can be thought of as a chain of dense and indistinguishable dots. Lines can be curved or straight, thick or thin, short or long. Lines can be implied by separate but closely placed dots or other visual segments. Lines can also indicate direction. Similar to dots, lines can be arranged and manipulated to imply other visuals and invoke personalities.

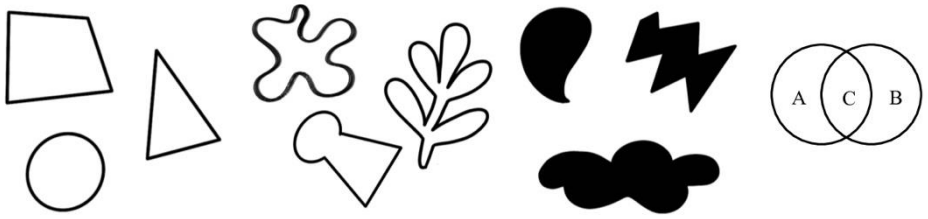
I-Variants of a straight line. All three suggest directions. II-Curves and straight lines with various thicknesses. III-An arrangement of lines that implies a shape.

I II III

Shape

A shape can be formed when a line returns to itself, defined by the contour of an object, or by a contrast of value, color, and many other elements. Shapes come in many variations, such as geometric shapes and organic shapes. Shapes are often used in graphs and charts to show relationships and/or processes.

I-Geometric shapes. II-Organic shapes. III-Shapes defined by filled areas. IV-Shapes used to indicate qualitative relationships, i.e., C is part of both A and B.

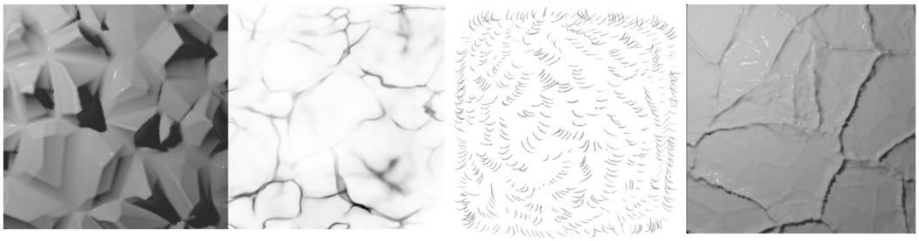


I II III IV

Texture

Texture refers to the actual or simulated surface quality of an object and often can be perceived by see, touch, or a combination of the two. Adjectives used to describe texture include smooth, bumpy, rough, hard, soft, etc. Texture can be used to fill a defined or abstract area to serve various purposes.

All the following four textures are implied using different visual techniques.

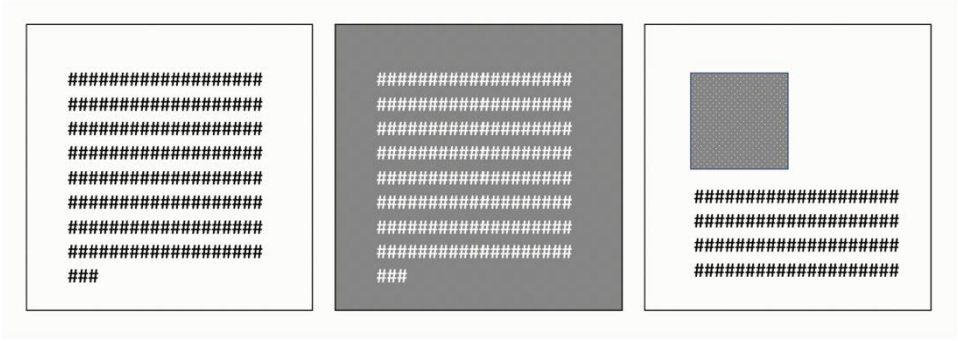


I II III IV

Space/White Space

Referred to as "white space" despite the actual color or texture of the area, space is an often-neglected visual element. It is frequently used to organize content and is critical to the overall balance of the design.

The blinking area in the following three squared frames represents the white space in the frames.

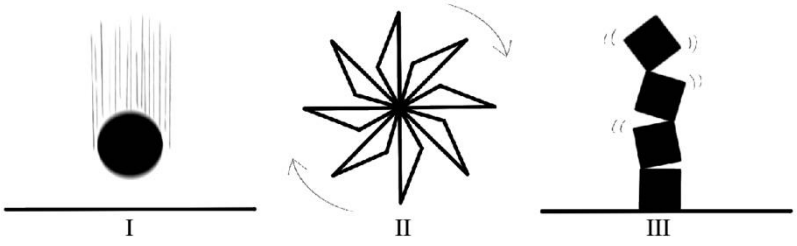


I II III

Motion/Movement

Movement or motion is often implied or suggested in a visual by manipulating other visual elements, such as lines and tones. Although it is often found in comic books, movement is widely used in instructional visuals, such as those used to teach physics concepts.

