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COGNITIVE LOAD THEORY IN SPECIAL EDUCATION: A THEORETICAL REVIEW OF FOUNDATIONS, ADAPTATIONS, AND FUTURE DIRECTIONS

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Abstract

Although Cognitive Load Theory (CLT) has been applied to instructional design for decades, its application to special education has frequently been done faster than the theoretical checking process. Numerous studies use CLT's terminology without considering whether a theory designed for typically developing learners applies to learners with special educational needs (SEN). This paper is a theoretical review, following the approach described by Grant and Booth (2009). It examines how CLT has been carried into special education, where that transfer has been adapted with care, and where it has simply been assumed. The review is based on a structured literature base for the core constructs of a CLT and twelve disability categories. It also compares CLT to five theories that are also used by special educators: working memory theory, the cognitive theory of multimedia learning (CTML), explicit instruction, universal design for learning (UDL), and executive function theories. The synthesis finds real theoretical extension in some areas, but shallow or borrowed use in others. There are several assumptions that have not been sufficiently tested, such as the assumption that the limits of WM are homogeneous across disability types. The paper suggests guidelines for future theoretical and empirical research.

Keywords: cognitive load theory, special education, instructional design, theoretical review

INTRODUCTION

Cognitive load theory (CLT) started with a simple observation. Working memory (WM) has limited capacity, and instruction that is outside of the capacity fails, regardless of accuracy or good intentions. (Sweller, 1988, 1994). This concept was expanded over the next few decades to become one of the most cited models in instructional psychology, resulting in a series of highly replicated effects, including the worked example effect, split-attention effect, modality effect, and expertise reversal effect (Sweller et al., 2011a, 2011b, 2011c, 2011d). This expansion has been one of the more successful narratives in the field of educational psychology, just because of how it never became a collection of slogans but always produced predictions that could be tested. (Sweller et al., 2019)

The theory proved to be very useful to special education researchers, who discovered this fact quite early. This is because if WM is a limiting factor for typical children, it should be even more limiting for children with disabilities that already have a problem with memory, attention, or processing speed. Kennedy and Romig (2024) state this quite explicitly: Learners with learning disabilities (LD) often find themselves struggling because they lack ability; they struggle in the classroom because their WM system has less spare capacity. This argument is intuitive and has led to a number of applications: from text presentation for learners with dyslexia (Tricot et al., 2020) to pedagogical agents for learners with dyscalculia (Ahuja et al., 2021) to virtual reality training for adolescents with autism spectrum disorder (ASD) (Zhang et al., 2017).

This is because, while it is easy enough to borrow a theory, it's not quite the same as adaptation. CLT was designed and tested primarily with learners with typical WM profiles, and its theoretical instruments and constructs for determining level of expertise and even definitions of load were developed with this population in mind (Sweller, 2018; Krieglstein et al., 2023). If a study does not

ask questions about the nature of memory, attention, or processing that are relevant to the disability label, it's simply loading into an existing CLT without testing its conclusions. This was the pattern that Duran et al. (2022) observed when they reviewed research on CLT's use in computing education; most of the studies they reviewed referenced the theory to support their design decisions but did not explore the more recent and more specific claims of the theory. It's hard to imagine there's much reason not to think that's not the case with special education research.

Meanwhile, actual theoretical efforts have been undertaken. A few researchers have moved beyond borrowing words and offered concrete additions: For example, for LD, Hussain (2025) proposed a phase-based instructional model, and for ASD, Fisher et al. (2023) and Le Cunff et al. (2024) offered neurophysiological accounts of how cognitive load relates to attention and perceptual processing in ADHD and ASD, respectively. The difficulty is that the contributions are spread across disability categories, instructional domains, and publication venues, and there are few attempts to coalesce them into a logical theoretical narrative. If a teacher or researcher wants to grasp the meaning of CLT's articles on, say, intellectual disability, versus those on hearing disability, then they will need to read a dozen individual papers, each articulating the issues differently and each making different assumptions.

This paper is an attempt at that pulling together. This is a theoretical review as opposed to a systematic review of empirical outcomes, and this is not intended to be a review of effect sizes but rather a review, comparison, and synthesis of the theoretical claims that link CLT to special education.

Objectives of the Study

Six objectives guide the review:

To examine the theoretical foundations of CLT relevant to special education.

