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PAPER

Conceptualizing Disciplinary Literacy in Higher Education: An Exploratory Review

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ABSTRACT

Disciplinary literacy (DL) has been a prominent concern in higher education over the past decade. By utilizing databases such as Scopus and Web of Science, the search strategy has identified articles published between 2014 and 2023. Firstly, this paper critically evaluates previous research in order to advance epistemological understanding of DL by examining DL-related components and strategies. Secondly, it sets the foundation for further research by highlighting gaps in the literature and suggesting topics that require investigation. Eighteen studies from a wide range of disciplines and contexts met the inclusion criteria, falling into four overarching themes, namely cognitive, linguistics, disciplinary reasoning, and sociocultural dimensions. The writing, reading, speaking, thinking, and feedback strategies are among the strategies derived from these dimensions that can enhance both disciplinary knowledge and English language proficiency in the subject discipline. The ongoing controversy about the inconsistent application of DL in higher education settings and its conceptualization in these contexts is corroborated by the existing evidence. Future research should focus more on the application of disciplinary-specific frameworks or clear guidelines based on DL strategies across a wide variety of disciplines with the use of rigorous research methodology taking into consideration diverse populations.

KEYWORDS

disciplinary literacy (DL), disciplinary literacies, strategies, framework, English as a first language, English as a second language (ESL), English as a foreign language (EFL), higher education

1 INTRODUCTION

Disciplinary literacy (DL) can be referred to as 'understanding of both disciplinary content and disciplinary habits of mind (i.e., ways of reading, writing, viewing, speaking, thinking, reasoning, and critiquing) [1]. Likewise, disciplinary

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literacies refer to specific practices and skills within a particular academic discipline that are essential for understanding and engaging with the subject matter effectively [2]. It has become an increasingly popular solution for university students' literacy issues across the last 10 years. Due to ongoing and concerned issues with reading and writing among university students, the generic methodologies used by most researchers in this field have occasionally been called into question [3] [4]. Research revealed that the majority of college students lacked the sophisticated academic literacy abilities needed to succeed [5] [6]. Research has also shown Mpofu and Maphalala, [7]; Bojović, [4] that the development of "general" literacy in schools appears to be a prerequisite for the foundational abilities needed for subject-specific teaching at the university level. Fang and Coatoam [1] argue that literacy instruction in academic disciplines should move beyond the focus on basic skills (e.g., vocabulary, fluency), general cognitive strategies (e.g., predicting, inferencing), and generic learning strategies (e.g., highlighting, note taking).

In higher education settings, recent studies emphasized that DL is grounded in the belief that reading and writing of texts across content areas are integral to disciplinary practices. In line with this, rising concerns in relation to other aspects stressing disciplinary enculturation and socialization have been highlighted, such as the ways in which disciplinary content is produced, communicated, and critiqued as manifested by content experts [8]. It could be inferred that there is a need for more explicit instruction and attention to DL components in higher education to better prepare students for the literacy demands of various disciplines. The emergence of new standards and the explicit requirement for teaching the literacy of science, literature, and history in middle and high schools highlight the increasing attention to DL [9]. Despite the growing body of studies that give prominence to DL, it would appear that scant attention has been paid to the epistemological understanding of DL and DL strategies due to their association with high school settings. It may lead to educators feeling left to infer the literacy practices valued in various fields on their own [10].

As such, this review paper seeks to address the gaps in current literature found in the field of DL by limiting the year range of reviewed literature to the last 10 years and focusing on strategies applicable across multiple-disciplines in colleges and universities in first, second, and foreign language-speaking settings across many countries. Additionally, this study will focus on identifying gaps in the literature and propose areas that need research.

1.1 Research objectives

The objectives of this review paper are as follows:

- To review research papers found in the field of DL by providing epistemological understanding of DL in higher education.
- To provide some fruitful directions for future research and development in this area.

1.2 Research question

The purpose of this review is to review research papers found in the field of DL so as to provide epistemological understanding of DL. Hence, the questions that motivated this review include:

- What components and strategies of DL can be found in reviewed papers to promote epistemological understanding of DL in higher education?
- What are some directions for future research and development in this area?

2 METHODOLOGY

2.1 Search strategy

For the purpose of this review, a search strategy used to identify relevant literature includes electronic database searching and citation searching. This search strategy was tailored to two databases: Scopus and Web of Science. In these databases, peer-reviewed literature and international publishers are accessible, while the search criteria used were the following: 'disciplinary literacy' or 'disciplinary literacies.' All searches spanned from 2014 until 2023, including open access and Scopus-or ISI-indexed journal articles and review papers that are published in English only.

2.2 Selection criteria

The selection criteria were based on the PRISMA statement [11]. As illustrated in Figure 1, a total of 292 published articles were identified from the search results. The search was mainly focused on mapping existing literature on strategies and practices adopted to promote DL in higher education. The chosen articles were then determined based on a set of inclusion criteria and focus of the study, which resulted in 113 of the articles being excluded. The journal articles reviewed are in English, published from year 2014 till 2023. The excluded articles were largely those focused on elementary and secondary settings and those that were not openly accessible.