I-Movement is implied using lines and blurred visuals. II-Motion is implied using arrows. III. Motion is implied by the positioning of the squares and the short curved lines next to the squares.



I II III

Value/Tone

The value or tone of a color refers to the relative lightness or darkness in a color. A difference in value creates contrast, although it is not the only factor in determining the strength of contrast. Meanwhile, value influences the personality of a design. Light tones indicate a sense of softness, while dark tones evoke strength.

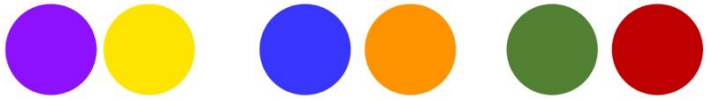
I-The second row shows the values corresponding to the colors in the first row. II-A big difference in value creates a strong contrast. III-Light tones on the right look softer than the tones on the left.

I II III

Complementary Colors

Colors that are directly opposite each other on the color wheel are known as complementary colors. They are used to create contrast, which makes the design dynamic and make certain objects stand out when used appropriately and purposefully.

I, II, and III are three pairs of complementary colors.



I II III

Analogous Colors

Analogous colors are those that are right next to a given color on the color wheel. They are easy on the eyes and create a seamless flow when used together.

I, II, and III are three groups of analogous colors.

I II III

Monochromatic Colors

Monochromatic colors are those of a given color mixed with different levels of black or white. A monochromatic color theme can create a sense of unity and harmony. Meanwhile, because monochromatic colors are produced from one given color but of different values, they can be used to create hierarchy and serve other roles.

I-Three groups of monochromatic colors. II-The letters appear to be in a hierarchy from left to right although their size and font are the same. The monochromatic colors applied to the characters made viewers perceive the hierarchy.

I II

Warm Colors

Warm colors are those that are commonly perceived by humans as being warm, such as red, yellow, and orange. The colors also share a physical quality in that they have relatively long wavelengths.

I, II, III are three examples of warm colors.

I II III

Cool/Cold Colors

Cool/Cold colors are those that evoke a sense of psychological or emotional coldness, such as blue, green, and purple. The wavelengths of these colors are relatively short.

I, II, III are three examples of cold or cool colors.

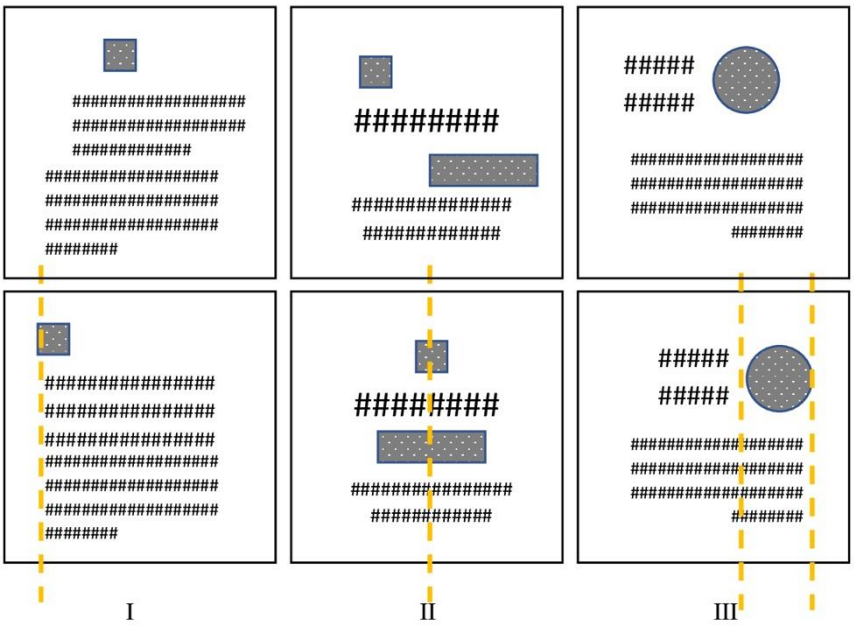
I II III

Visual Actions/Techniques/Arrangement

Alignment

This technique emphasizes that no visual piece should be randomly placed on a design. Instead, the objects should be organized so one or more invisible lines can be easily perceived by the human eye. The most common types of alignment are left alignment, center alignment, and right alignment. We tend to perceive visual pieces that are aligned as related.

I, II, III are three groups of "before" and "after" the implementation of the alignment technique. I is left alignment. II is center alignment. III is right alignment.

