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Identifying Key Domains and Criteria for the Assessment of K-12 Students' Digital Multimodal Composition
: A Literature Review

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I. Introduction

Digital multimodal composition (DMC) refers to composing practices related to digital texts that incorporate multiple modes of representation (e.g., written and oral language and visual, audio, tactile, gestural, and spatial representations) (Kalantzis, Cope, & Cloonan, 2010). Composing digital multimodal texts such as presentation slides, digital stories, book trailers, and games is becoming important to K-12 students and teachers in the 21st century (Lenhart, 2012; Miller & McVee, 2012; Purcell, Heaps, Buchanan, & Friedrich, 2013). Professional organizations of literacy educators including the National Council of Teachers of English (NCTE) and the International Literacy Association (ILA) and the Common Core State Standards (CCSS) also emphasize the importance of teaching critical analysis and production of various both print-based and digital texts using different modes (Boling & Spiezio, 2013; Dalton, 2012; NCTE, 2005; National Governors Association [NGA] Center for Best Practices, Council of Chief State School Officers [CCSSO], 2010). In spite of the ubiquity of DMC and growing importance of teaching it, many K-12 language arts teachers still put greater emphasis on formal writing (e.g., five-paragraph essays and papers) and are still less eager to integrate DMC into their classroom

teaching (Purcell et al., 2013). Lack of consensus on the content and methods of teaching and assessing DMC practices in schools is one of the barriers to DMC integration in schools (Miller & McVee, 2012; Smith, 2014; Zammit, 2014).

In particular, very little is known about evaluative domains and criteria that should be considered to assess K-12 students' DMC. The majority of studies on this topic have been conducted in the college composition field by discussing a few evaluative criteria such as coherence (Borton & Hout, 2007; Yancey, 2004) and rhetorical awareness (Burnett, Frazee, Hanggi, & Madden, 2014). Although there are a few studies discussing frameworks and metalanguages of DMC assessment in K-12 settings (Bearne, 2009; Eidman-Aadahl et al., 2013; Hicks, 2015; Levy & Kimber, 2009; McGrail & Behizadeh, 2017), the discussions are still theoretical, which calls on closer examination of possible domains and criteria to be used for actual assessments. Therefore, this study aims to identify key assessment domains and criteria representing the construct of DMC by conducting a systematic literature review. The following research question guides this work: *What are the key domains and criteria that can be systematically drawn from empirical studies in order to assess K-12 students' digital multimodal composition?*

II. Multimodality: A Conceptual Framework

Although writing some traditional print-based texts such as journal entries or picture books is also multimodal due to its communication of meaning through written language, visual images and layouts (Serafini, 2014), writing with digital tools such as the Internet and Web 2.0 tools is inherently multimodal because the digital environments allow people to have easy access to a variety of modes of representation and modal affordances, some of which are not supported in print-based environments (e.g., moving images and sound) (Jewitt & Price, 2012).

Multimodality is a broad concept indicating multiple layers: (a) the act of meaning-making using multiple modes (Kress & van Leeuwen, 2001), (b) the condition of an event or product involving multiple modes (Kress, 2003, 2010), or (c) a field of inquiry (Jewitt, 2014). Simply put, multimodality refers to almost everything related to meaning-making practices using several modes of representation such as oral, written, visual, audio, spatial, and gestural representation (Kalantzis et al., 2010).

Since there are different perspectives toward multimodality from a variety of disciplines and it is yet considered as "a field of application rather than a theory" (Jewitt, 2014, p. 2), choosing a specific approach to multimodality can limit our understanding of the concept. In acknowledging this, Jewitt (2014) introduces four theoretical assumptions that are universal for any theoretical perspective toward multimodality. The assumptions provide a useful lens through which to review the empirical studies on DMC assessment.

The first assumption emphasizes the importance of both linguistic and non-linguistic modes in multimodal ensembles as active conveyers of meaning. A mode is "a socially shaped and culturally given resource for making meaning. Image, writing, layout, music, gesture, speech, moving image, soundtrack are examples of modes" (Kress, 2014, p. 60). A multimodal ensemble is a multimodal text or artifact that conveys meaning through interrelated and co-presented modes. This assumption implies that only teaching and evaluating the affordances and meanings of language in students' DMCs is not adequate and that these students should also learn and be assessed on the affordances and meanings of the non-linguistic modes.