2.3 Quality assessment

For maintaining the quality of the review, all duplications were checked thoroughly and excluded. Abstracts of the articles were checked deeply for the analysis so as to ensure the quality and relevance of academic literature included in the review process. A total of 18 studies were chosen out of 31 after the inclusion and exclusion criteria were applied. A careful evaluation of each research paper was carried out by the lead author and assessed separately by the other author at a later stage. A number of pertinent research, fundamental literature, and references cited in all the studies were examined and included in this review. Due to the limited number of studies, this review combined quantitative and qualitative studies for more relevant and richer interpretation of data.

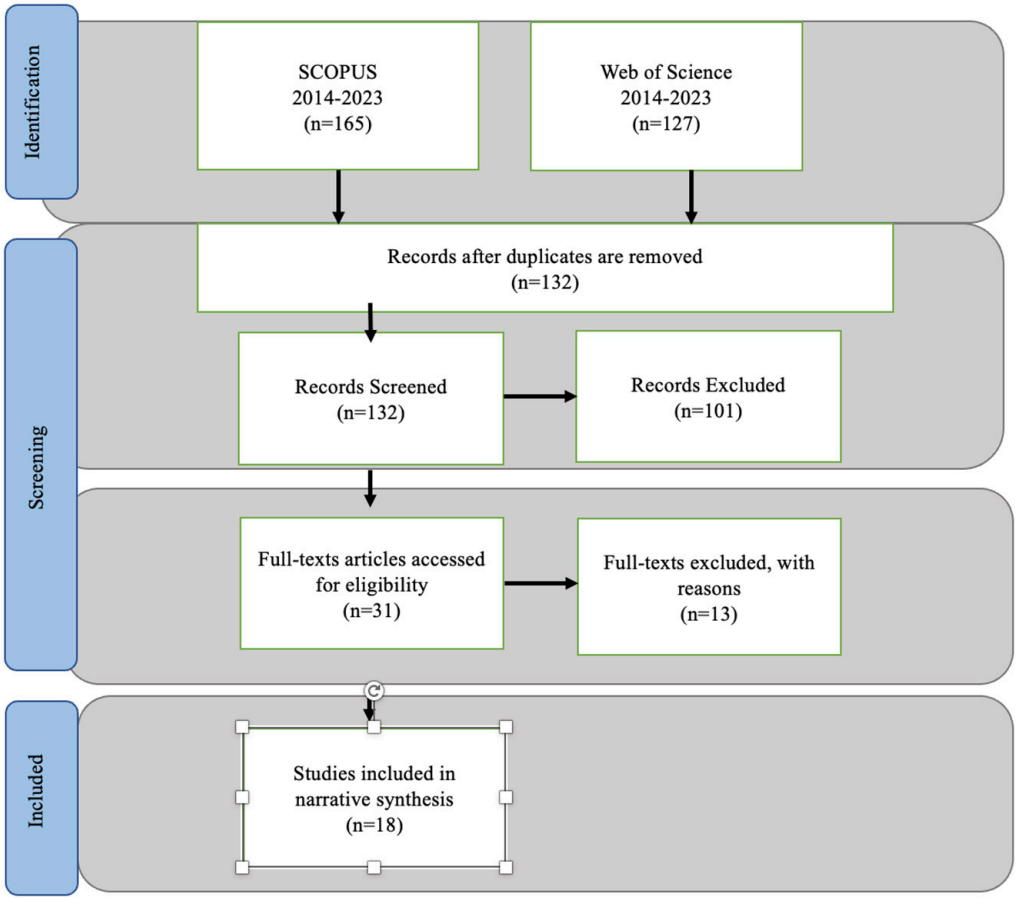

Fig. 1. Review process (PRISMA)

3 RESULTS AND DISCUSSION

3.1 Results

Research question 1: What components of DL can be focused on to promote academic achievement in higher education in English as a foreign language (EFL), English as a second language (ESL), and English as a native language setting?

By deploying the search strategy, 18 studies were identified and summarized in Table 1. The methodologies adopted in these studies include qualitative (n = 11), quantitative (n = 5), mixed methods (n = 1), and literature review (n = 1). The majority of the studies reviewed were conducted among undergraduates and college students across disciplinary areas of study in the nature of the writing, reading, speaking, and reasoning processes situated in the United States, the United Kingdom, Australia, and other English-speaking countries. Other a foreign language or second language settings include China, Ukrainian, South Africa Greek and so on. Four overarching themes, namely cognitive dimension, sociocultural dimension, linguistic dimension, and disciplinary reasoning, were revealed in this review.