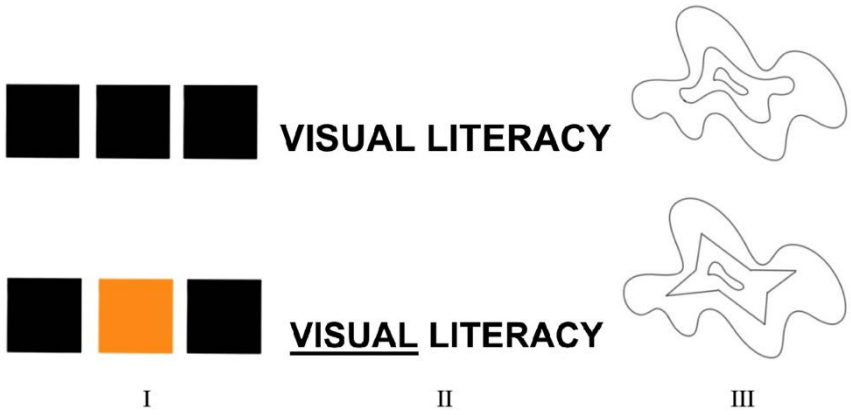


I II III

Contrast

The key to Contrast is to create visual differences by manipulating visual attributes of objects such as color, size, texture, etc. Contrast supports learning and training purposes in many ways, such as building a hierarchy, focusing attention, using visual contrast to indicate contrasting concepts, etc.

I, II, III are three groups of "before" and "after" the design action of contrast. As seen in the images, contrast is created by manipulating attributes of objects to make them look different. I-using color to create difference. II-using an underline to create contrast. III-changing one of the smooth shapes to a shape with sharp angles.



I II III

Repetition/Similarity/Consistency

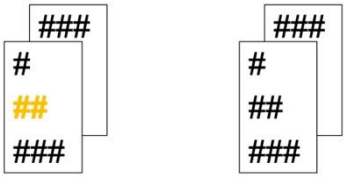
This visual action is employed to facilitate the mind in perceiving connections between pieces in a design by keeping some visual element or attribute of the pieces consistent. This technique is based on research on our visual perception. Specifically, we tend to perceive visually similar objects as being in a group.

I, II, III are three groups of "before" and "after" visuals of the technique of repetition. Similar to contrast, this technique is achieved by manipulating attributes of objects. However, the purpose here is to eliminate the difference so viewers would perceive the visually similar objects as being in one group. I-reserving the font style. II-removing the border of the middle square. III-keeping the font color consistent.

I

II

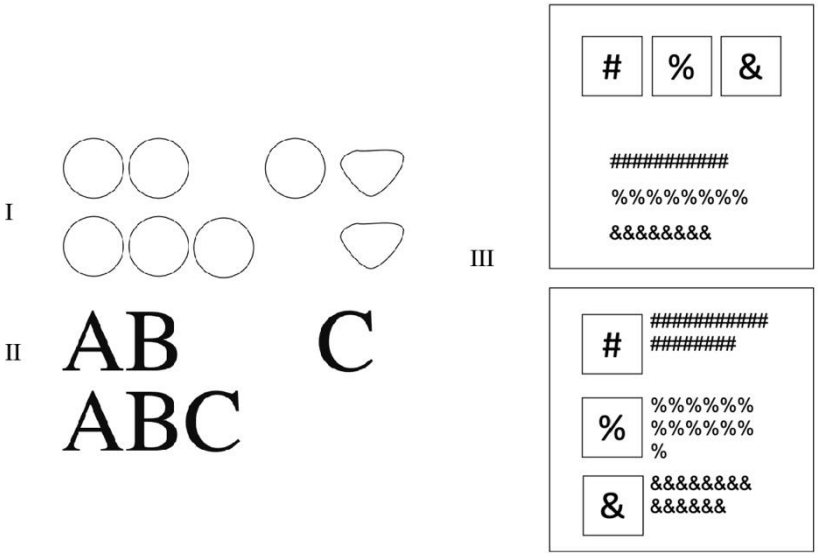
III



Proximity

This technique organizes information by placing related pieces close to each other to inform the viewer that they are connected. Conversely, when there is too much space between objects, it is likely that the viewer will question if they are connected even though they are inherently related.

