Review of the Empirical Research on Digital Multimodal Composing in L2 Learning Contexts

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Abstract: Driven by advances in multimedia technologies, digital multimodal composing (DMC) has gained growing scholarly interests. DMC affords language learners a new experience in language learning and use. While completing DMC projects, L2 learners construct meanings by assembling both linguistic and non-linguistic resources (e.g., visuals, audio, videos, etc.). This is largely in line with their out-of-class text composing experiences. To understand the state-of-the-art developments in DMC research, this article reviewed the empirical studies published between January 2011 and October 2022. It provides a general overview of these studies regarding the overall trends, theoretical underpinnings, research contexts, research methods, and major research strands. The research findings indicate: (1) DMC has been increasingly attended to by L2 researchers with the number of research articles showing an ascending trend; (2) These empirical studies were grounded in a variety of theories, including the social semiotic theory of multimodality, multiliteracies, task-based language teaching, social/cultural construction, meta-functions of systemic-functional linguistics, translanguaging, and others; (3) The bulk of research has been investigated in tertiary schools, although the research contexts were diversified; (4) Most studies were conducted qualitatively; (5) Scholarly attention has been paid to four major strands: composing process, teachers' and learners' perceptions of DMC, DMC's impact on L2 development, and assessment of DMC artifacts. The major research strands and sample studies were discussed in detail. This article ends with recommendations for future studies.

Keywords: Digital Multimodal Composing; Process; Perceptions; Assessment; L2 Development

1 Introduction

Unceasing technological breakthroughs (e.g., digital and multimedia technologies) have revolutionized the educational landscape in the contemporary world. One case in point is that language users are leading a technologically saturated life (Rideout et al., 2010) [1]. When communicating and connecting with others, they utilize various digital or mobile devices to conduct multimodal exchanges where meanings are conveyed linguistically and non-linguistically (Kafai & Peppler, 2011) [2]. Specifically, the multimodal communication is achieved via multifarious digital formats, and the most common ones include videos, web pages, blogs, social networking pages, podcasts, fanfictions, and video games (Smith, 2013) [3]. These formats permeate almost every

aspect of life, including the education sector where learning, especially language learning, is occurring in multimodal contexts. However, there exists a large disconnect between language learners' in-class and out-of-class text compositional practices (Kist & Pytash, 2015) [4]. Most language learners are still completing traditional paper-and-pencil composing tasks in class, while outside of class a growing cohort has been engaged in digital multimodal composing (DMC) projects via multimedia equipment. Fortunately, this mismatch between in-class practices and out-of-class reality has been given due attention, and there is an increasing research interest in digital literacy practices, such as the implementation of DMC projects. In Smith's (2017) [5] terms, DMC has shifted writing "from page to screen" (p. 259) by combining words, visuals, audio, and other semiotic resources to craft "digital texts". In contrast to monomodal composing, DMC provides writers with a brand-new meaning-making approach (Shin & Cimasko, 2008) [6].

Recent years have witnessed a surging scholarly interest in DMC due to its benefits in boosting learners' autonomy and peer collaboration (Hafner & Miller, 2011) [7], improving learners' speaking and writing capabilities (Hafner, 2014) [8], enhancing their ability in assembling semiotic resources to construct meaning (Nelson, 2006) [9], raising their reader awareness and increasing their composing motivation (Harman & Shin, 2018) [10], shaping learners' various identities (Belcher, 2017) [11], bridging the gap between learners' writing experiences in educational and real-life settings (Cummins et al., 2015) [12], and even engaging them in civic participation (Cimasko & Shin, 2017) [13]. On these bases, literacy experts and education policymakers recommend integrating DMC into writing courses to meet the needs of language learners (e.g., Hafner, 2015; Norton, 2013) [14-15]. In view of DMC's pivotal role in guiding language instruction in the digital era, the present study endeavors to critically review the empirical landscape of this burgeoning field and provide valuable insights for future practitioners.

2 Methods

2.1 Data Collection

To capture the panorama of DMC research, we retrieved relevant English sources in Web of Science Core Collection with "digital multimodal composing/composition/writing" and "L2 writing/learning" as the keywords. Chinese sources were from Chinese National Knowledge Infrastructure (CNKI) with "数字多模态写作" (digital multimodal composing) and "二语写作/学习" (L2 writing/learning) as the keywords. All the selected studies met the following criteria: (a) conducted empirically; (b) conducted in L2 settings; (3) indexed in SSCI (Social Science Citation Index), A & HCI (Arts & Humanities Citation Index), Scopus, or CSSCI (Chinese Social Sciences Citation Index); (4) published in English or Chinese between January 2011 and October 2022.