The second assumption is about a unique communicative purpose of each mode. This can be realized through modal resources, which means "potentials and constraints" (Bezemer & Kress, 2008, p. 172) of a mode when it is used to convey and represent meanings (Jewitt, 2014; Kress, 1993). With regard to the written language, the examples of its modal resources are words, sentences, punctuation,

spacing, and style, size, and color of font. (Bezemer & Kress, 2008; Kress, 2014). When composing multimodal texts with digital tools, selecting and utilizing modal resources can be constrained by the affordances of the digital tool. For example, the iMovie program is not appropriate to write an essay with several paragraphs in the *title* section because its affordance constrains written language to be used as a title, not a paragraph. On the contrary, iMovie supports some modal resources of written language such as font style (e.g., boldface and italic), font size and colors to highlight the written language in iMovie products. Therefore, any tools aiming to assess the multimodality of DMC should be able to assess the unique communicative purpose of each mode as well as affordances of digital tools.

The third assumption is related to the sign-maker's selection and configuration of modes. This means that even though all the people involved in DMC have exactly the same modal resources available to them, their resulting multimodal ensembles will be different due to their different selection and configuration of modes. When sign-makers select and combine modes in a multimodal ensemble, they consider both modal resources and the intersemiotic relationships—"meaning relations between the different semiotic systems such as writing and images that constitute a multimodal text" (Jewitt, 2014, p. 462).

The final assumption concerns the social aspects of meanings. When sign-makers create signs using multiple modes, they follow norms and rules that are consensual in that society. These norms and rules allow audiences to read or interpret the signs in context. That is, although sign-makers have their own intentions and interests when creating DMCs, the social conventions and principles related to the signs they are using should be considered part of that communication. With these four assumptions in mind, empirical studies on DMC assessment will be reviewed.

III. Methods

This section discusses the procedures of locating and analyzing relevant literature.

1. Locating literature

In order to locate relevant empirical studies on domains and criteria of DMC assessment, systematic searches were made of five different databases: Education Full Text, Education Resources Information Center (ERIC), Library and Information Science Abstracts (LISA), Linguistics and Language Behavior Abstracts (LLBA), and PsycINFO. Combined searches in Education Full Text using the search terms "multimodal composition" AND "assessment," "multimodal composing" AND "assessment," OR "digital writing" AND "assessment" yielded 44 publications. By reading the abstracts of each, eight relevant studies were identified. A search of the remaining four databases using the ProQuest search engine and using the same search terms and logic retrieved a further 86 empirical studies. Based on the information in the abstracts, 10 new relevant studies were added to the list. Reviewing the reference lists in the 18 studies and manual searches of book chapters added 26 more studies to the final list for a final total of 44 relevant papers in the prior literature.

2. Analyses of literature

Among the 44 papers identified in the literature, only one study systematically established the domains of DMC assessment (Eidman-Aadahl et al., 2013). Five domains—artifact, context, substance, process management and technique, and habits of mind—and their definitions were used as the *a priori* code for the categorization of criteria in this study.

For the first stage of the categorization, the remaining 43 studies were carefully reviewed to find relevant studies discussing evaluative criteria. After this process, only 18 studies remained on the list. Specifically, 10 studies (rubric literature) presented criteria in scoring rubrics for DMC (i.e., Borton & Hout, 2007; Brown, 2013; Burnett et al., 2014; Howell, Reinking, & Kaminski, 2015; Hung, Chiu, & Yeh, 2013; Husbye & Rust, 2014; Morain & Swarts, 2012; Ostenson, 2013; Towndrow, Nelson, & Yusuf, 2013; Vassilikopoulou, Retalis, Nezi, & Boloudakis, 2011), while the other eight studies (non-rubric literature) discussed one or more evaluative questions or criteria for DMC without presenting scoring rubrics (i.e., Adsanatham, 2012; Anderson, Atkins, Ball, Millar, Selfe, & Selfe, 2006; Levy & Kimber, 2009; Selfe & Selfe, 2008; Sorapure, 2006; Wierszewski, 2013; Yancey, 2004; Yu, 2014).