To analyze how CLT has been theoretically adapted across disability categories.

To compare CLT with related theories used in special education.

To identify unresolved theoretical issues.

To synthesize these developments into a coherent account.

To propose directions for future theoretical work.

Research Questions

The objectives of the study translate into six research questions.

RQ1: What theoretical foundations underpin CLT's use in special education?

RQ2: How has CLT been adapted for learners with different disabilities?

RQ3: How does CLT relate to other major theories in the field?

RQ4: Which assumptions remain insufficiently examined?

RQ5: What theoretical gaps limit current applications?

RQ6: How can existing perspectives be integrated to strengthen future work?

METHOD

Review Type

This study follows the theoretical review format described by Grant and Booth (2009). A theoretical review does not sum up empirical effect sizes; that is the role of a systematic review or meta-analysis. Rather, it focuses on the ways in which the central tenets of a theory have been adopted, extended, or

disputed in a specific literature, aiming to improve the theory. That is a good fit for this project, because the question is not whether CLT-based interventions work, but whether CLT as a theory has been sufficiently adapted to special education populations and where further adaptation is needed.

Data Sources

The databases used for the literature search were Scopus, Web of Science, ERIC, PsycINFO, Education Source, and Google Scholar. These sources were selected because they reflect the literature in psychology, education, and special education but do not focus excessively on any of these disciplinary perspectives, which is important for a theory that is grounded in the field of cognitive psychology and instructional design.

Search Terms

A union of two sets of search terms was used. The initial family was CLT, and the core constructs of CLT: "cognitive load theory", "intrinsic cognitive load", "extraneous cognitive load", "germane cognitive load", "working memory", "worked examples", "expertise reversal", "split-attention effect", "modality effect", "redundancy effect", "element interactivity", "transient information effect", and "cognitive load measurement". The second family included disability categories specifically for special education: "learning disabilities", "dyslexia", "dysgraphia", "dyscalculia", "autism/autism spectrum disorder/ASD", "ADHD", "hearing impairment", "visual impairment", "physical and health impairment", "multiple disabilities", "giftedness", and "intellectual disability". The terms from both families were combined by using AND for example, "cognitive load theory" AND "autism spectrum disorder", and another search was conducted for each disability term combined with "cognitive load" in general for that term to capture studies that include discussions about load without employing the formal vocabulary of CLT.

Inclusion and Exclusion Criteria

The sources included were peer-reviewed journal articles, basic CLT publications, theoretical and conceptual papers, framework development articles, review papers with significant theoretical content, influential book chapters, and seminal papers from instructional psychology and special education. Conference abstracts, editorials, and opinion articles with no theoretical contribution; empirical studies with only description but no theoretical discussion; articles that spoke of CLT only occasionally; and articles that were not published in English were excluded.

Analytic Approach

The analysis was not a coded systematic extraction, but rather a critical theoretical synthesis. Sources were grouped first by CLT construct (core theory, measurement literature, and major effects) and then by disability category to facilitate direct comparison of the presence, or lack, of the constructs across disability groups. The subsequent steps in the synthesis process included mapping the evolution of CLT is core assumptions, identifying how those assumptions have been adapted for each disability category, comparing CLT with other related theories, identifying assumptions that have not been explored or challenged, and looking for gaps in which theoretical development has not caught up with the number of applied studies. The steps are directly linked to the six research questions and will guide the results that follow.

RESULTS

Theoretical Foundations of CLT

There are relatively few claims about human cognitive architecture that underlie CLT. WM is only able to store and manipulate four to seven elements at a time, and when the information is new, the capacity is even smaller (Baddeley, 2003). In contrast, long-term memory is taken to be essentially unlimited, and one of CLT's more significant assertions is that expertise is essentially composed of organized knowledge structures, which are known as schemas, in long-term memory (Sweller, 2024). After the schema construction, it can be used as one unit of WM instead of several units so that experts can manage information that will be too much for a novice. Sweller (1988) initially presented

this as a problem-solving issue, saying that traditional means-ends problem solving requires so many WM resources that it leaves insufficient space to develop the very schemas that would enable the learner to become more efficient in solving problems.