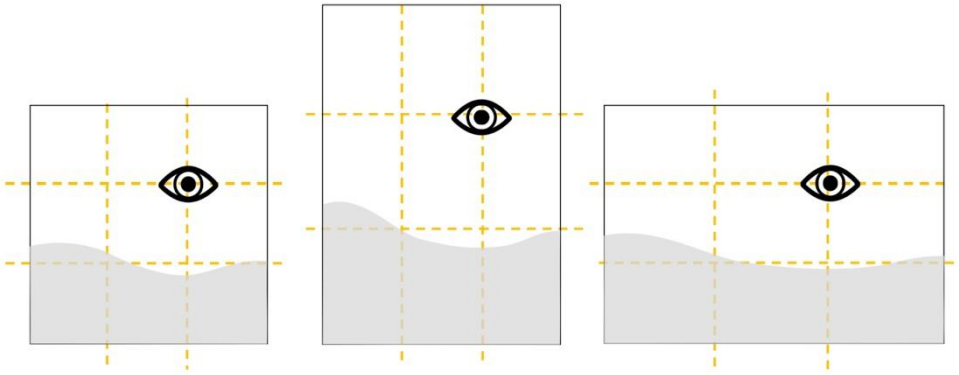
Below are three groups of "before" and "after" visuals demonstrating the technique of proximity. I-Placing the objects that are related closely to each other. II-By positioning C close to AB, viewers perceive ABC as being in one group. III-Placing the connected objects close to each other.



Rule of Thirds

The rule of thirds technique suggests placing the focal points of a design on or near the intersections of the imaginary horizontal and vertical lines that divide a frame into nine equal pieces.

I, II, III are three pages in different aspect ratios. The rule of thirds has been applied to all three to focus the attention of viewers on the eye shapes. The wavy shape at the bottom of the pages, roughly aligning with one of the horizontal lines, balances the frame as a whole.

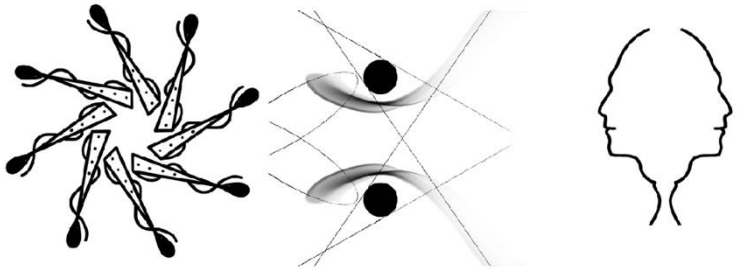


I II III

Symmetry

Symmetry is a good way to evoke a sense of balance. There are many types of symmetry. For example, bilateral or mirror symmetry indicates that objects on one side of a center line or axis is mirrored on the other side. Rotational symmetry or radial symmetry is achieved by rotating objects around a central axis.

II and III are two variants of mirror symmetry arrangement. I presents an example of rotational symmetry.



I II III

Perspective/Point of View

Perspective is a way of arranging objects in a 2D environment to suggest depth, distance, and proportion.

I, II, III are one group of objects arranged corresponding to three different perspectives (mainly horizontal differences).

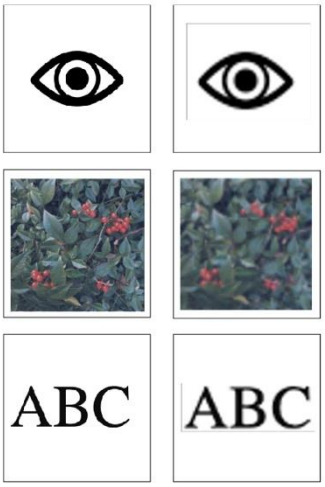
I II III

Foundational terms for Digital Visual Communication

Resolution

Resolution describes the degree of fineness, sharpness, or clarity of a digital image or a printed digital image. A high-resolution image is crisp, while an image in low-resolution is often referred to as "pixelated".

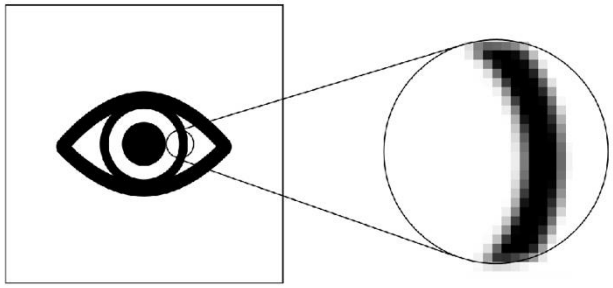
As indicated below, the resolution of the images in I is higher than that of II.



I II

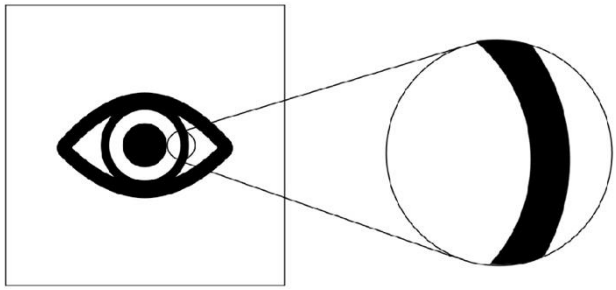
Raster/Bitmap Graphics

Images made up of pixels. When zoomed in to a certain degree, individual pixels or squares can be detected. Photos and scanned documents are typical raster graphics. Common bitmap graphics are in JPEG, GIF, BMP, etc.