Next, Dinsmore, Alexander, and Loughlin's (2008) framework was applied to evaluate the definitional clarity of the concepts (Conradi, Jang, & McKenna, 2014). An explicit (E) code was assigned to a criterion if the author provided exact wording in the definition of each term, while an implicit (I) code was assigned if words, phrases, or references that alluded to the meaning of a criterion was used in the text, and, if no definition of the criterion was provided, an absent (A) code was assigned. Most criteria presented in scoring rubrics were categorized as explicitly clear concepts except for the ones in the rubric of Vassilikopoulou et al. (2011). Unlike other studies presenting their rubrics with clear definitions of criteria and descriptors of performance levels, the Vassilikopoulou et al. (2011) rubric listed only criteria without any explanations. For this reason, 16 criteria in this rubric were coded as absent. Implicit codes were assigned to 33 criteria presented in Adsanatham (2012), Anderson et al., (2006), Selfe and Selfe (2008), Wierszewski (2013) and Yancey (2004). In cases of Adsanatham (2012) and Anderson et al. (2006), evaluative criteria were mentioned in sentences without explicit definitions. On the other hand, Yancey's (2004) implicit definition of coherence provided a lot more information in its relationship with patterns: "Patterns

are one way to talk about coherence in digital texts. Another way to think about this patterning and how the pieces within a pattern connect … is to think in terms of weaving" (p. 90). To sum up, a total of 129 criteria were categorized into 80 explicit, 33 implicit, and 16 absent criteria. This resulted in the removal of the Adsanatham (2012); Anderson et al., (2006), and Vassilikopoulou et al. (2011) since they did not provide with enough information to be categorized through either explicit or implicit definitions of the criteria. Thus, a total of 111 criteria from 15 studies remained on the list.

In the final stage, the constant comparative method (Strauss & Corbin, 1998) was applied to group the criteria according to their different names and categorize them under appropriate domains. First, the definition of each domain was carefully considered, after which an explicit or implicit definition was determined. Wherever similarities were found among the definitions provided for different criteria, these were grouped together. This was an essential stage of the analytic process because scholars often used different terms to represent similar concepts. The explicit definitions of domains and examples provided by the Eidman-Aadahl et al., (2013) were then applied, and explicit or implicit definitions of criteria were categorized into individual groups. This constant comparison of the definitions of domains and criteria in some cases led to the renaming or relocation of certain criteria. Finally, the definitions of the criteria in each group were synthesized, and a new explicit definition assigned to each new criterion. Table 1 presents relationships among domains, new criteria, and original criteria in both the rubric and non-rubric literature, which were considered during the step-by-step analyses for the new criterion, *coherence of multimodal product*.

Table 1. Relationships among Domains, New Criteria and Original Criteria in Both the Rubric and Non-Rubric Literature

Domain 1: Artifact		
New Criterion	**Original Criteria in Rubric Literature**	**Original Criteria in Non-Rubric Literature**
Coherence of multimodal product	• Design for medium (Burnett et al., 2014) • Organization (Ostenson, 2013) • Organization & Coherence (Borton & Hout, 2007) • Physical design: Timing (Morain & Swarts, 2012)	• Coherence (Yancey, 2004) • Cohesion (Levy & Kimber, 2009) • Design for a print PSA (Selfe & Selfe, 2008) • Metaphor (Sorapure, 2006) • Metonymy (Sorapure, 2006) • Multimodality (Wierszewski, 2013) • Structure, organization, arrangement (Selfe & Selfe, 2008) • Use of modalities, media, and genre (Yu, 2014)

IV. Findings

As a result of the step-by-step analyses described in the methods section, the 111 criteria identified in the literature were reduced to 19 separate criteria. In this section, I will explain in detail the 19 new criteria categorized under the five existing domains.