There are three types of cognitive load that CLT draws from this architecture. Intrinsic cognitive load (ICL) is the complexity of the material itself, which is basically the number of interacting elements that a learner has to retain in his or her mind at one time (Sweller, 1994). Extraneous cognitive load (ECL) is a result of presentation, and it is viewed as "wasteful" because it may take up WM capacity without adding to learning (Skulmowski & Xu, 2021). Germane cognitive load (GCL), the most debated of the three, refers to the effort spent on actually building schemas (Klepsch & Seufert, 2020). As Kalyuga (2011) has suggested, the three-way division might be more nuanced than it appears, because ICL can be considered a form of GCL that is engaged productively instead of being ignored, and this controversy has never reached its resolution. There has been a similar development of progress and disagreement in the area of measurement. The subjective rating scales have been the most frequently used measures to date, on the back of previous physiological and behavioral measurement methods (Schultheis & Jameson, 2004) and more recent reviews of the operationalization of the three load types over time (Orrù & Longo, 2019). The standard three-factor questionnaires were shown to be reasonably reliable by Krieglstein et al. (2022) and taken alongside physiological measures such as eye tracking, EEG, and heart rate variability, which are also becoming more common (Ekin et al., 2025), as self-report is not always available or reliable for learners with communication or cognitive difficulties.

These basic statements were not designed with disability in mind. The four-to-seven element estimate is based upon research done with typically developing adults and children. The idea that GCL is always good is based on the assumption that there is enough capacity for the learner to invest in schema building in the first place. These are not really flaws, per se, because every theory has to have a beginning, but it does imply that anyone using CLT with special education populations is already using a theory that has not undergone stress testing with the population it is trying to explain.

Core CLT Effects as Theoretical Mechanisms

CLT's practical impact is largely in a few known effects, and we can categorize them by the claims made, not just list them. The first set of concerns relates to skills. The worked example effect suggests that novices learn more from reading a worked example than from attempting a problem on their own because they are using WM for solving the problem rather than comprehending why the problem follows this format (Ward & Sweller, 1990; Atkinson et al., 2000). However, as learners build their expertise, this advantage turns into a disadvantage, which is called the expertise reversal effect (Tetzlaff et al., 2025; Kalyuga, 2009): procedures that might support beginners may actively interfere with those who already have the related schemas, as redundant guidance becomes another source of ECL. Later, Chen et al. (2017) suggested that this effect is not truly unique but rather a subset of a larger element interactivity effect, i.e., the number of elements that a learner must process as separate units changes with expertise.

The second group is related to the presentation format. The split-attention effect refers to the fact that when related information is physically separated, such as the diagram and the caption, then WM capacity is required to keep the pieces together, even though the information is related (Chandler & Sweller, 1992). Mayer and Moreno (1998) extended this to multimedia environments, where the same effect was observed: the audio presentation of text in conjunction with the visual presentation of a diagram was less costly than the audio presentation of text alone. This is what is called the modality effect, and Ginns (2005) showed that this effect is fairly consistent across many studies. The redundancy effect is near at hand: when the same content is repeated in two different representations, the second repetition does not support learning, but rather imposes a redundant load on processing by adding no new knowledge to the first presentation, whether the repetition occurs within the same channel or from a second one (Kalyuga & Sweller, 2021; Trypke et al., 2023).

The third relates to the structure of the content. Element interactivity refers to the number of pieces that must be kept in mind at the same time because they are related to each other and as such is regarded as one of the primary variables of CLT since ICL is merely a function of element interactivity as compared with the learner's expertise (Sweller, 2023). There is also the transient information effect, which introduces the time element: Information that is transient, like spoken instructions or animations, is harder to process than information that remains visible, as the learner must hold it in WM instead of checking it again (Leahy & Sweller, 2011). These three groups together provide CLT with an adequate degree of internal consistency. The expertise changes the amount of load created; the format for the presentation changes the efficiency of the distribution of load; and the structure of the content sets a bottom line on the amount of load that exists before any instructional decisions are made. If not explicitly stated by researchers, this logic is what special education applications acquire.

Theoretical Adaptations across Disability Categories

This section reviews the twelve disability types addressed by the CLT review and asks whether, and how, the CLT has actually adapted to the population.