Vector Graphics

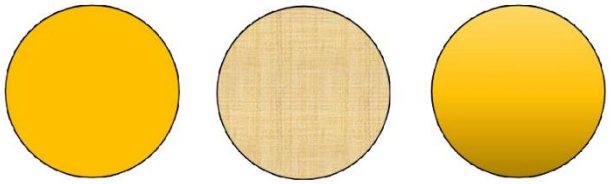
Vector graphics are formed by mathematical formulas and not resolution dependent. They can be precisely scaled without losing details or clarity. Common file types are AI, EPS, and SVG.



Fill

The space enclosed by a closed stroke or path that is assigned some kind of quality, such as color, gradient, or texture.

I-A solid color fill. II-A texture fill. III-A gradient fill.

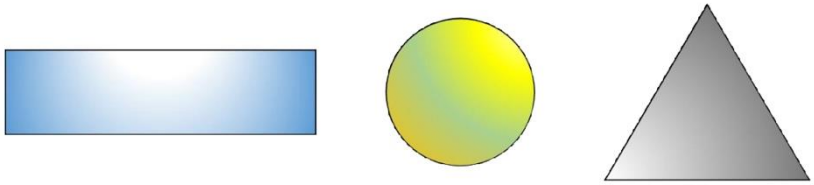


I II III

Gradient

A type of fill that shows gradual, usually smooth color or tonal change.

The following are three variants of gradients.



I II III

Font

Font is a collection of letters, numbers, special characters in a specific style. Font has personalities.

I-A relatively formal font. II-An energetic font because the characters appear to be stretched vertically. III-A playful font.

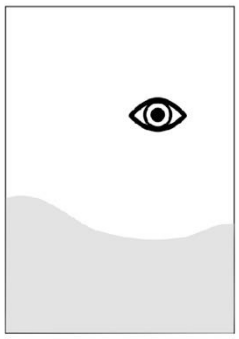
I A1$

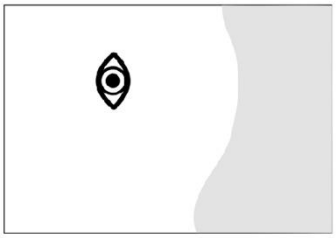
II A1$

III A1$

Orientation

General direction of visual pieces or the entire page design. The orientation of a page design is usually either horizontal or vertical.





Serif

A type of font that contains serifs, which is a short line or wedge shape attached to the letter, number, or character. This type of font is associated with a classical feeling. Meanwhile, when the size of the text is relatively small, a serif font is not recommended for digital text display.

A N & $ 7 2

Sans Serif

Contrary to serifed font, a sans serifed font does not contain the short line or wedge shape. This type of font is often perceived as being modern. Meanwhile, it is a better choice for displaying small or regular-sized text on a digital screen.

A N & $ 7 2

Leading/Line Spacing

Leading or line spacing is the vertical space between lines of text, which impacts the readability of the text. Also, since leading interferes with our perception of the white space on a page, it influences the viewers' perception of the balance in the design.

Instructional Design is

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xxxxxxxxxxxxxxxxxxx

Instructional Design is

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xxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxx

Kerning

Kerning is the horizontal space between individual letters or characters of a word. Similar to leading, kerning impacts the readability of text. Meanwhile, kerning can communicate emotions. For example, when the value of kerning is overly small (see the first row of text below), the crowded visual can evoke a sense of stress. Conversely, when the value of kerning is inappropriately big, it could be difficult to read for many and therefore creates negative emotions.

VISUAL LITERACY

VISUAL LITERACY

VISUAL LITERACY

RGB

A type of color mode used for digital display. The colors are made from red, green, and blue. An example code of a RGB color is: 134, 31, 65

R G B. RGB code: 134, 31, 65

CMYK

A type of color mode typically used for print. When you notice the printed colors are different from how they look on the screen, it means CMYK is not selected as the color mode for your digital design. The colors are mixed from cyan, magenta, yellow, and key/black. An example code of a CMYK color is: 15, 100, 37, 45

C M Y K CMYK code: 15, 100, 37, 45

Appendix G: The "What's Next" Page

(Note. The following content is displayed on the last slide of the product.)

WHAT'S NEXT

Note: scroll down to view more content.