2.2 Data Analysis

Both researchers examined the openly published journal articles that met the above criteria by following three steps: (a) conducting the initial examination of the literature retrieved in the databases, removing the introductory and review articles, and only retaining the empirical research papers; (b) browsing the abstract sections of the remaining articles to exclude research not relevant to DMC; (c) reading the contents and consulting the reference sections of the remaining articles to include the articles not retrieved previously. After finalizing the whole examining process, both researchers analyzed the same batch of articles (20 in total) by referring to the coding scheme displayed in Table 1. The coding session yielded a satisfactory inter-coder agreement rate (91.6%). The other articles were randomly divided into two batches and analyzed independently by each researcher. Any disagreement was resolved via negotiation.

Table 1 Coding Scheme

Category	Items
Name of Journal	*Journal of Second Language Writing*, *Computer-Assisted Language Learning*, etc.
Publishing Year	From 2011 to 2022
Teaching Contexts	Primary, Secondary, or Tertiary students
Theoretical Framework	Systemic Functional Linguistics, Multi-literacy, Sociocultural Theory, etc.
Methodological Design	Qualitative, Quantitative, or Mixed
Research Instruments	Interview, Written Reflection, Classroom Observation, etc.
Research Strands	L2 Development, Composing Process, DMC Perceptions, DMC Assessment, etc.

3 Findings

In this section, we first present the overall trends of publications on DMC, then summarize the theories in which the empirical studies were grounded and the research methods adopted, and finally critically review each research strand.

3.1 Overall Trends

Literature retrieval, reading and examination resulted in 118 journal articles that met the criteria of this study. Substantive scholarly interest in DMC research is particularly evidenced by the special issues released in multiple renowned journals, such as *TESOL Quarterly 2015 (Multimodality: out from margins of English language teaching), Computers and Composition 2016 (Pedagogies of Multimodality and the Future of Multiliteracy Centers), System 2018 (Multimodal perspectives on English language teaching in higher education), and Journal of Second Language Writing 2020 (Multimodal composing in multilingual learning and teaching context).* The information on publications in major journals is shown in Table 2.

Table 2 Distribution of Articles on DMC in Major Journals

Journal Title	Number of Articles	Journal Title	Number of Articles
Computers and Composition	17	*Language and Education*	3
Journal of Second Language Writing	14	*ELT Journal*	2
System	11	*Journal of Literacy Research*	2
TESOL Quarterly	8	*Computer Assisted Language Learning*	2
Written Communication	5	*Literacy*	2
Journal of Adolescent & Adult Literacy	5	*British Journal of Educational Technology*	2
Language, Learning & Technology	4	*Innovation in Language Learning and Teaching*	2
Learning, Media and Technology	3	*Other*[*]	33
RELC Journal	3		

[*]Note: The journals with only one published article on DMC fall under the category "other".

Presumably fueled by the release of the special issues, DMC has gained higher visibility. As illustrated in Figure 1, the number of articles on DMC experienced a general ascending trend.
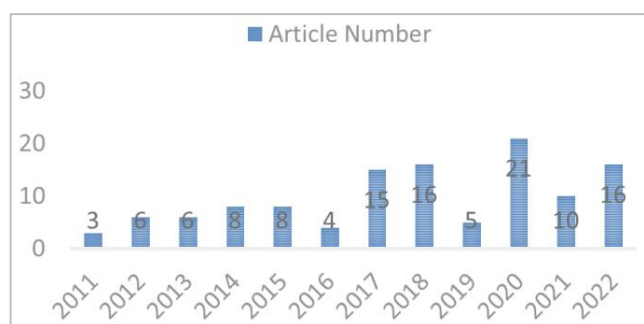

Figure 1 Publications on DMC Overtime

3.2 Theoretical Frameworks

As a cross-disciplinary field, DMC research has drawn upon diverse theoretical perspectives (e.g., linguistics, applied linguistics, education, and multimedia communication), with 72% of studies having clearly stated their theoretical underpinnings. Of all the theoretical frameworks, the social semiotic theory of multimodality (e.g., Hafner, 2020; Jocius, 2018; Lim & Nguyen, 2022) [16-18] and multiliteracies (e.g., Dahlström, 2021; Maghsoudi et al., 2022) [19-20] have occupied an overwhelmingly dominant place in DMC research. Other perspectives include systemic functional linguistics (e.g., Mills et al., 2020; Shin et al., 2020; Unsworth & Mills, 2020) [21-23], sociocultural theory (e.g., Kim & Kang, 2020; Silseth & Gilje, 2017; Yang, 2012) [24-26] and concepts or approaches in second language acquisition like investment and engagement (e.g., Jiang & Luk, 2016; Jiang et al*.,* 2020a, 2020b) [27-29] and task-based language teaching (e.g., Kim et al., 2022) [30]. Translanguaging, i.e. language users' selection and deployment of "particular features from a unitary linguistic repertoire to make meaning and to negotiate particular communicative contexts" (Conteh, 2018) [31], is also gaining momentum in DMC research (e.g., Ho, 2022) [32]. Of note is that most studies took multiple perspectives as their theoretical bases (see Table 3).