1. Criteria for the Artifact Domain

The *artifact* domain is linked to a finished digital multimodal product. This finished product incorporates elements related to multiple modes such as message, structure, medium, and technique (Eidman-Aadahl et al., 2013). For the artifact domain, 10 criteria emerged: (a) multimodal coherence, (b) organization of content, (c) conventions of linguistic modes, (d) relational relevance of linguistic modes, (e-g) technical aspects of audio, visual, and spatial modes and (h-j) relational relevance of audio, visual, and spatial modes.

1) Multimodal coherence

This criterion is about the overall unity of a DMC. If a digital multimodal artifact consists of different modes that match, complement, or blend in with each other and the results of using mixed modes convey and support ideas and enhance the comprehensibility and usability of the artifact, it can be considered a highly coherent product. This criterion emerged from 13 different criteria, including coherence (Yancey, 2004), cohesion (Levy & Kimber, 2009), design for medium (Burnett et al., 2014), organization (Ostenson, 2013), and multimodality (Wierszewski, 2013). Although these 13 criteria were identified from different names in the literature, they were all defined in terms of the relationships between different modes for the evaluation of the unity of multimodal products. For example, Levy and Kimber (2009) explicitly defined the cohesion criterion as "the way in which the various elements of the text are drawn together to achieve unity" (p. 493). Although they used the term "cohesion," using "coherence" is more appropriate to indicate the overall quality of a digital multimodal artifact as a united whole.

2) Organization of content

The organization of content criterion denotes a logical structure of messages or content conveyed by a DMC. This definition was drawn from reviews of the following criteria: cognitive design-completeness (Morain & Swarts, 2012) and organization (Burnett et al, 2014; Wierszewski, 2013). The organization criterion of a programmatic rubric suggested by Burnett et al. (2014) covers definitions related to both the multimodal coherence criterion presented above and the organization criterion of traditional writing. Unlike the multimodal coherence criterion, which focuses on the relationships among modes, this criterion focuses on the connection between messages or content in different sections of a digital multimodal artifact. In a traditional writing assessment, the organization criterion targets the quality of connections between components of an essay such as the introduction,

body, and conclusion. In DMC, on the other hand, structures differ by their types or purposes. In this study, therefore, the organization of content criterion of DMC pays attention to the logical flow of messages conveyed by the artifact.

3) Conventions and relational relevance of linguistic modes

Linguistic modes included in digital multimodal artifacts are oral and written language. Preparing valid criteria for linguistic modes is crucial because different types of DMC, such as blog posts, presentation slides, and digital book reviews or trailers, still heavily rely on linguistic modes when they convey messages. A review of existing literature resulted in two criteria for linguistic modes: conventions and relational relevance. To be specific, most of the literature included criteria for linguistic modes that focused on English conventions such as grammar, mechanics, style, citation and genre (Borton & Hout, 2007; Burnett et al., 2014; Hung et al., 2013; Selfe & Selfe, 2008; Towndrow et al., 2013; Wierszewski, 2013; Yu, 2014). Among these studies, only Hung et al. (2013) attempted to consider the relationship between linguistic modes and other modes in a multimodal text. In order to put equal weight on both English conventions and the relationship between linguistic modes and other modes, I created two separate criteria under the linguistic mode: conventions and relational relevance.

4) Technical aspects and relational relevance of audio, visual, and spatial modes

Previous studies on evaluative criteria of DMC attended to two different spheres of audio, visual, and spatial modes: technical aspects and relational relevance. The former refers to the effects of modal resources and technical skills related to the mode on its quality. The latter intends to consider the relationship between one mode and the other modes in a multimodal text.

Technical aspects of the audio mode encompass voice elements (e.g., fluency, articulation, intonation, volume), sound elements (e.g.,

pitch, volume, length), and general editing techniques (e.g., handling noises, cuts, fades) (Brown, 2013; Hung et al., 2013; Morain & Swarts, 2012; Ostenson, 2013; Selfe & Selfe, 2008; Towndrow et al., 2013). Technical aspects of the visual mode include camera shots and angles, lighting, color, size, movement, and sequencing (Brown, 2013; Hung et al., 2013; Levy & Kimber, 2009; Morain & Swarts, 2012; Ostenson, 2013; Selfe & Selfe, 2008; Yu, 2014). Lastly, the spatial mode is assessed by consideration of technical aspects including layout, alignment of modes and margins (Hung et al., 2013; Wierszewski, 2013). It should be noted that the specific technical aspects of each mode could differ depending on the type of DMC. For example, if a student created a music video in iMovie using only static images, the shots and camera angles might not be relevant aspects for the music video since he or she did not use any camera recording techniques.