As revealed at the beginning of this assessment, the purpose of this product is to help instructional designers, particularly those who have yet to receive formal education or training in visual literacy or a related area of study, identify the terms and concepts in the fundamental vocabulary of visual literacy with which they are familiar and those with which they are less familiar. I hope that the results of the assessment have informed you of your strengths and weaknesses regarding your knowledge of the visual literacy vocabulary.

Now what?

Well, to start, the terms and concepts are further discussed on the additional feedback slides, which can be accessed as you review individual items. If you have not already done so, please feel free to go to the previous slide and access each of the "REVIEW" buttons. Also, a compilation of all the terms and concepts can be found and downloaded on the previous slide. You are recommended to pay particular attention to those terms and concepts that did not match your responses. Since these terms and concepts denote the most fundamental knowledge of a visually literate individual, as an instructional designer or aspiring instructional designer who is expected to communicate effectively using the visual form, you may purposefully pursue further visual literacy training and learning based on the results of this assessment. For example, if your responses did not match many of the concepts in the Visual Actions section, you may emphasize your learning of visual actions, techniques, or principles.

That said, keep in mind that this product only assesses whether you can name the term or concept being portrayed in the visuals with the assistance of various cues, such as the verbal cues in each item. Dealing with visuals, especially in the workplace where instructional designers are often expected to play a variety of roles, does not stop at recognizing terms and concepts, but involves more complex and advanced interactions with visuals, such as applying the visual actions or techniques in specific contexts for unique purposes and evaluating visual messages.

Therefore, in the long run, I recommend that you not only study the terms and concepts, but also pursue a broader spectrum of visual literacy topics and interests. The Association of College and Research Libraries (ACRL) provides an example set of standards for higher education visual literacy competencies that emphasize skills related to visual decoding and encoding from an information literacy perspective. As can be seen in the following list, the standards address visual information retrieval and ethical use of visuals, which is not commonly found in other lists:

- Determine the nature and extent of the visual materials needed
- Find and access needed images and visual media effectively and efficiently
- Interpret and analyze the meanings of images and visual media

- Evaluate images and their sources
- Use images and visual media effectively
- Design and create meaningful images and visual media
- Understand many of the ethical, legal, social, and economic issues surrounding the creation and use of images and visual media, and access and use visual materials ethically

(The Visual Literacy Standards Task Force, 2012)

It is worth noting that while some of the above competencies might be better suited to your job as an instructional design professional than others, or there are other visual competencies not listed here, the list provides several general directions or content domains for you to consider. Most importantly, if you have not already, you should begin decoding and encoding visuals for professional and intentionally and carefully developing your visual literacy skills.

The following books are great resources to begin this journey. Some of these concern general visual communication, while others emphasize visual literacy in instructional design and learning.

Curtiss, D. (1987). *Introduction to visual literacy: A guide to the visual arts and communication*. Prentice-Hall.
Clark, R. C., & Lyons, C. C. (2011). *Graphics for learning: Proven guidelines for planning, designing, and evaluating visuals in training materials* (2nd ed.). Pfeiffer.
Dondis, D. A. (1973). *A primer of visual literacy*. MIT Press.
Hagen, R., & Golombisky, K. (2017). *White space is not your enemy: A beginner's guide to communicating visually through graphic, web & multimedia design* (3rd ed.). CRC Press. https://doi.org/10.1201/b22218
Lohr, L. (2008). *Creating graphics for learning and performance: Lessons in visual literacy* (2nd ed.). Pearson/Merrill/Prentice Hall.
Williams, R. (2015). *The non-designer's design book: Design and typographic principles for the visual novice* (4th ed.). Peachpit Press.

This is the end of the product. Questions, comments, and suggestions about this assessment product or visual literacy in general should be directed to Mingyu (Ming) Li, minggbt@vt.edu. Thank you!

Reference: The Visual Literacy Standards Task Force. (2012). Visual literacy competency standards for higher education: Approved by the ACRL Board of Directors, October 2011. *College & Research Libraries News, 73*(2), 97-104. https://doi.org/10.5860/crln.73.2.8709

Appendix H: Expert Review Survey

(The original survey was created and distributed using Qualtrics. It was protected by a password.)

Expert Review Survey | An Assessment of A Fundamental Vocabulary of Visual Literacy

Q1 Please indicate the degree to which you agree that a fundamental vocabulary of visual literacy is well represented by the three categories assessed by the product, including Visual Elements, Visual Actions, and Digital Visuals.