Table 3 Theoretical Perspectives in DMC Research

Theoretical Bases	Number of Articles	Percentages
Social semiotic theory of multimodality	78	66.10%
Multiliteracies	68	57.63%
Task-based language teaching	27	22.88%
Social cultural/construction	27	22.88%
Meta-functions of Systemic-Functional Linguistics	21	17.80%
Translanguaging	12	10.17%
Other (genre, identity, investment, agency, motivation, adaptive transfer, etc.)	18	15.25%
Unmentioned	33	27.80%

3.3 Teaching and Learning Contexts

A close examination of the existing literature revealed immense diversity in the teaching and learning contexts where empirical research on DMC transpired. Most studies (46.15%) were conducted in tertiary schools, followed by secondary schools (34.62%) and primary schools (19.3%). Geographically, investigators of DMC have conducted research across a wide range of countries and regions. For example, they probed into the potential integration of DMC into American and Australian high school and primary school English courses (e.g., Unsworth & Mills, 2020) [23], EFL (English as a foreign language) college courses in South Korea (e.g., Kim & Belcher, 2020) [33], Hong Kong Special Administrative Region of China (e.g., Hafner, 2020) [16], China's Taiwan Province (e.g., Lee, 2014) [34], and China's mainland (e.g., Jiang, 2017; Lei & Zhang, 2018; Liu & Dai, 2012) [35-37].

3.4 Research Methods

As for the research type, most studies were categorized as qualitative inquiries (69.5%), 20.33% of the studies were conducted quantitatively, and few studies (10.17%) adopted a mixed approach (e.g., Kim & Kang, 2020; Vandommele et al., 2017) [24, 38].

The bulk of research (N=48) analyzed the DMC products to demonstrate how EFL learners orchestrated numerous semiotic resources in meaning construction. Besides, researchers deployed a wide range of instruments to collect data, including interviews (N=32), classroom observations (N=12), language tests (N=8), questionnaires (N=7), field notes (N=4), etc. Some studies used more than one instruments to glean data (e.g., Lim & Nguyen, 2022; Wang, 2022) [18, 39].

3.5 Major Strands

Most studies addressed one or more of the following research strands: composing process (N=68), teachers' and learners' perceptions of DMC (N=57), DMC's impact on L2 development (N=9), and assessment of DMC artifacts (N=6). Studies that did not address the four agendas fall under the "other" category (N=14). To get a clear knowledge of what has been researched, we provide a critical overview of research in each strand and expound on selected sample studies in the following sections.

3.5.1 Composing Process

This line of research mainly adopted a qualitative research method to delve into three major sub-themes: learners' collaborative performances and their deployment of multimodal resources to make meaning (e.g., Hafner, 2014; Kim & Kang, 2020) [8, 24], teachers' and learners' multiple identities in DMC implementation (e.g., Hafner, 2014; Lei & Zhang, 2018) [8, 36], and teachers' and learners' investment and engagement in DMC (e.g., Jiang, 2018; Jiang et al., 2021) [40-41].

Peer collaboration in DMC research is often associated with the way students interacted with each other when assembling semiotic resources in composing digital texts. In digging into learners' peer collaboration, Kim and Kang (2020) [24] videotaped the interactions of 60 Korean Grade-11 students while they were completing DMC projects. Results showed that students zoomed in on content development, and that language and images were the most frequently mentioned semiotic resources during the collaborative discussion. Beyond the cohort studies, case analyses were also conducted. For example, Shin et al. (2020) [22] explored a sixth-grade writer's DMC process and his development of the metalanguage of modal and intermodal resources of language and images. This study highlighted the concurrence and complementarity intermodal relations in designing slides with words and images. It also found that this learner used non-linguistic resources as the main semiotic mode to convey ideational meaning. Moreover, DMC practices

raised this learner's awareness of intermodal relations and helped understand the meta-functions of sign systems in a non-linear way.

As for the identity construction and expression in teachers' integrating DMC into L2 instruction and students' implementing DMC projects, researchers have discerned an array of identities for language teachers and learners. For instance, Hafner (2014) [8] described an undergraduate course in English for science, which incorporated elements of digital literacies. Results demonstrated teachers' multiple discoursal identities in an attempt to appeal to the audience: (a) planners and organizers of students' learning, helping design the tasks and processes; (b) mentors, providing various resources needed, designing relevant classroom learning activities, and anticipating learner needs; (c) feedback providers, offering advice for script writing, video editing, and lab report writing. Lei and Zhang (2018) [36] used classroom observations, student journals, and interviews to explore the learner identity of third-year English majors in a Chinese college in DMC activities. The study found that students' self-identified roles included language learners, English writers, designers of multimodal texts, critics of various proposals, researchers of real-world problems, and collaborators of learning in and out of class.