Table 1. Summary of reviewed literature on disciplinary literacy

Item	Authors	Objectives	Study Design/Analysis/Method/ Demographic/Country
1	Pavlovičová [12]	Investigating DL of university students with an emphasis on understanding the mathematical language and symbolism in the task's assignment.	Quantitative/Questionnaire/Experiment/Technical college/74 students aged 19 to 21 studying Mathematics/Middle Europe
2	Wilson-Lopez, et al. [13]	Developing more robust conceptualizations of disciplinary literacies in engineering through exploring the literacy practices of engineers.	Comparative case study/Observation/Interview/ Retrospective protocols/ Eight White engineers from different engineering subdisciplines (e.g., aerospace, environmental)/3 years/USA
3	Hubbard [14]	Comparing DL requirements in STEM through quality subject benchmark statements, exploring implications this has for interdisciplinary teaching, and presenting some published pedagogical strategies for engaging students in original research papers.	Qualitative Approach/Thematic analysis/STEM undergraduates /UK
4	Mpofu and Maphalala [7]	Exploring the preparation practices used to prepare student teachers to use English language skills in disciplinary content teaching	Qualitative approach/Focus group discussions and document analysis/102 purposively fourth-year Bachelor of Education students learning through the medium of English from 3 universities/ South Africa
5	Liashenko and Bula [15]	Revealing new connections between the DL and ESP sphere in preparing the cynological translators with practical meaning for future application.	Quantitative/Nonparametric tests/Bachelor students of Sumy National Agrarian University/n = 17 who study English for Specific Purposes course/Ukrainian
6	Sanchez-Perez [17]	Analysing the relationship between the use of disciplinary-literacy variables related to the genre and specialized-language features of the laboratory report at the levels of text structure, cohesion, grammar, and vocabulary, and students' content proficiency in English-medium writing.	Quantitative/Tests and Interview/2nd and 3rd year non-native English undergraduates in two nonlanguage-related academic disciplines, i.e., Chemical Engineering (N = 69) and Agricultural Engineering (N = 67)/Spanish
7	Goldfarb Cohen and Tabak [18]	Examining whether model annotations can foster DL in higher education.	Quantitative/Experimental design/ Post-test and Interview/102 education undergraduates of the Department of Education participated/Israel
8	He [19]	Reviewing ELT for English majors at the university level in China and clarifies the need for disciplinary English and its position in the English major curriculum.	Literature Review/English majors/China
9	Cisco [20]	Exploring the benefits, if any, of the difficulty paper, a written formative assessment that asks students in a multidisciplinary "Great Works" course to explore their difficulties with challenging texts.	Qualitative Case study/Inductive analysis/13 students ranging from physical sciences, humanities and social sciences in a public research university/USA
10	Carless et al. [21]	Understanding disciplinary feedback possibilities and challenges	Qualitative Approach /Interviews and classroom observations/At a research intensive English medium university, years 3/5/6 33 undergraduates and 22 teaching staff comprised two soft applied and two hard applied disciplines: architecture, education, engineering and medicine/Hong Kong
11	Ioratim-Uba [22]	Providing insight into the impact of Interactive pedagogy on the construction and communication of knowledge by novice writers in their disciplines.	Mixed-method/pre- and post-classroom intervention and questionnaire/L2 PhD students from different disciplines at a Sino-British University/China
12	Esterhazy [5]	Exploring the relational dynamics between different elements of the course and how these dynamics matter for the emergence of productive feedback encounters	Qualitative case study/observation and interview/170 undergraduates from software engineering course unit/UK

(Continued)

Table 1. Summary of reviewed literature on disciplinary literacy *(Continued)*

Item	Authors	Objectives	Study Design/Analysis/Method/ Demographic/Country
13	Dafouz et al. [23]	Examining the discursive characteristics and language practices of English-medium instruction (EMI) content teachers in the area of economics and business administration (oral and written modes).	Qualitative/Discourse analysis. The sample consisted of two groups: FinAcc group had roughly 35–40 first-year students, and the ConsBeh had approximately 40–45 fourth-year students/Spanish
14	Prinsloo [24]	Determining how four disciplinary groups of students responded to literature when no apparent pedagogic purpose was explicitly assigned to short stories as supplementary reading.	Qualitative survey/content analysis/The population of sample consists of natural science, engineering, art, and music students (N = 55)
15	Staudinger [25]	Developing interpretive reading strategies appropriate for political theory and the humanities, understanding what undergraduates experience when reading political theory texts, and also seeing what happens when they become better (sub)disciplinary readers.	Qualitative/Thematic analysis/Comparing essays written at the start and end of the courses/Political Science and Democracy and Justice Studies majors who are sophomores, juniors, and seniors/USA
16	Reynolds and Rush [26]	Examining how experts and novices in the study of literary texts read those texts, and to make suggestions for an English Language Arts (ELA) disciplinary literacy	Qualitative/Thematic Analysis/4 English Language Arts (ELA) professors of literature and four English Language Arts (ELA) college freshmen/USA
17	Bojović [4]	Exploring the concepts of DL and content-area literacy, DL in EFL for biotechnology engineering as well as the use of reading strategies in English by undergraduate students and experts.	Quantitative/94 undergraduate students of biotechnical sciences at the University of Kragujevac and 46 biotechnology engineering experts/Serbia
18	Carlson [6]	Examining developing understandings of DL from the perspective of one beginning teacher candidate enrolled in a secondary literacy course with an embedded field experience.	Qualitative exploratory study/Semi-structured interviews and field notes/journal analysis/five teacher candidates/ from the discipline of History/ Social Studies/USA

Table 2 summarizes the descriptive analysis of the reviews, which lead to four (4) overarching themes, namely cognitive dimension, sociocultural dimension, linguistic dimension, and disciplinary reasoning dimension, comprising various DL strategies or practices.