The purpose of establishing the relational relevance criterion of each mode is to closely examine the intersemiotic relationships between and among modes. As Jewitt's (2014) second and third assumptions on multimodality state, each mode in a multimodal ensemble plays a unique role in close connection with other modes. Evaluating only the overall coherence of digital multimodal texts cannot capture the unique contribution of each mode. In fact, evaluating relational relevance between the target mode and the other modes helps us assess the overall coherence in the end. Beginning the evaluation by grasping the meaning of the most dominant mode in the digital multimodal text is the most effective way of examining relational relevance. For example, if a student's digital report on his/her community relies heavily on images, meanings in each image should be listed first. Then the meanings of the visual mode need to be compared to the gist of the second dominant mode. If all or most of this one-to-one comparison shows a high relevance of meaning between modes, the digital multimodal artifact can be evaluated as a coherent one in general.

2. Criteria for the Context Domain

The *context* domain concerns purposes, audiences, and tasks surrounding the creation and circulation of the artifact (Eidman-Aadahl et al., 2013), which is emphasized by Jewitt's (2014) fourth assumption on the social aspects of meaning. This domain included two criteria: rhetorical awareness-task and rhetorical awareness-audience.

1) Rhetorical awareness-task

The rhetorical awareness-task criterion was developed from seven previous criteria, such as a mode of presentation (Borton & Hout, 2007), following the assignment and purpose (Wierszewski, 2013), physical design: accessibility (Morain & Swarts, 2012), rhetorical awareness (Burnett et al., 2014), rhetorical context (Selfe & Selfe, 2008), rhetorical knowledge (Yu, 2014). This criterion emphasizes the composer's consideration of DMC task environments such as purposes, genres, directions, and physical environments. In fact, rhetorical awareness-tasks and rhetorical awareness-audience are difficult to be separate. In some cases, directions for DMC tasks require composers to be aware of all rhetorical components, including audiences. For example, Burnett and colleagues (2014) define rhetorical awareness as a "response to situation, considering elements such as context, purpose, audience, and register" (p. 57). In this study, I purposefully separated the audience awareness component in order to underscore the importance of having real, virtual or interactive audiences for students who are composing digital multimodal texts (Baker, Rozendal, & Whitenack, 2000; McGrail & Behizadeh, 2017).

2) Rhetorical awareness-audience

The rhetorical awareness-audience criterion attends to the composer's consideration of explicit or implicit audiences and their engagement with the artifact. This new criterion was drawn from six criteria from existing literature, including the following items: audi-

ence (Wierszewski, 2013), engagement (Morain & Swarts, 2012), rhetorical awareness (Burnett et al., 2014), rhetorical context (Selfe & Selfe, 2008), rhetorical knowledge (Yu, 2014), and voice (Howell et al., 2013). For example, the engagement criterion included in Morain and Swarts's (2012) rubric was included here in order to supply the rhetorical awareness-audience criterion because it allows us to check if the video created by students is "designed to interest and motivate users" (p. 24) and if the goal is directly related to the consideration of audiences.

3. Criteria for the Substance Domain

According to Eidman-Aadahl et al. (2013), the *substance* domain "refers to the content and overall quality and significance of the ideas presented." Credibility, accuracy, and significance of information presented in the artifact are also evaluated with the criterion. While reviewing existing criteria about the substance domain, it was obvious that different communicative purposes such as to inform and to persuade influenced on the organization as well as quality of the content. Particularly, existing assessment criteria of DMCs that were composed for persuasive or argumentative purposes focused on the author's stance, opinion/arguments, and use of reasons/evidence. For these reasons, I identified two different criteria for this domain: the quality of ideas and quality of opinions/arguments.