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree or disagree
- ○ Agree
- ○ Strongly agree

Display This Question:
If Q1 = Strongly disagree
Or Q1 = Disagree
Or Q1 = Neither agree or disagree

Q1.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q2 Please indicate the degree to which you agree that the terms and concepts of each of the following categories are a good representation of that category.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Category: Visual Elements	○	○	○	○	○
Category: Visual Actions	○	○	○	○	○
Category: Digital Visuals	○	○	○	○	○

Display This Question:

If Q2 = Strongly disagree

Or Q2 = Disagree

Or Q2 = Neither agree nor disagree

Q2.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q3 Please indicate the degree to which you agree that the verbal and/or visual cues in the assessment items align with the following components of the performance objective or indicator for **verbal information**.

Verbal information: *Given a combination of written and visual descriptions of the term, students will name the term.*

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Condition: Given a combination of written and visual description of the term	○	○	○	○	○
Behavior: Name the term	○	○	○	○	○

Display This Question:

If Q3 = Strongly disagree

Or Q3 = Disagree

Or Q3 = Neither agree nor disagree

Q3.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q4 Please indicate the degree to which you agree that the verbal and/or visual cues in the assessment items align with the following components of the performance objective or indicator for **defined concept**.

Concrete Concept: *Given at least three varied visual instances of the concept, students will name the concept.*

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Condition: Given at least three varied visual instances of the concept	○	○	○	○	○
Behavior: Name the term	○	○	○	○	○

Display This Question:

If Q4 = Strongly disagree

Or Q4 = Disagree

Or Q4 = Neither agree nor disagree

Q4.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q5 Please indicate the degree to which you agree that the verbal and/or visual cues in the assessment items align with the following components of the performance objective or indicator for **defined concept**. ***Defined Concept:*** *Given at least three varied visual instances of the concept and minimum verbal cues, students will name the concept.*

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Condition: Given at least three varied visual instances of the concept and minimum verbal cues	○	○	○	○	○
Behavior: Name the term	○	○	○	○	○

Display This Question:

If Q5 = Strongly disagree

Or Q5 = Disagree

Or Q5 = Neither agree nor disagree

Q5.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q6 Please indicate the degree to which you agree that the visual and verbal cues in each assessment item describe the term or concept as intended.

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

Display This Question:

If Q6 = Strongly disagree

Or Q6 = Disagree

Or Q6 = Neither agree nor disagree

Q6.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q7 Please indicate the degree to which you agree that the amount of verbal cues in this product assessing visual knowledge is appropriate.

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

Display This Question:

If Q7 = Strongly disagree

Or Q7 = Disagree

Or Q7 = Neither agree nor disagree

Q7.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q8 Please indicate the degree to which you agree that the additional feedback, i.e., explanations of the terms and concepts and suggestions on future directed learning and training, is appropriate and adequate.

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree nor disagree
- ○ Agree
- ○ Strongly agree

Display This Question:

If Q8 = Strongly disagree

Or Q8 = Disagree

Or Q8 = Neither agree nor disagree

Q8.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q9 Please indicate the degree to which you agree with the following statements regarding the directions provided in the product.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The directions about the assessment aspect of the product, such as explaining the three sections or categories, are sufficient and clear.	○	○	○	○	○
The directions about the product regarding the technology aspect, such as how to interact with the buttons, are sufficient and clear.	○	○	○	○	○

Display This Question:

If Q9 = Strongly disagree

Or Q9 = Disagree

Or Q9 = Neither agree nor disagree

Q9.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

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Q10 Please indicate the degree to which you agree with the following statements regarding the results of this assessment product.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
They reflect the knowledge of a fundamental vocabulary of visual literacy of the assessees.	○	○	○	○	○
They direct targeted visual literacy learning or training for the assesses.	○	○	○	○	○
They provide insights for curriculum redesign or adjustment for instructional design programs.	○	○	○	○	○

Display This Question:

If Q10 = Strongly disagree

Or Q10 = Disagree

Or Q10 = Neither agree nor disagree

Q10.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product design and development or the product itself made you select that option?

Q11 Based on your understanding of the analysis, design and development of this product and the product itself, what are your thoughts or comments on the future directions of this product or a potential continuing research effort related to the product?

Q12 Please feel free to share any additional thoughts, comments, observations, or suggestions here.

Appendix I: Pilot Test Survey

(The original survey was created and distributed using Qualtrics. It was protected by a password.)

Pilot Test Survey | An Assessment of A Fundamental Vocabulary of Visual Literacy

Q1 Please indicate the device you used to access and experience the product by selecting one of the following options.

- ○ Laptop
- ○ iPad or other tablets
- ○ Smartphone
- ○ Others (Please specify using the textbox below) _____

Q2 Please indicate the browser you used to access and experience the product by selecting one of the following options.

- ○ Google Chrome
- ○ Firefox
- ○ Safari
- ○ Brave
- ○ Others (Please specify using the textbox below) _____

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Q3 Approximately how long did it take you to complete the assessment?