Learners' and teachers' investment in DMC has been researched mainly by Jiang and his colleagues. Most of these studies adopted a qualitative research method and showcased participants' individual differences in investment patterns. For instance, Jiang (2018) [40] inquired into the investment change of three focal students in completing five DMC projects and found three investment patterns for each student: (a) repositioning from a resistant writer to an active composer; (b) evolving from an exam-oriented writer and textbook-decoder to a multimodal designer; (c) displaying little change in investment in English writing. Further, Jiang et al. (2020a) [28] corroborated that integrating DMC projects into EFL teaching increased the investment of a Tibetan student in English learning. The DMC tasks helped build the student's confidence in using English and capitalizing on the ethnic knowledge, which was deemed valuable cultural capital in classroom participation. Situated within Darwin and Norton' (2015) [42] investment model, Jiang et al. (2020b) [29] redefined teachers' DMC investment as "language teachers' devotion of time and efforts to DMC, but also the conditions that enable or constrain such devotion in power-laden contexts" (p. 298). This study

reported on the factors that impacted an EFL teacher's investment in DMC practice, such as cultural capital (e.g., expertise and shills), social capital (e.g., the expanded social network via participation in workshops to share her teaching practice), and institutional ideology (e.g., whether the school administrators and policymakers back up a specific teaching practice). It is noteworthy that the results of these studies may not be generalized to other contexts due to a small sample size.

3.5.2 Teachers' and Learners' Perceptions of DMC

This research strand covers teachers' and learners' overall perceptions of DMC practices, their impact on writing ability, and the problems and challenges encountered by learners in the composing process.

For example, DePalma and Alexander (2015) [43] pointed out the failure of 15 undergraduates and 9 postgraduates to correctly judge the readers of DMC artifacts and to meet the challenges in technological adaptations and efficient peer collaboration. Jiang (2017) [35] examined Chinese college EFL teachers' understanding of the affordances of DMC in promoting EFL teaching. By synthesizing the experiences and perceptions, this study proposed technological, educational, and social affordances of DMC practices. At the micro level, students' technical know-how in computer operation improved, and their anxiety about making mistakes was lessened by the real-time replay, review, and revision of videos. All these boosted learners' confidence in demonstrating their English skills. At the macro level, DMC projects contributed to the creation of an autonomous learning space for students whose meaning construction was no longer limited to linguistic expressions. Tan and Matsuda (2020) [44] found that despite the divergent attitudes of 9 teachers in American public schools towards DMC, an overall positive stance on DMC was held by these teachers who believed that students should hone their skills in DMC to adapt themselves to the increasingly digitalized and multimodal world. Most of Kim and Kang's (2020) [24] subjects acknowledged that DMC practices facilitated EFL learning. Kim and Belcher's (2020) [33] subjects held positive perceptions of DMC's effectiveness in making meaning but had mixed opinions about its role in improving their English writing ability. In a word, teachers' and students' perceptions are mixed, which

might boil down to the divergence in sample selection.

3.5.3 Assessment of DMC Artifacts

Given the changing landscape of literacy in the digital age, there is an urgent need to develop new assessment methods to adapt to learners' multiliteracy skills. In recent years, researchers have come to investigate the assessment of DMC products, but the specific assessment dimensions are different in various studies due to the diversity of DMC patterns.

For example, guided by New London Group's (2000) [45] pedagogy of multiliteracies, Hung et al. (2013) [46] designed a rating rubric for the DMC project (slides making) of the course *Communication and Presentation,* which was provided for students in a certain Taiwanese university. This rubric was composed of five factors—linguistic design, visual design, gestural design, auditory design, and spatial design—followed by three to four evaluation questions on a five-point scale. As the researchers claimed, this rubric could be used to evaluate a wide range of multimodal texts. Silseth and Gilje (2017) [25] based their study on the sociocultural theory to explore how DMC assessment unfolded in classroom teacher-student interactions and whether there were differences in teachers' and students' opinions on DMC assessment constructs. The study required students to collaborate in the production of commercials and teachers to provide necessary guidance and formative evaluations in the process of students' project production. Moreover, students received multiple teacher feedback until the work was completed, and teachers did not provide summative evaluations. The results showed that teachers and students had different understandings of DMC assessment standards and that formative evaluation throughout the whole process could positively affect learners' learning trajectories. Unfortunately, this study did not indicate specific evaluation criteria for formative assessment.

3.5.4 DMC's Impact on L2 Development

Teaching experiments were conducted to determine the effect of DMC practices on learners' L2 development, and most studies corroborated its positive impact.