1) Quality of ideas

This criterion was set to cover the goals of evaluating the quality of content in narrative or informative texts. Eleven existing criteria were categorized under the quality of ideas criterion: character analysis (Husbye & Rust, 2014), cognitive design: accuracy and pertinence (Morain & Swarts, 2012), content (Levy & Kimber, 2009; Towndrow et al., 2013; Yu, 2014), critical thinking skills (Borton & Hout, 2007), economy (Towndrow et al., 2013), interpretation (Husbye &

Rust, 2014), movement (Wierszewski, 2013), theme (Husbye & Rust, 2014); theme/point of view (Towndrow et al., 2013). Although most of these criteria aimed to evaluate the quality of content presented in the DMC, three criteria on Husbye and Rust's (2014) rubric, character analysis, interpretation, and theme, were targeted to check the student multimodal composers' understanding of these key narrative text components. On the other hand, Towndrow et al.'s (2013) three criteria—content, economy, and theme/point of view—were measuring the interest, uniqueness, depth, length, and focus of the DMC content.

2) Quality of opinions/arguments

As mentioned earlier, this criterion was separated from the quality of ideas in order to emphasize the persuasive purpose of DMC content. Two existing criteria were considered to comprise this criterion: ideas and organization (Howell et al., 2015), and stance and support: argument, evidence, and analysis (Burnett et al., 2014). For example, the ideas and organization criterion of Howell and colleagues (2015) evaluated the quality of the argument by considering the relationships between multiple modes.

4. Criteria for the Process Management and Technique Domain

The fourth domain, *process management and technique*, is related to technical and task management skills during the entire composing process of multimodal texts, from planning to composing to publishing. By reviewing existing literature, I identified three criteria: collaboration, technical skills, and writing processes and strategies.

1) Collaboration

The collaboration criterion was the only task management skill found in two studies (Howell et al., 2015; Yu, 2014). Although two examples are not enough to establish a new criterion, both defined

collaboration in a substantively similar way and so it can be considered an important aspect of DMC.

2) Technical skills

The technical skills criterion was created from previous criteria such as development of new literacies (Brown, 2013), *ICT usage* (Towndrow et al., 2013) and technical execution (Wierszewski, 2013), in order to refer to the composer's ability to use both print-based and digital media.

3) Writing processes and strategies

I set writing processes and strategies as an independent criterion encompassing writing process (Brown, 2013) and publication (Howell et al., 2015), both criteria from literature. Writing processes and strategies need to be taught and evaluated explicitly because engaging in various steps of the writing process, such as brainstorming, drafting, writing, image construction, revising, editing, and publishing, can facilitate seamless application of technical skills and collaboration.

5. Criteria for the Habits of Mind Domain

The final domain, *habits of mind*, included two criteria: creativity (Wierszewski, 2013; Yu, 2014) and self-efficacy (Morain & Swarts, 2012). While the definition of the domain listed several behavioral or attitudinal characteristics such as creativity, engagement, mindfulness, and risk-taking, self-efficacy was newly identified from Morain and Swarts (2012).

1) Creativity

The creativity criterion refers to the uniqueness and originality of the composer's ideas and of the ways used to convey meaning using multiple modes. This criterion was mentioned several times in non-rubric literature, and not included in the rubric literature. This

does not mean that creativity cannot be measured or is not important. Attempts to measure creativity in writing can be indeed found in the scholarship (e.g., Baer & McKool, 2009; Mozaffari, 2013). One feasible explanation is that a rubric may not be understood as an appropriate means of assessing the creativity of students' writing or DMC. More studies are needed to define creativity in DMC and how to assess them.

2) Self-efficacy

The other criterion, self-efficacy, indicates an individual's belief in self as a skilled and confident composer of digital multimodal texts. For example, two criteria from Morain and Swarts's (2012) rubric, confidence and self-efficacy, contained content related to the composer's belief in a knowledgeable and skilled self through the use of a confident and persuasive voice.