Table 2. Summary of descriptive analysis of the overarching themes and subthemes of the reviewed articles

Overarching Themes	Subthemes	Articles
Cognitive	Reading	Pavlovičová [12], Hubbard [14], Cisco [20], Goldfarb Cohen and Tabak [18], Staudinger [24], Bojović, [4]
Sociocultural	Oral feedback	Carless et al. [20] Carlson [6], Esterhazy [5], Mpofu and Maphalala [7]
Linguistics	Speaking, listening, reading and writing	Mpofu and Maphalala [7], He [19], Sanchez-Perez [17], Ioratim-Uba [22]
Disciplinary Reasoning	Metacognition and critical thinking	Prinsloo [24], Dafouz [23], Reynolds and Rush [26], Liashenko and Bula [15], Wilson-Lopez [13]

Cognitive strategies. The findings based on the study conducted by Pavlovičová [12] suggested that insufficient time in regular teaching and inexperienced teachers may result in the deficiencies of conceptual understanding among undergraduates in the mathematical discipline. The teachers and students agreed that the major cause of students' misunderstanding of the assignment was due to

their failure in tasks requiring higher reading of mathematical symbols. Mathematics teachers viewed general reading practices in alignment with disciplinary goals as irrelevant. A mix of approaches to enhance mathematical disciplinary reading includes looking for patterns and relationships in disciplinary texts, deciphering symbols and abstract ideas, and asking questions based on mathematical reasoning with the use of previous knowledge.

In a similar vein, Hubbard [14] argued that STEM requires undergraduates to read and understand research-level materials, such as disciplinary textbooks and original research materials. However, students struggling to read are easily overlooked and expected to autonomously read, understand, and then explain the complicated thoughts embedded within the disciplinary text. Hubbard [14] put forth the strategy of in-person discussion of texts, which enables both disciplinary experts and students to openly share about the difficulties of reading complex materials.

This echoed with views of Cisco [20] in addressing confusion among students, recommending a generic strategy that can be put into use across subject areas, namely physical sciences, humanities, and social sciences. This strategy is viewed as a transactional approach to reading, which encourages the reader to be open to cognitive dissonance and avoid "rigid attitudes" that "may seriously impair the reader's judgment" [27]. According to Cisco [20], utilizing difficulty paper as an instructional and program assessment can further provide a space to log knowledge or experience exploration as well as to raise the importance of using metacognition, prior knowledge, and intertextuality. Moreover, such an approach also encourages students to model effective reading processes, makes them tackle uneasiness and perplexity without disregarding it, acknowledges one's own prejudices, and permits other interpretations and solutions.

With the similar emphasis on broader interactions and supports, the effects of textual annotation tools found in another study undertaken by Goldfarb Cohen & Tabak [18] after one-time exposure appeared to be promising. Incorporating this tool as part of instructional practices, such as holding discussions by disciplinary experts, may also eliminate the feeling of frustration, uncertainty, or incapacity as mentioned by Cisco [20]. The modeling of labeled annotations has been reported to encourage readers to acquire DL by going beyond the texts for problematizing, prompting learners to avoid simplification, and making experts' reading moves explicit to readers.

In connection to the metacognitive aspect that resonated with Cisco's [20] account, Staudinger [25] reported a "deep reading" or interpretive reading strategy used to improve inner dialogue with self, text, and world in the setting of the undergraduate political theory classroom. Staudinger [25] pointed out the equal contributions to academic discourse by means of teaching disciplinary content and disciplinary reading habits. While undertaking deliberation for developing disciplinary code, this activity might favor dominant or well-versed students. However, deep reading strategy offers struggling students' opportunities to first interpret texts in relation to this world, existing disciplinary knowledge, their own belief, and voices of marginalized. According to Staudinger [25], generalized strategies echoed with Bojović [4] include creating visual maps and building class-wide maps whereas another applicable approach is generating questions using a political theory approach.

There is rising demand for graduates to collaborate between STEM disciplines and the social sciences, creative arts, or business and enterprise. This results in practical approaches to developing inter DL as well as engaging students in research processes, which are of value to educators working across disciplines, namely writing an abstract for a 'classic' paper, Wilmott et al. [28], and using key sentences in read

articles [29]. These approaches embed literature-based teaching in their curricula, emphasizing elements such as the structure of research articles (e.g., abstracts, introduction, results, methods), primary concepts, triangulation reading from other sources of knowledge linked to the paper, figures and tables, and definitions of key terms. These steps encourage students to 'think like a scientist' through reading, interpreting, elucidating, and thinking through iterated processes over a number of taught sessions. While these approaches are practical for approaching complex scientific texts, differentiated approaches should be considered due to the limited schema of struggling and novice readers by encouraging them to start off with abstracts or introductory paragraphs of the research as well as technical terminology, which they tend to ignore [30].