Liu and Dai (2012) [37] divided the subjects into experimental and control groups, with the former applying video-making software to complete DMC tasks and the latter making PowerPoint slides. The post-test showed a higher gain of the experimental group in grades,

awareness of audience-centeredness, and non-verbal communication skills. Vandommele et al. (2017) [38] divided 84 Dutch beginners into three groups, two experimental groups, and one control group. The first experimental group completed web design projects with classroom intervention, the second experimental group completed the same task after class without intervention, and the control group completed only traditional writing tasks. The study also examined the changes in accuracy, complexity, and fluency of participants' writing. The syntactic complexity, essay length, communicative effectiveness, content, and lexical diversity of the two experimental groups were significantly improved to varying degrees. Still, no significant improvement was found in the control group. Maghsoudi et al. (2022) [20] designed a quasi-experiment which investigated the differential impacts of monomodal and multimodal writing practices on 59 Iranian EFL learners' writing ability in content, communicative achievement, organization, and language across five times. Once again, the multimodal group outperformed the monomodal group in the writing ability.

It should be mentioned that the factors contributing to the learning outcomes are multifaceted (Kyriakides et al. 2013) [47], so the implementation of DMC projects in English instruction will not be the sole reason for students' improvement in English. However, when designing the experimental and control groups, a dearth of researchers have considered controlling other variables that might confound and complicate the research results. Future research should take this issue into full account.

3.5.5 Other Themes

In addition to the above four themes, a small number of studies have focused on the motivation of EFL teachers and students to be engaged in DMC practices (e.g., Jiang & Luk, 2016) [27], the effect of DMC practice on learning transfer (e.g., Shepherd, 2018) [48], and its role in cultivating learners' ability to express emotions (e.g., Mills et al., 2020) [21] and empathize with others (e.g., Chen, 2018; Friesem, 2016; Jiang & Gao, 2020) [49-51].

Using in-depth semi-structured interviews and written reflections, Jiang and Luk (2016) [27] surveyed 21 EFL learners and five teachers in China's mainland and investigated their motivation sources in DMC practices. Seven motivating factors were found: the challenge of integrating multiple resources, the sensory curiosity generated by video production, the cognitive curiosity from acquiring new knowledge in the DMC process,

personal control of the learning process, the fantasy of virtual roles, peer cooperation, direct/indirect competition, and social recognition. The study justified the possibility of integrating DMC practices into the EFL curriculum, and provided insights for creating a motivating teaching environment, but did not discuss how motivational factors would affect learners' and teachers' investment in English learning and teaching and the development of learners' English literacy skills.

Shepherd (2018) [48] used online questionnaires and interviews to explore whether 151 first-year students from the United States and Canada could establish connections between extracurricular DMC practices and classroom writing practices. Results showed that most participants were unable to make a connection between the two writing practices, so the transfer of learning between the two was difficult to achieve. To make a connection between DMC and traditional pen-and-paper writing, the author proposed a "high-road transfer" in which learners should consciously apply abstract knowledge acquired in one situation to the other.

Based on the appraisal theory proposed by Martin and White (2005) [52], Mills et al. (2020) [21] designed a DMC teaching practice to improve learners' ability to elaborate on their views and express emotions through multimodal semiotic resources. The subjects in this study (i.e., English learners in an Australian primary school) learned to use attitudinal language (affect, judgment, and appreciation) and applied this knowledge to multimodal design. Their self-confidence in using appraisal resources to construct multimodal texts was greatly enhanced. However, considering the cognitive ability of the subjects, this study only addressed the narrative genre. Future research can be extended to more genres (e.g., argumentative essays and expository essays, etc.).

Digital empathy involved in compositional practices is a novel research territory and is becoming a growing concern among language teachers, researchers, and policymakers in recent years (Chen, 2018; Friesem, 2016) [49-50]. The concept of digital empathy came into being due to the adverse effects brought by the spread of Internet technology, such as online bullying and a lack of empathy with others. Friesem (2016) [50] defines digital empathy as "the cognitive and emotional ability to be reflective and socially responsible when strategically using digital media" (p. 146). Specifically, cognitive ability refers to the capacity to understand others' experiences, emotions, or mental states; emotional ability

denotes the ability to respond to others' experiences or emotional states with appropriate emotions. Two studies have identified digital empathy as a goal of EFL teaching and explored how to cultivate this ability through DMC practices (Chen, 2018; Jiang & Gao, 2020) [49, 51]. Chen (2018) [49] took 46 English majors from a Taiwanese university as the research subjects, pointing out that the multimodal learning experience of video production could help improve students' awareness of digital empathy and enhance students' understanding of social issues. On that basis, this study postulated that it was possible to use video production as part of language courses. However, this study used the questionnaire results as the main data source, undermining the reliability of the conclusion. In addition, the dynamics of learners' digital empathy remain unknown. Considering these shortcomings, Jiang and Gao (2020) [51] explored the changes in digital empathy of 49 students from a vocational school in China's mainland. Unlike Chen (2018) [49], Jiang and Gao (2020) [51] designed more detailed teaching steps, such as requiring students to watch videos related to cyberbullying, organizing students to discuss views and solutions to bullying incidents, and other activities related to video production. This study was triangulated by more data sources, such as semi-structured in-depth interviews, classroom observations, and all the student-authored DMC artifacts. Results revealed that students' digital empathy was greatly enhanced after DMC practices, which was manifested in changes in cognitive empathy (i.e., objectively sensing others' feelings and emotions), meta-cognitive empathy (i.e., seeing situations from the victim's perspective), and affective empathy (i.e., responding others' mental states with appropriate emotions) with those suffering from cyber violence. With increased empathy, students learned to use digital technology to solve social problems and participate more actively and responsibly in online communication. Moreover, DMC projects also engaged students in English expression.