To sum up, a total of 19 distinguishable criteria were drawn by reviewing 111 criteria from existing non-rubric and rubric literature. These 19 criteria might not be the exhaustive components of the DMC as a construct. However, the 19 criteria provide us with an overview of DMC and with ideas for what to teach and what to assess. A table included in the appendix presents definitions of the 19 distinguishable criteria.

V. Discussion and Conclusion

This literature review synthesized empirical studies asseing DMC from Jewitt's (2014) four theoretical assumptions on multimodality in order to identify key domains and criteria for the assessment of K-12 students' DMCs in school settings.

Not surprisingly, almost half of the newly created criteria (n = 10) were categorized under the artifact domain. One possible reason for this preponderance of the domain is due to the complex layers of

meanings in digital multimodal artifacts. In other words, using three different modes (e.g., written language, visuals, and audio) for DMC means that the composer needs to consider maximum three relationships: written language × visuals; written language × audio; visual × audio. If a digital multimodal text includes one more mode, the maximum number of relationships to be considered is doubled. Another possible explanation about the big artifact domain is that existing literature may focus too much on the assessment of artifacts. In fact, most of the existing studies presented evaluative criteria in rubrics did not assess the processes and strategies of DMC except Brown (2013) and Howell et al. (2015). As Jewitt (2014) pointed out, however, assessing and observing the author's processes and strategies for multimodal composition is important in order to fully understand the author's intentional use of modes and their technical aspects (Bruce, 2009; Gilje, 2010, 2011; Ranker, 2008). Therefore, more evaluative criteria for writing processes and strategies need to be investigated in future studies.

There were four uncategorized criteria: One criterion was reading comprehension (Brown, 2013). Since the task presented in Brown's study was reading and writing graphic stories, the evaluative criterion on reading digital multimodal texts was essential. Admittedly, most writing or DMC practices accompany readings. However, assessing students' reading skills of digital multimodal texts is another huge sphere to be investigated. Consequently, the reading comprehension criterion was left to be uncategorized. Other three unassigned criteria were mood (Husbye & Rust, 2014), overall (Wierszewski, 2013), and style/tone (Yu, 2014), which were more related to aspects of print-based literary texts rather than the ones for digital multimodal texts.

In conclusion, this review of the literature provides a comprehensive list of criteria of DMC assessment, which can be used to develop assessment tools for specific DMC tasks. Even though the domains and criteria were obtained through the systematic procedures, this review still has two limitations. First, about half of the studies re-

viewed in this paper investigated or speculated the assessment criteria devised for college composition classes. This means that using these criteria in K-12 settings call extra caution. Second, the criteria of DMC assessment only inform the components to be assessed. Actual assessment of those criteria requires a lot of future works. For example, specific instructional units or assessment tools of DMC should be developed with the consideration of the following components: students' and teachers' literacy and technical knowledge and skills, possible technical resources in schools, and available time for DMC education.

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ABSTRACT

Identifying Key Domains and Criteria for the Assessment of K-12 Students' Digital Multimodal Composition

: A Literature Review

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The study systemically reviewed empirical studies on the assessment of digital multimodal composition (DMC) and identified key domains and criteria for the assessment of K-12 students' DMC. Based on the concept of multimodality and universal theoretical assumptions on it (Jewitt, 2014), this study argued that assessment tools of DMC should consider both linguistic and non-linguistic modes, their unique communicative roles, relationships between modes, and social norms and conventions about signs. The multi-step analyses drew 19 distinguishable criteria from 111 criteria presented in 15 relevant studies. The findings section defined new criteria and described how they are related to the *a priori* domains and the existing criteria. This literature review contributes to the field by providing a comprehensive list of criteria for DMC teaching and assessment. Limitations of the study and suggestions for future studies were also discussed.