An experiment was carried out by Bojović [4] to explore the perceived use of EFL reading strategies as a component of DL by 94 third-and fourth-year biotechnology engineering students in an academic ESP classroom and by 46 biotechnology disciplinary experts (e.g., agricultural extension service advisors, food producers, researchers, vocational high school teachers, and university teaching staff). Interestingly, Bojović [4] noted that the number of biotechnology engineering faculty teaching staff members in Serbia to receive any formal pedagogical training to deliver disciplinary reading was small. Nevertheless, most had learned how to read for their discipline from their own supervisors/mentors during graduate training and, most often, through their own experience. As suggested by Bojović [4], interdisciplinary cooperation between the biotechnology engineering experts and EFL teachers should be taken into account so that both parties could incorporate the knowledge and procedures characteristic of the biotechnology engineering profession interwoven with biotechnology disciplinary reading expertise into their teaching practices. Moreover, the reading strategies of both bioengineering experts and students employed when approaching the unique features of disciplinary texts also revealed an approach that promotes generalized learning strategies (e.g., EFL reading strategies: visualization of information, confirming predictions) and processes that could be adapted across different disciplines; however, it is unclear about the disciplinary-specific reading strategies used in biotechnology engineering.

Sociocultural strategies. Studies Carless et al. [21], Esterhazy [5], and Bojović [4] highlighted that productive feedback should account for disciplinary practices. A novel concept of signature feedback practices as compared to generic feedback to denote characteristic feedback strategies built into disciplinary pedagogy was revealed. They reported that in the current climate of pandemic-driven online learning, feedback in the form of video based on multiple students works is widely applicable across a wide range of disciplines, such as sports science. Wilkie and Liefeith, [31], architecture, engineering, education [32]. As respondents expressed that it was motivating to have regular, timely, personalized, sustained, two-way transmission of feedback, promoting disciplinary ways of thinking and sharing responsibility for feedback processes and real-life interactions. Such a conducive environment resonated with experiential learning in internships or placements in other disciplines. Nevertheless, due to the heavy workloads of teaching staff and high student enrollment, summative performance, such as end-of-semester written feedback, seemed to dominate formative feedback [21].

In addition to this, a qualitative narrative inquiry study set out by Carlson [6] has proven the authenticity of apprenticeship, whereby a teacher candidate was placed in a field experience with disciplinary experts, as a result of unconscious acquisition of the ways of thinking, speaking, and valuing rather than the result of overt or direct instruction from a teacher. A reflective disposition was also crucial while engaging in instructional activities such as planning, enacting, and assessing lessons.

By addressing the relational aspects of feedback in higher education settings, Esterhazy [5] contended that productive feedback encounters are characterized by fluidity, whereby elements, namely adequate time, space, and material resources (e.g., online sources), are organized. This may help unpack problem-solving skills before they seek help and develop the skills of locating relevant knowledge.

As a result, it can be explained that DL does not happen in a vacuum but in an open and personal relationship between instructors and students grounded in disciplinary orientation and students' encounters with the feedback. As highlighted in a study conducted by Mpofu and Maphalala [7] in South Africa, English language, which is known as language of learning and teaching (LoLT) and considered as language employed in learning, serves as an interpretive disciplinary medium for interaction and conceptual development. The study sought to understand student teachers' development of English language skills within their sociocultural environment, which is a second language learning environment. The fourth-year Bachelor of Education students noted that presentations played a huge part in the pedagogical practices without further support and resources in communicating about disciplinary knowledge and developing disciplinary ways of thinking. There appeared to be mixed results concerning whether or not teachers in the soft applied disciplines, namely architecture and education, seemed to invest more time and commitment in providing personalized feedback than those in the hard disciplines, namely engineering and medicine. However, it is noteworthy that disciplinary priorities, social, cultural, and contextual factors should be taken into account in developing a curriculum that enables sufficient time and space for productive encounters authentic to the discipline.

Linguistics strategies. Richards [33] has shown that disciplinary knowledge comprehension can be further facilitated due to students' competence in the English language of the subject. In a qualitative multiple case design study (N = 102) conducted by Mpofu & Maphalala [7], a preparation approach, English across the curriculum activities (also known as English for specific purposes), is designed to include courses and learning materials meant to develop students' LoLT proficiency. It is argued that without a strong foundation in language skills such as grammar, lexis, discourse, and genre, students may struggle to effectively apply DL strategies in varied academic contexts. It is essential to ensure that students are equipped with the necessary linguistic and literacy skills to meet the discipline language demands [34]. According to the author, micro-teaching and lesson planning modules were where disciplinary language skills and content were deliberately used in practice. Through these activities, knowledge was constructed, sustained, and communicated among student teachers' interactions and experiences. It is because language makes the articulation of thought, knowledge, and experience possible. However, some curriculum specialists argue that excessive focus on DL could potentially overshadow the essential linguistic skills that students need to communicate effectively in English [7] [35]. According to Mpofu and Maphalala [7], an analysis of the module content discovered that the focus of institutions studied was on student teachers' knowledge of generic language skills–speaking, listening, reading, and writing.