_____

Q4 Did you experience any lag in loading the product? If so, please be as specific as possible. For example, specify on which slide and which element on that slide was lagging. If not, please feel free to skip this question.

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Q5 Have you noticed any errors or improprieties in the language used in the product, such as grammar, spelling, potential bias, etc.? If so, please specify. If not, please feel free to skip this question.

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Q6 Have you noticed any functional issues with the product, such as broken links, unresponsive buttons, mismatched content and buttons, etc.? If so, please specify. If not, please feel free to skip this question.

_____

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_____

Q7 Please indicate the degree to which you agree that the directions provided in the product regarding the following aspects are clear and sufficient.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Directions related to the technology aspect of the product, such as where to click/press and how to advance through the product.	○	○	○	○	○
Directions related to the assessment itself, such as the number of items in each section, the overall introduction to the assessment, directions on what to do next, etc.	○	○	○	○	○

Display This Question:

If Q7 = Strongly disagree

Or Q7 = Disagree

Or Q7 = Neither agree nor disagree

Q7.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product made you select that option?

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Q8 Would you agree that the descriptions of the sections/categories provided at the beginning of each section/category serve as cues for you? If you agree, could you specify in what way they helped you with the assessment? If not, please also try your best to specify why they did not serve you.

_____

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_____

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_____

Q9 Please indicate the degree to which you agree with the following statements regarding the assessment results you received.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
The results reflect fairly accurately my knowledge of the fundamental vocabulary of visual literacy.	○	○	○	○	○
The results direct future visual literacy training and learning for me.	○	○	○	○	○

Display This Question:

If Q9 = Strongly disagree

Or Q9 = Disagree

Or Q9 = Neither agree nor disagree

Q9.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product made you select that option?

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Q10 Please indicate the degree to which you agree that the additional feedback explaining the terms or concepts in detail, i.e., the feedback shown on the screen when you press "See More Feedback", helps you learn the terms and concepts that you did not answer correctly.

- ○ Strongly disagree
- ○ Disagree
- ○ Neither agree or disagree
- ○ Agree
- ○ Strongly Agree

Display This Question:

If Q10 = Strongly disagree

Or Q10 = Disagree

Or Q10 = Neither agree or disagree

Q10.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product made you select that option?

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Q11 Please indicate the degree to which you agree with the following statements regarding the content of the "What's Next" slide.

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
It helps me identify short-term visual literacy learning goals and objectives.	○	○	○	○	○
It helps me identify long-term visual literacy learning goals and objectives.	○	○	○	○	○
I plan to access some of the external resources provided on that slide.	○	○	○	○	○

Display This Question:

If Q11 = Strongly Disagree

Or Q11 = Disagree

Or Q11 = Neither agree nor disagree

Q11.1 You are seeing this question because you have selected "Strongly disagree", "Disagree", or "Neither agree to disagree" for the previous question, could you specify what aspect of the product made you select that option?

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Q12 Please feel free to share any additional thoughts, comments, observations, or suggestions here.

Appendix J: The IRB Decision Letter

Division of Scholarly Integrity and Research Compliance
Institutional Review Board
North End Center, Suite 4120 (MC 0497)
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-3732
irb@vt.edu
http://www.research.vt.edu/sirc/hrpp

MEMORANDUM

DATE: April 1, 2021

TO: Ken Potter, Mingyu Li

FROM: Virginia Tech Institutional Review Board (FWA00000572)

PROTOCOL TITLE: Creating a Product for Instructional Designers to Assess Their Knowledge of a Fundamental Vocabulary of Visual Literacy: A Design and Development Study

IRB NUMBER: **21-315**

Based on the submitted project description and items listed in the Special Instructions section found on Page 2, the Virginia Tech Human Research Protection Program (HRPP) has determined that the proposed activity is not research involving human subjects as defined by HHS and FDA regulations.

Further review and approval by the Virginia Tech Human Research Protection Program (HRPP) is not required because this is not human research. This determination applies only to the activities described in the submitted project description and does not apply should any changes be made. If changes are made you must immediately submit an Amendment to the HRPP for a new determination. Your amendment must include a description of the changes and you must upload all revised documents. At that time, the HRPP will review the submission activities to confirm the original "Not Research" decision or to advise if a new application must be made.

If there are additional undisclosed components that you feel merit a change in this initial determination, please contact our office for a consultation.

Please be aware that receiving a "Not Research" Determination is not the same as IRB review and approval of the activity. You are NOT to use IRB consent forms or templates for these activities. If you have any questions, please contact the Virginia Tech HRPP office at 540-231-3732 or irb@vt.edu.

PROTOCOL INFORMATION:

Determined As:	**Not Research**
Protocol Determination Date:	**April 1, 2021**

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.