4 Directions for Future Research

Overall, empirical research in the DMC field is capturing substantive academic attention, but the research efforts remain far from enough due to the enormous L2 teaching and learning communities. Consider China's mainland ─ the most significant L2 teaching context across the globe. Although DMC projects such as slides and video production have long been practiced in L2 courses, teachers mainly regard them as

classroom-sharing activities. So far, scant attention has been paid to systematic teaching and learning research on all aspects of multimodal composition. We believe that DMC research has great practical significance and potentials for L2 teaching. Based on the critical review of this study, we discuss in what follows how to optimize the research design of existing research and afford some constructive suggestions for future studies.

In terms of research methods, the ratio of qualitative and quantitative research is seriously imbalanced. The existing research in this field is mostly qualitative in nature and can only partially depict some individual learners' and teachers' perceptions of DMC, learners' deployment of semiotic resources in meaning construction and conveyance, etc. Therefore, whether the research results can be generalized to other populations remains unknown. Future research should break this imbalance by giving more attention to quantitative design or a mixed approach. For example, to explore students' perception of DMC, researchers can devise quantitative questionnaires with multiple dimensions, conduct pilot studies, and run factor, reliability, and validity analyses to ensure the quality of the questionnaires. Moreover, researchers should adopt more data sources to interpret the results comprehensively. That means diverse research instruments have to be employed in one single study. To our knowledge, some research tools (e.g., think-aloud protocols, brain scanning, etc.) haven't been employed. Research tools are essential to help expand the scope of the DMC investigation. Still, to guarantee the generalizability and explanatory power of the research results, it is advisable to cover more subjects and diversify the subject groups, factoring into their language proficiency, country or region of origin, and cultural background. Last, most existing studies are cross-sectional, so longitudinal inquiries are needed.

Beyond the well-planned research design, future studies can extend the research scope or carry on the innovative investigations based on the current body of literature. First, teachers' and students' self-efficacy in DMC practices has been neglected. How and to what extent teachers and students adapt to new literacy teaching and learning remains unanswered. Second, students' emotions (both positive and negative) involved in DMC projects have not been discussed yet. Research on emotions would be a novel avenue for DMC research as language learning and teaching research is experiencing an "affective turn" in recent years (Li, 2021) [53]. Students' emotions (e.g.,

anxiety, boredom, enjoyment, etc.) in the composing process would shed new light on DMC practices. Third, the research strand of the DMC process has been investigated by analyzing the DMC artifacts, and how learners compose digital texts is still a "black box". Future researchers can glean comprehensive data in a way akin to an ethnographic approach: from learners' selection of multimedia, utilization of technologies, orchestration of all semiotic resources, and any other behaviors revolving around the composition of digital texts. Fourth, in-depth interdisciplinary research is rarely documented. For instance, the operating mechanism of learners' brains during DMC has received little attention. Last, in addition to original research, replicate studies conducted in different teaching contexts are also valuable to confirm or falsify the results obtained previously.

5 Conclusion

This article reviewed the empirical research on DMC between 2011 and 2022. Results show that DMC has piqued substantial scholarly interest in L2 research with the number of research articles experiencing an ascending trend. We also find that the empirical studies, most of which adopted a qualitative research method, were grounded in a variety of theories, such as the social semiotic theory of multimodality, multiliteracies, task-based language teaching, social/cultural construction, meta-functions of systemic-functional linguistics, translanguaging, and others. With regard to the research contexts, the bulk of research has been conducted in tertiary schools, despite a diversification of the contexts. Then, four major research strands have emerged in the DMC landscape: composing process, teachers' and learners' perceptions of DMC, DMC's impact on L2 development, and assessment of DMC artifacts. For the limited space, we only critically reviewed representative research in each strand and provided some suggestions to illuminate future research.

As must be pointed out, DMC implementation is not designed to prepare learners for standardized tests. Some scholars and teachers may have doubts or reservations about integrating DMC into in-class practices, opining that L2 writing instruction needs to focus on language development and that DMC is detached from the classroom reality. As a result, DMC practice is still marginalized by institutional policymakers. However, we should not ignore the conflict between contemporary multimedia and

multimodal communication and traditional writing practices based on print media. Given the increasing importance of DMC practice in language teaching and the prevalence and ubiquity of multimodality in learners' daily life, language teachers' multimodal awareness needs to be raised to keep pace with the changing times. Therefore, more empirical research is needed to explore the affordances and potentials of DMC practices.