Learning Disabilities

It is the category that has been most seriously subjected to theoretical discussion from the perspective of CLT. Kennedy and Romig (2024) bring a different perspective to the topic of the CLT for special and general educators: learners with LD frequently have an elevated ICL, since gaps in previous knowledge require that more information must be taken in as individual units instead of schemas. Hussain (2025) takes it further and suggests a phase-based instructional design framework that operationalizes CLT directly with this population, rather than as a generic justification. Barbieri and Rodrigues (2025) test this theory specifically in mathematics difficulty, as well as Shaban et al. (2021), who test it empirically via a cognitive training application, which they find WM gains correlate well with the level of load controlled by the application. Collectively, this is a body of work that suggests that CLT is a process to be emulated rather than simply referenced.

Dyslexia

Here, there is real nuance in the work. Tricot et al. (2020) use CLT to explain how difficulties in decoding cause a corresponding increase in ICL for reading tasks, because letter-to-sound conversion never becomes completely automatic and occupies WM that could otherwise be used for comprehension. This picture has been complicated by more recent work. Ramezani Doroh et al. (2026) report that verbal WM deficits interact with the type of cognitive load, depending on the nature of the dyslexia (linguistic vs. perceptual), indicating that a single load profile does not characterize the entire dyslexia category. In a neurophysiological perspective, Le Cunff et al. (2024) found that the signatures of load on electroencephalography (EEG) and related measures differed across dyslexia, ADHD, and ASD, despite the fact that all three conditions have been presented under the umbrella of processing difficulty.

Dysgraphia

The presence of CLT here is weaker and less adapted. Aiswarya and Ponniah (2024) offer a very convincing memory-based description of dysgraphia, which relates it to the disruption of orthographic long-term memory and orthographic WM, but the emphasis here is more on general memory research than on CLT specifically. When CLT does appear, as it does in the work by Zou et al. (2025) on embodied cognition, it serves as a general lens for the reasons why movement may aid learning but does not appear as a disability-specific theoretical adaptation. This gap is significant because dysgraphia is a motor and orthographic output problem, while CLT's vocabulary that is based on perceiving and processing incoming information does not map as easily as it does in reading or listening.

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Dyscalculia

Here the adaptation is more active. Ahuja et al. (2022) test pedagogical agents specifically with dyscalculia and non-dyscalculia learners side by side and find that the agents boost GCL and improve retention for both without appreciably increasing ECL; this is a useful demonstration that the three-way distinction of CLT is relevant even in a population with a specific numerical processing deficit. On a more basic science level, Ashkenazi et al. (2009) demonstrate that the basic impairments of attention and numerical processing interact in ways that are not the same as those seen in typical development and, as such, indicate that there is not a common load profile across the disability. Fatqurhohman et al. (2025) link this to the instructional practice, noting that using multimodal representations and differentiated learning can achieve load reduction and also serve to reduce math anxiety, thus viewing load reduction and emotional regulation as synergistic rather than separate objectives.

Autism Spectrum Disorder

This category holds one of the more theoretically interesting findings in the entire review. Despite what some suggest, autistic people do not seem to lack perceptual capacity, because Remington et al. (2012) and Bayliss and Kritikos (2011) both report that autistic people do not have a perceptual capacity filtering problem; they actually have a perceptual capacity overloading problem. This contradicts the common-sense notion, demonstrated in certain more casual applications of CLT to disability, that a diagnosis equals decreased processing power. There are added layers of complexity here, with Wadhera and Kakkar (2020) demonstrating that under cognitive load, more segregated brain network activity is associated with ASD and less integrated brain network activity. Zhang et al. (2017) applied it with a virtual reality driving simulator that real-time measures cognitive load to tailor training, which is indeed an adapted use of CLT, not a borrowed one.

Attention-deficit/Hyperactivity Disorder

ADHD research offers one of the most surprising theoretical twists in the literature. Forster et al. (2013) suggest that perceptual load is a double-edged sword: if perceptual load is increased, distractor interference decreases, in other words, distractor information is crowded out by perceptual load effects. Fisher et al. (2023) expand on this by separating the effects of perceptual load from cognitive load directly, revealing that greater perceptual load benefits performance in ADHD, whereas greater cognitive load detriments performance. This is a real theoretical refinement as it reveals that, in theory, more load is not necessarily bad, even within the same disability category, much less across disability categories, as CLT typically assumes.

