



## Investigating the Effect of Translanguaging on University Students' Cognitive Load during Reading Comprehension Tasks

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### Abstract in English

The study aims at investigating the pedagogical potential of planned Translanguaging (TRANS) strategies, namely the teacher-centered approach on mitigating the cognitive load (CL) imposed by monolingual instruction and fostering deeper learning through a strategic integration with Cognitive Learning Theory principles to enhance EFL university students' performance in reading comprehension skills. To bring about this aim, a quasi-experimental design and an adapted version of Lipkin's 2014 self-reported questionnaire have been utilized with a sample of 120 university EFL students during the academic year 2024-2025. The results demonstrate the pedagogical effectiveness of TRANS on mitigating CL with a statically significant effect on student's performance with a mean difference of 1.0833 points in favor of Experimental Group (EG). On considering such a quantitative evidence, the study concludes that Translanguaging has a measurable, and cognitively grounded impact on EFL students' Cognitive Load, hence yielding substantial improvements in comprehension outcomes. This also differentiates planned Translanguaging from traditional scaffolding techniques as it forwards a measurable model for cognitive efficiency within Cognitive Load Theory's architecture. And highlights that Translanguaging, as a cognitive concept, allows researchers to go beyond measuring outcomes (product) to investigate the within mechanisms (process) of learning.

### Paper Info

#### Keywords

*Keywords*  
*Translanguaging(TRANS),*  
*Cognitive Load Theory(*  
*CLT), Cognitive*  
*Load(CL,EFL)*

## 1. Introduction

Studies on bilingual education have abandoned the notion of languages as separate code systems, and embraced, instead, a view of communication wherein speakers draw on the linguistic and semiotic resources at their disposal for meaning-making and communication (Jorgensen et al., 2011; Blackledge et al., 2013). Current trends on research focus on the way language users are constructing and interpreting different kinds of linguistic and semiotic signs for communication. In this respect, one may be confronted with a number of alternative terms referring to the flexible and fluid use of language practices, such as Mignolo's (2000) 'bilanguaging', Jacquement's (2005) 'transidiomatic practice', Jorgensen's (2008) 'polylingualism', Otsuji and Pennycook's (2011) 'metrolingualism', Canagarajah's (2013), and the list is longer. The terminologies are different, yet they all share the same idea that communicators do not reproduce named languages. Rather, they have access to a wide range of repertoire which can be easily deployed in social interactions. In the present study, the term 'Translanguaging' (TRANS) has been employed as a conceptual framework that has emerged as a pedagogical asset that can better capture the fluidity of language practices in educational settings.

One of the fundamental challenges in EFL education is the development of student's language proficiency at various educational levels. Students bring to classroom diverse linguistic repertoires, cognitive resources, and prior knowledge. These resources or funds are deeply-rooted in their first language (L1). As for Iraqi university students in particular, Arabic serves as both a cognitive and cultural repertoire by means of which students can make sense and comprehend the new academic content. Nevertheless, monolingual approaches to EFL instruction tend to marginalize or even suppress the use of the L1.

Based on the monolingualism dogmas and the traditional idea of an "English only" policy in language classes, teachers and even students think it would be harmful to use L1 (in our context Arabic), hence looking for a classroom environment where they could immerse themselves in English. Nevertheless, students and teachers cannot help but resort to shared linguistic repertoire, which is not entirely verbal, but non-verbal in the form of body gestures, symbols, emoji, signs, facial expressions, and even tones that contribute to communication (Hardison & Pennington, 2021) in various situations. Disturbingly, even though it is a natural practice to use L1 and is being considered as the norm not the exception when learning and teaching English (Blommaert 2010; Lamb 2015), still the educational authorities restrict its use and encourage instruction in only English.

The problem is that the suppression of L1 not only disregards students' funds of knowledge but also imposes a higher cognitive load by forcing them to process unfamiliar input exclusively in English without scaffolding from their established linguistic systems.

When students with low-language proficiency (English) are deprived from chances to mobilize their background knowledge and cognitive schemas to internalize new information, their learning potential becomes constrained. In the language learning

journey, students are expected to construct meaning while decoding texts to develop the required literacy in a foreign language without access to the cognitive shortcuts and the conceptual bridges framed via home languages. In such unfair spaces, students may experience slower language development, superficial comprehension, and high cognitive load, all of which cause disengagement from academic literacy practices. A persistent challenge for teachers is how to balance these practices particularly when dealing with an abstract and cognitively difficult entity like language. It is even more insistent when students are undergoing the process of developing their English proficiency as well as academic literacies (Lo, 2015). It is therefore particularly challenging for low-English proficiency students to acquire the required threshold level of English proficiency while being impaired from their linguistic repertoire.