References

[1]   Rideout, V. J. et al. *Generation M2: Media in the Lives of 8-18 Year-olds* [M]. Washington, DC: Kaiser Family Foundation Study. 2010.

[2]   Kafai, Y. B. & K. A. Peppler. Youth, technology, and DIY: Developing participatory competencies in creative media production [J]. *Review of Research in Education.* 2011 (1): 89-119.

[3]   Smith, B. E. Beyond Words: The Landscape of Research on Adolescents and Multimodal Composition [M]. In Ferdig, R. E. & K. E. Pytash (eds.). *Exploring Multimodal Composition and Digital Writing* (pp. 1-19). Hershey, PA: IGI Global. 2013.

[4]   Kist, W. & K. E. Pytash. "I love to flip the pages": Preservice teachers and new literacies within a field experience [J]. *English Education.* 2015 (2): 131-167.

[5]   Smith, B. E. Composing across modes: A comparative analysis of adolescents' multimodal composing processes [J]. *Learning, Media and Technology.* 2017 (3): 259-278.

[6]   Shin, D. S. & T. Cimasko. Multimodal composition in a college ESL class: New tools, traditional norms [J]. *Computers and Composition.* 2008 (4): 376-395.

[7]   Hafner, C. A. & L. Miller. Fostering learner autonomy in English for science: A collaborative digital video project in a technological learning environment [J]. *Language Learning & Technology.* 2011 (3): 68-86.

[8]   Hafner, C. A. Embedding digital literacies in English language teaching: Students' digital video projects as multimodal ensembles [J]. *TESOL Quarterly.* 2014 (4): 655-685.

[9]   Nelson, M. E. Mode, meaning, and synaesthesia in multimedia L2 writing [J]. *Language Learning & Technology.* 2006 (2): 56-76.

[10]   Harman, R. & D. S. Shin. Multimodal and community-based literacies: Agentive bilingual learners in elementary school [M]. In G. Onchwari & S. Keengwe (eds.), *Handbook of Research on Pedagogies and Cultural Considerations for Young English Language Learners* (pp. 217-238). Hershey, PA: IGI Global. 2018.

[11]   Belcher, D. D. On becoming facilitators of multimodal composing and digital design [J]. *Journal of Second Language Writing.* 2017: 80-85.

[12]   Cummins, J. et al. Identity texts and academic achievement: Connecting the dots in multilingual school contexts [J]. *TESOL Quarterly.* 2015 (3): 555-581.

[13]   Cimasko, T. & D. Shin. Resemiotization and authorial agency in L2 multimodal writing [J]. *Written Communication*, 2017 (4): 387-413.

[14]   Hafner, C. A. Remix culture and English language teaching: The expression of learner voice in digital multimodal compositions [J]. *TESOL Quarterly.* 2015 (3): 486-509.

[15]   Norton, B. *Identity and Language Learning: Extending the Conversation* [M]. Bristol: Multilingual Matters. 2013.

[16]   Hafner, C. A. Digital Multimodal Composing: How to Address Multimodal Communication Forms in ELT [J]. *English Teaching.* 2020 (3): 133-146.

[17]   Jocius, R. Becoming entangled: an analysis of 5th grade students collaborative multimodal composing practices [J]. *Computers and Composition.* 2018 (47): 14-30.

[18]   Lim, F. V., & T. T. H. Nguyen. If you have the freedom, you don't need to even think hard-considerations in designing for student agency through digital multimodal composing in the language classroom [J]. *Language and Education.* 2022: 1-19.

[19]   Dahlström, H. Students as digital multimodal text designers: A study of resources, affordances, and experiences [J]. *British Journal of Educational Technology.* 2022 (2): 391-407.

[20]   Maghsoudi, N. et al. Integrating digital multimodal composition into EFL writing instruction [J]. *Journal of Language and Education.* 2022 (1): 86-101.

[21]   Mills, K. A. et al. Multimodal language of attitude in digital composition [J]. *Written Communication.* 2020 (2): 135-166.

[22]   Shin, D. S. et al. Development of metalanguage for multimodal composing: A case study of an L2 writer's design of multimedia texts [J]. *Journal of Second Language Writing.* 2020: Article 100714.

[23]   Unsworth, L. & K. A. Mills. English language teaching of attitude and emotion in digital multimodal composition [J]. *Journal of Second Language Writing.* 2020: Article 100712.

[24]   Kim, Y. & S. Kang. Writing to make meaning through collaborative multimodal composing among Korean EFL learners: Writing processes, writing quality and student perception [J]. *Computers and Composition.* 2020: 1-19.

[25] Silseth, K. & Ø. Gilje. Multimodal composition and assessment: A sociocultural perspective [J]. *Assessment in Education: Principles, Policy & Practice.* 2019 (1): 26-42.