Hearing Impairment

The most explicit theoretical account for this category is the Framework for Understanding Effortful Listening (FUEL) by Pichora-Fuller et al. (2016), which defines listening effort as an interaction of hearing difficulty, task demands, and motivation. This is supported by pupillometry data presented by Zekveld et al. (2011), who found that the cognitive load involved in speech perception in noise increased with hearing loss but decreased with the use of vocabulary and with context use, suggesting a compensating mechanism that is not captured by CLT's core model. One of the more advanced theoretical adaptations in the entire review, although to some extent, the effort-based framework of auditory and hearing science existed prior to the introduction of CLT.

Visual Impairment

The focus of the work here is more on interface and interaction design than on classroom teaching. Veldman et al. (2024) correlate concentration difficulty directly with fatigue severity in adults with visual impairment, indicating that load needs to be related to a longer time course than the single-session measures CLT typically uses, and Modanwal et al. (2022) compare gesture-based and Braille-based computer interaction under different load conditions. The theoretical adaptation here is real, but limited, since it focuses on tactile and auditory modalities of substituting for the visual rather than a more comprehensive discussion about how visual impairments alter ICL or ECL.

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Physical and Health Impairment

This classifies as one of the thinnest groups in the database. Burcal et al. (2019) demonstrate that cognitive load negatively affects motor performance among those with musculoskeletal injury; this is a beneficial result, but more applicable to sports medicine than special education instructional theory. Many of the tags associated with this category, including Zou et al. (2025) for the work on embodied cognition, apply more broadly than to physical or health impairment and do not yet have a dedicated theory development within CLT research on this topic.

Multiple Disabilities

No specific theoretical work exists for learners who have multiple co-occurring disabilities. All of the sources cited in this review focus on single-disability populations or general contexts of health behaviors, with no source specifically discussing how load might exacerbate or interact when two or more disabilities are experienced concurrently by a learner. This is a surprising omission, as co-occurrence is fairly common in special education classrooms.

Giftedness

Giftedness falls on a fascinating theoretical spectrum between CLT, which was created to overcome capacity limitations, and giftedness, which is the idea of having more capacity or more efficient processing to begin with. Kuznetsova et al. (2024) report increased cognitive function and brain activity among gifted children, without directly tying it to the load theory. Renati et al. (2024) study parental stress and not the cognitive processing of the gifted learners themselves. For this reason, this group is currently one of the least well developed in terms of CLT connections, and although gifted education is a long-standing discipline, with its own instructional literature, its connection with CLT is not as well developed.

Intellectual Disability

This category indicates some of the most obvious physiological interactions with CLT constructs. Lapshina et al. (2021) recorded cognitive auditory evoked potential in adolescents with intellectual disability (ID) while they performed the load task and observed no significant changes in amplitude or latency, which the authors interpret as evidence that "traditional load paradigms may not yield the same results in a population of ID adolescents" Jouira et al. (2024) broaden the scope to motor and postural control, revealing that both cognitive load and visual variability influence the balance of adolescents with ID, highlighting load effects that extend beyond the cognitive realm and into physical function.

Table 1. Theoretical adaptation of cognitive load theory across disability categories

Disability Category	Primary CLT Issue	Major Theoretical Adaptation	Key References	Level of Theoretical Development
Learning Disabilities	High intrinsic load	Phase-based instructional design	Kennedy & Romig (2024); Hussain (2025)	Strong
Dyslexia	Reading-related intrinsic load	Decoding-specific load mechanisms	Tricot et al. (2020); Le Cunff et al. (2024)	Strong
Dysgraphia	Orthographic and motor processing	Limited adaptation	Aiswarya & Ponniah (2024); Zou et al. (2025)	Weak
Dyscalculia	Numerical processing load	Multimodal load management	Ahuja et al. (2021)	Moderate
ASD	Perceptual processing	Perceptual overload rather than reduced capacity	Remington et al. (2012); Zhang et al. (2017)	Strong
ADHD	Perceptual vs cognitive load	Opposing effects of different load types	Fisher et al. (2023)	Strong
Hearing Impairment	Listening effort	FUEL framework	Pichora-Fuller et al. (2016)	Strong

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Table 1 (Continued). Theoretical adaptation of cognitive load theory across disability categories