KEYWORDS Multimodality, Digital multimodal composition, Multimodal assessment, Domains and criteria of literacy assessment, Literature review

APPENDIX

Finalized Domains and Criteria of Digital Multimodal Composition Assessment

Domain 1: Artifact "is the finished product. Audiences expect artifacts to convey a coherent message with a clear focus created through an appropriate use of structure, medium, and technique. Artifacts incorporate elements from multiple modes, and are often digital, but do not have to be—they may be analog works (e.g., texts that incorporate both writing and drawing)" (Eidman-Aadahl et al., 2013, para. 5).	
Criteria	**Definitions**
1. Multimodal coherence	The overall unity of the digital multimodal product; to support unity, the different modes used in the multimodal product should match, complement, or blend in with each other (relationship among modes) and the results of using different modes should convey and support ideas and enhance the comprehensibility and usability of the multimodal product.
2. Organization of content	Logical structure of content or messages within and among frames or sections
3. Conventions of linguistic mode	The effects of grammar, mechanics, style, citation, and genre on the quality of written and oral language
4. Relational relevance of linguistic mode	The relationship between written or oral language and other modes
5. Technical aspect of audio mode	The effects of fluency, articulation, intonation, volume, pitch, length and editing techniques (e.g., cuts and fades) on the quality of audio mode such as voice, sound effects, and music
6. Relational relevance of audio mode	The relationship between the audio mode and other modes
7. Technical aspects of visual mode	The effects of camera shots and angles, lighting, color, size, movement, and sequencing on the quality of visual mode such as static or moving images
8. Relational relevance of visual mode	The relationship between the visual mode and other modes
9. Technical aspects of spatial mode	The effects of layout, alignment of modes, and margins on the quality of spatial design
10. Relational relevance of spatial mode	The relationship between the spatial mode and other modes
Domain 2: Context "is the world around the artifact, around the creation of the artifact, and how the artifact enters, circulates, and fits into the world. Authors attend to the context of a multimodal artifact when they make design decisions related to genre or to an artifact's intended uses. Given their purposes, authors consider the affordances, constraints, and opportunities, given purpose, audience, composing environment, and delivery mode" (Eidman-Aadahl et al., 2013, para. 5).	

Criteria	Definitions
11. Rhetorical awareness-task	Consideration of specific purposes, genres, task directions, and physical environments of DMC
12. Rhetorical awareness-audience	Consideration of explicit or implicit audiences and their engagement with the artifact

Domain 3: Substance "refers to the content and overall quality and significance of the ideas presented. The substance of a piece is related to an artifact's message in relationship to the contextual elements of purpose, genre, and audiences. Considering the substance of a piece encourages authors to think about elements such as quality of ideas, quality of performance, credibility, accuracy, and significance" (Eidman-Aadahl et al., 2013, para. 5).

Criteria	Definitions
13. Quality of ideas	Clarity, credibility, significance (depth and length), and interest of the content and the pace of content progress or development
14. Quality of opinions/ arguments	Clarity and persuasiveness of arguments and the use of analysis and evidence to support the argument

Domain 4: Process Management and Technique "refers to the skills, capacities, and processes involved in planning, creating, and circulating multimodal artifacts. Creating multimodal products involves the technical skills of production using the chosen tools, but it also includes larger project management skills as well as the ability to collaborate with others in diverse and often interactive situations. Over time, individuals learn to more effectively control the skills and manage the processes of producing and circulating digital content" (Eidman-Aadahl et al., 2013, para. 5).

Criteria	Definitions
15. Collaboration	In the case of group projects, students work collaboratively by generating ideas together, dividing the labor fairly, and providing comments on each part of the project
16. Technical skills	The ability to use print-based and digital media and to export, import, modify, and switch between modes in the medium effectively
17. Writing processes and strategies	Engaging in various writing processes such as brainstorming, drafting, writing, image construction, revising, editing, and publishing and use of different writing strategies effectively

Domain 5: Habits of mind "are patterns of behavior or attitudes that reach beyond the artifact being created at the moment. They develop over time and can be nurtured through self-sponsored learning as well as teacher-facilitated activities throughout the process. Examples include creativity, persistence, risk-taking, mindfulness, and engagement. Habits of mind can also include an openness to participatory and interactive forms of engagement with audiences" (Eidman-Aadahl et al., 2013, para. 5).

Criteria	Definitions
18. Creativity	Uniqueness and originality of ideas and of the ways used to convey meaning using multiple modes
19. Self-efficacy	An individual's belief in self as a skilled and confident composer of digital multimodal texts