[26] Yang, Y. F. D. Multimodal composing in digital storytelling [J]. *Computers and Composition.* 2012 (3): 221-238.

[27] Jiang, L. & J. Luk. Multimodal composing as a learning activity in English classrooms: Inquiring into the sources of its motivational capacity [J]. *System.* 2016: 1-11.

[28] Jiang, L. et al. Chinese ethnic minority students' investment in English learning empowered by digital multimodal composing [J]. *TESOL Quarterly.* 2020a (4): 954-979.

[29] Jiang, L. et al. An EFL teacher's investment in digital multimodal composing [J]. *ELT Journal.* 2020b (3): 297-306.

[30] Kim, Y. et al. Peer interaction, writing proficiency, and the quality of collaborative digital multimodal composing task: Comparing guided and unguided planning [J]. *System.* 2022*:* Article 102722.

[31] Conteh, J. Translanguaging [J]. *ELT journal.* 2018 (4): 445-447.

[32] Ho, W. Y. J. The construction of translanguaging space through digital multimodal composing: A case study of students' creation of instructional videos [J]. *Journal of English for Academic Purposes.* 2022: Article 101134.

[33] Kim, Y. & D. Belcher. Multimodal composing and traditional essays: Linguistic performance and learner perceptions [J]. *RELC Journal.* 2020 (1): 86-100.

[34] Lee, H. C. Using an arts-integrated multimodal approach to promote English learning: A case study of two Taiwanese junior college students [J]. *English Teaching: Practice and Critique.* 2014 (2): 55-75.

[35] Jiang, L. The affordances of digital multimodal composing for EFL learning [J]. *ELT Journal.* 2017 (4): 413-422.

[36] Lei, Q. & D. L. Zhang. A study on English learner identities in multimodal composing [J]. *Technology Enhanced Foreign Language Education.* 2018 (6): 52-57, 64.

[37] Liu, L. & C. J. Dai. An empirical study on application of computer screen video expert software to multimodal English composition [J]. *Journal of Xi'an International Studies University.* 2012 (1): 86-90.

[38] Vandommele, G. et al. In-school and out-of-school multimodal writing as an L2 writing resource for beginner learners of Dutch [J]. *Journal of Second Language Writing.* 2017: 23-36.

[39] Wang, H. International English learners' perspectives on multimodal composing and identity representation via multimodal texts [J]. *SAGE Open.* 2022 (2): 1-15.

[40] Jiang, L. Digital multimodal composing and investment change in learners' writing in English as a foreign language [J]. *Journal of Second Language Writing.* 2018: 60-72.

[41] Jiang, L. et al. Teacher engagement with digital multimodal composing in a Chinese tertiary EFL curriculum [J]. *Language Teaching Research.* 2021 (4): 613-632.

[42] Darvin, R. & B. Norton. Identity and a model of investment in applied linguistics [J]. *Annual Review of Applied Linguistics.* 2015: 36-56.

[43] DePalma, M. J. & K. P. Alexander. A bag full of snakes: Negotiating the challenges of multimodal composition [J]. *Computers and Composition.* 2015: 182-200.

[44] Tan, X. & P. K. Matsuda. Teacher beliefs and pedagogical practices of integrating multimodality into first-year composition [J]. *Computers and Composition.* 2020: Article 102614.

[45] New London Group. A pedagogy of multiliteracies: Designing social futures [J]. *Harvard Educational Review.* 1996 (1): 60-92.

[46] Hung, H. T. et al. Multimodal assessment of and for learning: A theory-driven design rubric [J]. *British Journal of Educational Technology.* 2013 (3): 400-409.

[47] Kyriakides, L. et al. What matters for student learning outcomes: A meta-analysis of studies exploring factors of effective teaching [J]. *Teaching and Teacher Education.* 2013: 143-152.

[48] Shepherd, R. P. Digital writing, multimodality, and learning transfer: Crafting connections between composition and online composing [J]. *Computers and Composition*, 2018: 103-114.

[49] Chen, C. W. Y. Developing EFL students' digital empathy through video production [J]. *System.* 2018: 50-57.

[50] Friesem, Y. Empathy for the digital age: Using video production to enhance social, emotional, and cognitive skills [M]. In S. Y. Tettegah & D. L. Espelage (eds.), *Emotions, technology, and behaviors* (pp. 21-45). London: Academic Press. 2016.

[51] Jiang, L. & J. Gao. Fostering EFL learners' digital empathy through multimodal composing [J]. *RELC Journal.* 2020 (1): 70-85.

[52] Martin, J. R & P. R. R. White. *The Language of Evaluation: Appraisal in English* [M]. New York: Palgrave Macmillan. 2005.

[53] Li, C. A control-value theory approach to boredom in English classes among university students in China [J]. *The Modern Language Journal.* 2021 (1): 317-33.