Disability Category	Primary CLT Issue	Major Theoretical Adaptation	Key References	Level of Theoretical Development
Visual Impairment	Interface and fatigue	Modality substitution	Veldman et al. (2024)	Moderate
Physical/Health Impairment	Cognitive-motor interaction	Minimal adaptation	Burcal et al. (2019)	Weak
Multiple Disabilities	Unknown	No theoretical framework	—	Very weak
Giftedness	Processing efficiency	Very limited CLT integration	Kuznetsova et al. (2024)	Weak
Intellectual Disability	Reduced available germane load	Physiological evidence	Lapshina et al. (2021)	Moderate

CLT in Relation to Complementary Theories

CLT is not the sole provider of special education, and it is important to appreciate the limits of CLT by examining how it relates to the theories in which it is most frequently articulated in relation. To be sure, working memory theory (Baddeley, 2003) is not a competitor to CLT, but rather its parent theory: the whole load framework of CLT relies on the model of Baddeley's limited central executive and its specialized subsystems. The difference lies in focus: Working memory theory is a general theory of cognitive architecture, while CLT is an instructional design theory that builds on it. This leaves CLT with all the unanswered questions in WM research, such as the continuing debate over capacity limits: whether they are fixed or resource-based (Awh & Vogel, 2025).

The cognitive theory of multimedia learning (CTML), mainly developed by Mayer, has the same focus on channel capacity as CLT, but it also has a dual channel assumption: Visual and auditory information is processed somewhat independently, as this is the reason for the existence of the modality effect (Mayer, 2014). In this respect, the two theories run so close together that some studies have applied them interchangeably, but CTML has tended to focus more on elements specific to multimedia, such as coherence and signaling, while CLT has maintained a more general claim to instructional design in general, not just multimedia.

Explicit instruction, as articulated by Archer and Hughes (2011), shares some similarities with CLT in terms of modeling, guided practice, and gradual release of responsibility, which correspond rather straightforwardly to the worked example and the expertise reversal effects. However, explicit instruction is not derived from a cognitive architecture research base, but rather from applied behavior analysis and direct instructional traditions in special education, so it provides more detail on its classroom-level procedures than CLT does, although it shares some commonalities.

Universal design for learning (UDL) adopts a different approach altogether. Unlike CLT, which assumes a fairly consistent cognitive architecture around which instruction should be designed, UDL starts with the premise that there is variability and that multiple means of representation, action, and engagement need to be incorporated into instruction from the beginning (CAST, 2018). The two are not mutually exclusive—though it is true that reducing ECL is one approach to providing multiple means of representation, UDL is a design philosophy, and CLT is a cognitive theory, and mixing and matching them up is a recipe for making UDL's flexibility sound like it is just an application of the load reduction of CLT, which in turn obscures what UDL is actually saying about learner diversity.

Going back to Rumelhart (1980), schema theory is CLT's other parent in some ways, because from it CLT takes its account of expertise as accumulated schemas in long-term memory. The distinction is that classic schema theory focuses primarily on comprehension and knowledge organization, whereas CLT focuses on the WM cost of using or building schemas during instruction.

Executive function theories (Diamond, 2013) include WM, inhibitory control, and cognitive flexibility, which are three related but distinct functions. It is relevant to special education because

many of the categories of disabilities, particularly ADHD and ASD, are described in executive function terms instead of CLT terms. Both Fisher et al. (2023) and Tsermentseli et al. (2026) provide evidence that inhibitory control and cognitive flexibility do work; it is clear that while one WM bottleneck does capture a lot of executive function theory, it is not enough to explain some special education phenomena.

Table 2. Comparison of CLT with related theories

Theory	Primary Focus	Assumption about Learning	Relationship to CLT	Contribution to Special Education
Working Memory Theory	Cognitive architecture	Limited working memory	Foundational theory	Explains capacity limitations
CTML	Multimedia learning	Dual channels	Complementary	Multimedia instructional design
Explicit Instruction	Teaching procedures	Structured instruction	Procedural overlap	Classroom implementation
UDL	Learner variability	Flexible instruction	Complementary philosophy	Inclusive design
Executive Function Theory	Self-regulation	Multiple executive processes	Broader cognitive framework	Explains ADHD/ASD beyond WM

Convergence and Divergence across Theoretical Perspectives

There are some patterns that span the disability-specific sections above. First, categories that have had a strong tradition of cognitive/neuropsychological research prior to the arrival of CLT, such as the effort-based FUEL framework for hearing impairment and the perceptual load research for ADHD and ASD, demonstrate the most genuine theoretical adaptation. In those fields, CLT did not need to be imported in its entirety but instead was able to interrelate with a well-established body of theory. Second, categories lacking that history include giftedness, physical and health impairment, and multiple disabilities and show the thinnest and most borrowed use of CLT, using only the general theory (Sweller, 2024) without its more specific claims.