In a study conducted by he [19], English language teaching (ELT) for English majors in Chinese universities was examined, revealing disciplinary English to be included as a significant part of the curriculum for English major programs. This is done by emphasizing the particular literacy practices that are inherent in each discipline, much like in middle and secondary schools in the United States [4] [36]. As defined by Hamp-Lyons [37], disciplinary English is employed in the teaching and research of English across different disciplines in the higher education context and can be categorized into different subtypes based on the classification of disciplines

(e.g., English for education, English for economics, English for physics) and fields of practice (e.g., business English, journalistic English). It is located between English for academic purposes (EAP) and DL, and the focus includes academic language of English used in different academic disciplines, discipline-specific vocabulary, grammar, and other aspects of language, aiming to build discipline-specific knowledge. In terms of nature, EAP and disciplinary English are both approaches to ELT, while DL is largely a teaching methodology in the content areas. A common ground between the EAP and disciplinary English is that content and language of the academic disciplines are inseparable, as implied by the term 'literacy-content dualism,' and the emphasis from each depends on the levels of education [19]. He [19] further distinguished that learners of EAP and disciplinary English are non-native speakers, whereas DL learners are English native speakers. Dissimilar findings concerning the importance of focusing on English language while building disciplinary knowledge were found in studies [7] [19].

On the other hand, consistent with Mpofu and Maphalala [7] and He [19], the study of Liashenko and Bula [15] indicated that specific vocabulary units are crucial for DL development. In English for specific purposes (ESP) courses, it was proposed to apply disciplinary communicative practices (e.g., professional situations) in class, targeting specific information, specialized vocabulary, and language structures, as this can boost the development of expertise in specific disciplines. These findings are in line with a study conducted among L2 PhD students from the hard disciplines (HD-science and engineering) and the soft disciplines (SD-humanities and social sciences) in China. Ioratim-Uba [22] stressed the roles of interactive pedagogy and functional language features, namely structure-moves and linguistic features, in the construction and communication of knowledge in the disciplines in disciplinary writing development. Similarly, Sanchez-Perez [17] elaborated on the frequency of occurrence of certain disciplinary-literacy variables at the level of text structure, cohesion, vocabulary, and grammar, and students' content proficiency in English-medium writing related to the genre and specialized-language features of the laboratory report.

Based on the studies reviewed with respect to linguistic strategies, it is unequivocal that the cross-disciplinary approach, which is focused particularly on the nature of the collaborative process between discipline and academic language and literacy staff, is highly recommended to be deployed. For instance, forming a unique team and teaching and embedding academic language and practices into the curriculum constitute one of the models of best practices [38]. Most importantly, studies have shown the relevance of language as part of DL skills and evidenced the intertwined nature of disciplinary English and disciplinary content. These constituent skills are crucial in providing remedial support for struggling students in English-medium contexts.

Disciplinary reasoning strategies. As Moje [39] proposed, a number of elements play a role in the production of knowledge and critical thinking. Other than discipline-specific linguistic codes, technical vocabulary, and discourse practices, cultures 'in which certain kinds of texts are read and written for certain purposes and with or to certain audiences.' A study founded on case study design set out by Prinsloo [24] among students between B1 and upper-B2 on the Common European Framework of Reference (CEFR) across hard pure or applied (e.g., natural sciences vs. engineering) and soft pure or applied disciplines (e.g., art vs. music) based on their perceptions of the use of literature. It has suggested the use of short stories as a less time-consuming and versatile aid through implicit or explicit teaching inside or outside class so as to stimulate general or specific critical thinking across disciplines

due to the restraints of time and resources in establishing an independent critical thinking course or setting extra time in teaching general or disciplinary-specific thinking. Three thinking patterns identified in the study included heterogeneous patterns across disciplines, homogenous thinking patterns, and cross-disciplinary homogenous coupling as a result of an imbrication of content with DL and general with specific critical thinking. As such, the same hard or soft family do not have to be grouped together because of the assumption of similar thinking patterns. Moreover, this study has demonstrated that both content literacy/general critical thinking and disciplinary literacy/specific critical thinking could be utilized simultaneously or progressively depending on students or institutional needs. Content literacy and general critical thinking could lead to soft inter-, multi-, or transdisciplinary heterogeneous thinking because a general skill set could be easily transferred to a specific discipline granted that the zone of proximal development is optimal and purposeful [8]. DL and specific critical thinking could lead to hard, intradisciplinary, homogeneous thinking, as specific skill sets inculcate students into specific disciplinary discourse communities.

Three authors, namely Dafouz [23] and Reynolds and Rush [26], shed light on the integration of language and content through dialogic teaching strategy. Dafouz [23] suggested that English-medium instruction (EMI) teachers should place emphasis on helpful aids such as clarifying the definitions and translations of subject disciplinary terminologies and modeling the linguistic patterns in English in prompting behavior fostering reasoning (e.g., drawing on preceding talk, clarifying). Reynolds and Rush [26], on the other hand, specified the technique of interpretive, purpose-driven reading, paying attention to prior knowledge through the strategies of questioning, i.e., inferential questions, summary skills, analysis skills, and so on. Moreover, given the importance of disciplinary features such as disciplinary oral conventions and reasoning. Dafouz [23] argued that both TESOL professionals and content specialists can co-construct language-sensitive syllabus, materials, and pedagogy. This strategy coincides with the collaborative nature as posited by Prinsloo's [24] arguments.

In a comparative case study, collecting many of the texts that engineers read or wrote across engineering sub-disciplines in workplaces was conducted by Wilson-Lopez [13]. Transformative DL pedagogies resulting in new and expanded activity and instantiations of what engineering students can explicitly learn and apply have been explored. They employed hybridized genres (e.g., technical texts, testimonials, schedules, maps, and petitions), common and expensive evaluative frameworks, and common and expansive literacy practices across multiple domains (i.e., firms, roles, and disciplines with an equal number of participants who identified as male and female). Interestingly, the study found out that the written genres identified were consistent with Vygotskian-inspired theories of activity systems, that the typified yet dynamic mediational tools (i.e., varied genres) are reproduced among professionals within the same disciplines reflected the traditions of their sub-disciplines (schematics in electrical engineering; aerial maps in civil engineering), as well as in ways that enabled them to achieve basic objects consistent with their company roles (managers frequently created schedules to coordinate labor).

It is also noted that corresponding to the aforementioned sociocultural and linguistics domains such as modelling (e.g. interactive think-aloud) and sharing exemplar texts and discussing their attributes, critical thinking competence are deemed essential which includes identifying and evaluating datasets and information they would need to define a problem, critiquing, rewriting and expanding genres (e.g. standards), engaging in peer review in producing compositions, using multilingual or monolingual to address under-consulted shareholders., reproducing disciplinary linguistic

and representational forms (e.g., specific measurements through scaled maps can help to avoid roads that are dangerously narrow).

3.2 Discussion

The objective of the present study is to determine the components in relation to DL in recent research to promote learning and achievement in higher education so as to develop epistemological understanding of DL. In this review paper, it has been shown that recent studies shed light on four DL components, including linguistics, cognitive, sociocultural, and disciplinary reasoning. These domains attest to the definition that DL is a set of developing skills, namely speaking, writing, and reading, assisted with critical thinking abilities to acquire the specific knowledge of the discipline.

Based on the articles reviewed, the past decade has witnessed the exponential growth of scholarship on DL or disciplinary literacies, recognizing that previous generic approaches to reading and writing instruction have not resonated with the goals of many educators. Some scholars, Shanahan and Shanahan [36], define "disciplinary literacy" as a set of skills, such as the "literacy skills specialized to" a discipline (p. 44), whereas others refer to it as an instructional approach, such as one of the "approaches to academic literacy development in the content areas" [1]. Others defined disciplinary literacies to include patterned ways of interpreting, evaluating, composing, or using texts to achieve discipline-specific goals [13] [40].

Based on the review, the definition of DL is often associated with the evaluation of specific knowledge and generating knowledge in the specific area as proposed by Moje [41]. Furthermore, the definition of DL also appears to be associated with a combination of content knowledge with the skills of reading, writing, listening, speaking, critical thinking, and adequate performance. Based on the previous review, DL could be interpreted as the proficiency in mastering fundamental skills along with advanced cognitive abilities, enabling individuals to acquire specialized content knowledge that reflects a thorough and sophisticated understanding required for a particular profession or field of study. This is in line with Liashenko and Bula's [15] definition of disciplinary literacy, which refers to the ability to master the primary skills with the high-order thinking skills to acquire specific content knowledge that reflects the deep and developed knowledge for a job. By considering the studies reviewed previously, it could be argued that the concept of DL has the potential to help students bridge the gap between high school and college or work, referring to a particular combination of disciplinary-specific communicative practices to be developed for three specific domains: the academic community, the workplace, and society [42]. The potential for DL to help students transition from high school to college is highlighted, indicating the relevance of DL across educational levels. Nonetheless, it could be inferred that the challenges in integrating DL into subject-area teaching and the proposed alternative approaches highlight potential inconsistencies in the current implementation of disciplinary literacy. Due to the increasing number of studies focused on disciplinary forms of literacy, this also provides strong evidence supporting the need for a DL framework in higher education settings. This framework should consider the unique literacy practices of different disciplines and the importance of integrating DL instruction in higher education settings, which could also address the literacy demands of diverse student populations.