There also is a persistent issue in dispute that can be identified as such. Multiple studies make this assumption, either implicitly or explicitly, that disability is a loss of WM capacity in general (Kennedy & Romig, 2024). However, this is complicated considerably in the ASD and ADHD literature. Remington et al. (2012) find enhanced perceptual capacity in ASD, and Forster et al. (2013) find that added perceptual load can help rather than hurt attention in ADHD. The results of this study are not in conflict with CLT's basic structure, but they do refute the straightforward argument that disability is synonymous with reduced capacity, an argument that has not been addressed or even explicitly recognized in the general education literature that references CLT.

Unexamined and Challenged Theoretical Assumptions

There are four assumptions that need to be closely examined. The first is that WM limits are the same for all disabilities. This is not as clearly apparent as the ASD and the ADHD findings above make clear, and handling all disabilities as if they create the same load overload also reduces differences that have instructional design implications.

The second is that GCL is always desirable. This is a reasonable assumption for a learner who has some WM capacity left after ICL and ECL have been taken away. It makes far less sense if the learner has an ID or extreme attention deficit, as he or she might not have much available capacity to accommodate schema building even if the instruction is very well thought out. Lapshina et al. (2021) also noted this issue in their study, which failed to find significant differences in cognitive evoked potentials in adolescents with ID.

The third is that interactivity of elements can be assessed in the same manner among populations. The interactivity of elements depends on the number of elements (or pieces of information) the learner must hold separately, which in turn depends on how much prior knowledge the learner has already synthesized into schemas. A measure of element interactivity in one disability category may not be the same as in another, since disability may influence the way that prior knowledge is organized first of all, rather than the amount of it that is available.

The fourth is that self-report assessments of load remain the most common measurement method (Krieglstein et al., 2022) and are also appropriate for all populations. Self-report is a non-trivial requirement for learners with communication problems, limited metacognitive ability, or intellectual disabilities, because it involves a process of accurate introspection followed by communication of that introspection. An alternative is physiological measures (Ekin et al., 2025), but there are also questions of validity for these measures that have not been extensively investigated in special education settings specifically.

Table 3. Major unresolved assumptions in CLT for special education

Assumption	Why It Is Problematic	Evidence Challenging It	Research Needed
WM limits are similar across disabilities	Disability profiles differ	ASD and ADHD evidence	Disability-specific models
Germane load is always beneficial	Some learners lack spare capacity	Intellectual disability	Adaptive GCL models
Element interactivity is comparable	Prior knowledge differs	Multiple disability profiles	New measurement methods
Self-report is universally appropriate	Communication limitations	ID, ASD	Physiological measures

Theoretical Gaps Limiting Current Application

In addition to the above, there are some gaps that are not necessarily deficiencies in existing theory but rather missing pieces. The most obvious gap is that no developmental account exists. Much of the core claims of CLT are constant: A learner has a certain capacity, a certain content produces a certain load, and instruction should manage that load. However, learners with disabilities grow and develop over time, perhaps at a different rate or trajectory than typically developing learners, and CLT currently provides little guidance on how load management may shift throughout a school year or across years of intervention.

A second gap is the lack of theoretical research on multiple co-occurring disabilities mentioned earlier in “Multiple Disabilities” subsection under section titled “Theoretical Adaptations across Disability Categories” above in results. This is a significant practical and theoretical gap since many learners in special education programs have more than one diagnosis.

A third gap is measurement standardization. Cross-category comparison is almost impossible because different disability categories employ different tools: subjective rating scales in dyscalculia research, EEG in ASD and ADHD research, and pupillometry in hearing impairment research. If there is no shared method of measurement, or at least a shared set of principles to determine between methods, it is not really possible to compare claims of higher or lower burden by disability.

The fourth gap, seen in giftedness and in physical and health impairment, is underdevelopment. These are not places where CLT has been tried and proven to be a failure. They are places where CLT has engaged with theory very superficially, if at all, and where there are real opportunities to make a contribution of theory to the movement in the future rather than excluding it.

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DISCUSSION and CONCLUSION

Toward an Integrated Theoretical Perspective

When all the above elements are put together, one general extrapolation is warranted. Contrary to the general impression regarding disability in literature, which treats it as an additive or subtractive to cognitive load, the evidence suggests that disability is a variable that alters the nature of the cognitive load that is relevant to a particular learner. Decoding difficulty increases ICL for reading specifically for a learner with dyslexia and not necessarily for the other domains (Tricot et al., 2020). For a learner with ADHD, perceptual load and cognitive load can work in opposing directions, making the typical recommendation to minimize all load at once at times the wrong approach (Fisher et al., 2023; Forster et al., 2013). For a learner with an ID, GCL, which is typically considered desirable by the CLT, might need to be treated with caution, as spare capacity for schema building cannot be assumed.

This reframing is neither an abandonment of CLT's core architecture nor an ignorance of or rejection of CLT's fundamental concepts. The distinction between WM limits, ICL, ECL, and core effects, as outlined in section titled "Core CLT Effects as Theoretical Mechanisms" above in results, continues to be a helpful starting point. What changes are in how they are applied? A viable integrated model would identify, for each disability category, the most likely type of load to be raised, the educational techniques to be avoided or facilitated, and the adjustments to the measure, based on the communication and processing needs of the populations. A number of the theoretical foundations for this already exist in the literature reviewed: the FUEL framework's effort-based account of hearing impairment (Pichora-Fuller et al., 2016), the perceptual-versus-cognitive load distinction for ADHD (Fisher et al., 2023), and the phase-based framework for LD (Hussain, 2025). What is missing is a structure that links these pieces together, and not just as isolated contributions.

Implications for Research and Practice

The most obvious implication for researchers is that references to CLT should not be used generically to support any instructional decision but rather with a clear statement of the type of load and why it is being targeted. The categories of disability with the most solid theoretical basis in this review, LD, ADHD, and hearing impairment, are precisely the categories in which researchers have made specific claims about load, rather than general ones. It would be especially beneficial for future research to be more specific in the categories with the least solid base, such as giftedness and multiple disabilities.

The practical implication for practitioners is that not all load-reduction strategies will be equally effective with all learners in an inclusive or a special education classroom. A method that facilitates reading-related ICL for one learner with dyslexia may have little effect on another learner with ADHD who may need a different type of perceptual involvement than an easier one. Many teachers, regardless of disability classification, work in resource-limited environments, and require teaching decisions to be made based on the specific load profile of the learner before them, not based on a general CLT-based load profile checklist.

Limitations of the Study

There are certain limitations of this review that are worthy of mention. It is based on English language, database-indexed literature and may not accurately reflect the theoretical work that has been published in other languages or in local special education journals not indexed in the major databases searched. It is also a theoretical review and does not claim to be a systematic review of outcomes; hence, it cannot make statements about the effectiveness of CLT-informed interventions compared to other interventions. It can only state that the theory is coherently adapted to explain why it might be effective.

Conclusion

CLT has given its due role in special education research, but its representation has been variable. In some disability categories, work has been produced that is genuinely theoretical and asks not only if CLT is applicable but also what is changed when it is applicable. Others have received little more than borrowed vocabulary. The future does not lie in the extension of CLT but in the more specific

application of CLT, where each disability category poses its own special questions regarding which load is relevant, how to measure it, and when the conventional wisdom of CLT, that the usual wisdom of reducing ECL while supporting GCL applies, should be rethought rather than taken for granted. A theory of such scope and impact deserves such attention and special education, with its direct engagement with the learner with the most divergent cognitive profiles being the field suited to give it.

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Ethics and Conflict of Interest
All ethical rules were observed at each stage of the research. The author declares that he acted in accordance with ethical rules in all processes of the research. This study is a theoretical literature review and did not involve human participants, animals, or identifiable personal data. Therefore, ethical approval and informed consent were not required. The author declares that they do not have any conflict of interest with other persons, institutions or organizations.

Data Availability
This study is based on published literature. No primary datasets were generated or analyzed. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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