One of the purposes of this review paper was to gain more of an understanding of the strategies used to develop DL based on studies of DL in higher education that

have been undertaken across a wide range of disciplines in both EFL and English as a native language setting, such as STEM, English, education, music, sports, and so on. Given the complexity of texts college or undergraduate students are expected to read, it is of key importance that assistance through university tutoring or academic support programs (i.e., Reading Effectively across Disciplines (READ)) must be in place to enable them to be career and college ready. The key to this is appropriate scaffolding [43]. Students should be given ongoing and collaborative opportunities to develop their processing skills before being expected to read, think, write, and speak independently. With the lack of opportunity to discuss the source and receive support, there is little likelihood for students to make breakthroughs in their fields [44]. This paper suggested a number of common strategies that can be adapted to teach discipline-specific skills across disciplinary contexts. The strategies identified involve writing strategies, reading strategies, speaking strategies, thinking strategies, and feedback strategies. Yet, the results showed that the development of students' DL has not been established across the curriculum, with content area instructors often considering literacy instruction as relevant only in English courses. In turn, it hinders students' capacity to think, read, and communicate in ways consistent with those practiced in the disciplines, potentially impacting their overall learning outcomes. Nevertheless, to teach DL in a more inclusive way, it should be mindful of students for whom English is not their first language to develop specialized disciplinary and professional varieties of English. Though it has been reported that there is an array of strategies that can be used to teach DL, only a minority of studies (i.e., Turner and Rossi, [3]) sufficiently address the use guidelines relating to skills or strategies involved. Studies in the future should look at measures of performances or guidelines for evaluation by exploring, for instance, the development of established assessment guidelines or rubrics prioritizing the acquisition and integration of new knowledge, extending and refining knowledge, using knowledge to perform meaningful tasks, and developing powerful habits of mind that enable students to regulate their behavior and think critically and creatively.

In answering the last research question with regards to some fruitful directions for future research and development in this area, a few suggestions are put forth. The review revealed that there is a dearth of DL-related research in countries where English is used as a second language or a foreign language. In addition, DL pedagogical strategies drawn from the existing studies may not be generalizable across various types of students in different settings. As a result, future research could explore the different educational theories and instructional approaches in different geographical regions with larger sample sizes or quantitative designs, such as ESL or EFL contexts, in order to establish their practicality and feasibility. Moreover, it is also worth mentioning that most researchers have granted attention to developing DL through learning the main generic skills for acquiring the specific content within the discipline. Due to the rise of correlation between successful job placement and increasing literacy in the academic process suggested by the researchers as rich diversity skills are suggested to be important professional skills of the 21st century [36], there seems to be some inconsistency in the additional components of disciplinary literacy. Hence, future researchers can seek to further develop frameworks and clarify how post-secondary instructors can best incorporate DL constituents pertaining to professional competency into course design, which influences the development of DL with students at universities as a result of the inconsistency of information [15] [16]. Most importantly, it is also interesting to find out if DL differences are distinct enough to be delineated by discipline, or could they be collapsed into approaches that could be commonly utilized across other sub-disciplines,

namely under Humanities and Social Sciences, which have received lesser attention compared to STEM sub-disciplines, such as Chemistry, Physics, and Mathematics.

3.3 Limitations

Given that the generalizability of DL strategies drawn from the existing study may be questionable, additional research could investigate the viability of the aforementioned DL strategies during pedagogical instruction in a bid to recognize and respond to the challenge that disciplinary language and disciplinary differences present to students, such as ESL, non-honors students, and struggling college learners. While the centrality of this paper is on the four dimensions of DL associated with the DL strategies (i.e., cognitive, sociocultural, linguistic, and disciplinary reasoning), the resulting focus of the four key aspects could be different due to a limited number of literatures reviewed and the few numbers of studies identified that were conducted with acting professionals in the discipline. However, this review paper underscored the importance of DL and raised awareness among instructors to provide timely and constant pedagogical supports by drawing from readily viable strategies that might be put into use cautiously.

3.4 Implications for practice

This study is beneficial for professionals specializing in content, practitioners, curriculum developers, and university leaders within higher education institutions to enhance teaching and learning approaches by fostering DL skills in an equitable and unbiased manner while conveying specialized subject knowledge [13]. It is imperative to underscore the collaborative efforts among subject matter experts, English for Specific Purposes (ESP) practitioners, and literacy educators, as they synergistically work together to support all learners in acquiring advanced disciplinary literacies in tertiary educational settings worldwide.

4 CONCLUSION

In a nutshell, this review has explored the etymological understanding of DL and DL components manifested in the types of strategies as well as practices and their effectiveness yielded in the latest studies spanning over the past 10 years. This conceptual paper sheds light on the concept of disciplinary literacy—the conceptual understandings and ways of reading, speaking, listening, writing, and thinking involved in critiquing and constructing knowledge in a discipline. This paper also highlights high-quality DL learning opportunities across subject areas in tertiary settings that engage students in critically examining the world around them, interrogating accepted knowledge, contributing their own perspectives to shape that knowledge, and sustaining and developing the literacies needed to do this work [45]. As a newly emerging skill in the 21st century, DL has arisen as a type of advanced literacy that is crucial for graduates' academic and professional attainment due to the increasingly strong demand for highly competent professional staff. Overall, this study aims to provide insights into how DL can be enhanced at the tertiary level, investigate dimensions of DL learning, and lastly identify gaps that deserve greater concentration for future studies. Based on the findings of this study, a conclusion

can be drawn that the activation of DL necessitates cross-curricular collaboration, ongoing professional supports, embedded learning of various skills, contextualized learning experiences, and most importantly, a driven mind.

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