On this basis, the current study addresses the problem of the continued reliance on restrictive monolingual practices in Iraqi EFL university classrooms, despite the evidence that TRANS can serve as a powerful pedagogical strategy and a source of information available in classroom. TRANS will be probed in the light of its impact on CL, yet is missing in the classroom context. Without the deliberate integration of planned TRANS to manage cognitive loads and enhance performance, EFL classroom risks becoming a site of linguistic deprivation rather than being a place for empowerment and growth. This study aims to quantitatively assess whether TRANS-based reading instruction affects the perceived CL and comprehension performance compared to traditional instruction. As such, following research questions have been addressed:

1. Does TRANS have a direct impact on the CL during reading comprehension tasks? and
2. Can CL alleviation consequently enhance university EFL students' performance?

To achieve this purpose, the current study has adopted an eclectic model for instructional design that subsumes TRANS strategies guided through CLT principles. The link between the two educational theories namely Translanguaging (TRANS) and Cognitive Load Theory (CLT) lies in the assumption that TRANS inherently utilizes learner's full linguistic repertoire, as a scaffolding means, so as to reduce the cognitive demands, while permitting concentration on meaningful schema formation. Sweller (2012) underscores the importance of balancing CL types for effective instructional design. The proposed framework hypothesizes that TRANS plays a pivotal role in reducing the extraneous load, hence managing intrinsic load and optimizing germane load by leveraging learners' full linguistic repertoires to facilitate deeper processing and meaningful learning. The present study argues that since TRANS is a cognitive process that can effectively address the three types of load, namely Intrinsic (ICL), Extranouse (ECL), and Germine Cognitive Load (GCL) , such integration can improve comprehension and reduce the cognitive strain in bilingual contexts (Sweller et al., 2011; García & Wei, 2014).

## 2. Literature Review

The aim of this article is to investigate the pedagogical potentials of TRANS in developing student's performance through mitigating the CL by examining both achievement and perceived load during reading comprehension tasks. In the following sections, the development of TRANS as a theoretical lens in language learning and the

functions of pedagogical TRANS will be presented first. The article then explores the CLT and its instructional principles to determine its content and the way it has been applied in EFL research domain.

## 2.1 Translanguaging.

The rising number of students with their diverse linguistic backgrounds in English language classrooms calls for a pedagogical change from monolingual bias to a more inclusive teaching and learning practices. This situation urged the launching of Translanguaging, a concept foregrounded in ESL/EFL so as to open new horizons on how learners instinctively use their repertoire (linguistic and non-linguistic) in making sense of the world around them. TRANS is viewed as an approach to bilingualism, centered around the observable practices of bilinguals (the function) not the languages (the form) as it was always the case in monolingual (Garcia, 2009). Considering the realm of linguistics theories, TRANS is relatively new. The last two decades have witnessed a huge expansion in the scholarly literature dedicated for defining and exploring its potentials.

In their book: *Translanguaging: Language, Bilingualism and Education*, Garcia and Wei (2014) attributed TRANS theory emergence to broader theoretical shifts in Socio- and Applied Linguistics due to the post-structural turn, since it is grounded in the understanding that languages do not exist as isolated systems but rather interacting dynamically within a shared cognitive knowledge. This perspective challenges the traditional view which categorizes the named languages as distinct entities. Instead, it states that an individual possesses integrated linguistic repertoire that draws on multiple languages simultaneously (Wei, 2024). The conceptual shift towards the newly proposed term reflects a broader movement in sociolinguistics that emphasizes connectivity, fluidity, and mobility in language use (Creese and Blackledge, 2015; Wei, et al, 2018). TRANS is currently considered as “the act performed by bilinguals to get access to different linguistic features of various modes that are described as autonomous languages, so as to maximize communicative potential” (García 2009: 140). It refers to the “constant, active invention of new realities through social action” and the -ing suffix emphasizes, then, “the act of meaning-making” (Mazak and Herbas-Donoso, 2015, p.698). As such, TRANS has developed from classroom to a theory of language learning (Otheguy et al., 2015p. 284). It frames bilingual studies within Applied Linguistics theoretical principle in a way that transcends the separate codes or languages owned by individuals that are viewed as a social ontology but not a cognitive linguistic one (Garcia & Otheguy, 2020), while linguistic features such as phonemes, morphemes, sentences, lexical and grammatical signs, rules, and so on can reasonably be seen as cognitively inherent by their different proponents and allocation to different languages or codes.

The term TRANS has been conceptualized by García’s (2009) elaboration and expansion of the construct of TRANS theory from its original Welsh instructional roots by Cen Williams (1994, cited in Lewis, Jones, & Baker, 2012). In this work, Garcia has not only reinforced the legitimacy and necessity of bilingual education for minoritized students but also represented a radical critique of prevalent instructional and theoretical assumptions in both bilingual education and monolingual English instructional programs. The concept was extensively expanded by Garcia and colleagues (García,

2009; García & Wei, 2014; Otheguy et al., 2015, 2018). They persuasively state that in bilingual education there is no other option, claiming that this is not merely Code-Switching (CS) cases or language alteration. It rather represents the fluid dynamic language practices of bilinguals who draw on the unique features of their entire linguistic and non-linguistic repertoire as an integrated system. García & Li Wei (2014, p. 14); Wei (2018); Cenoz & Gorter (2021) claimed that the act of translanguaging is the norm not the exception for bilingual individuals. Canagarajah (2011) in his seminal article focused on the practical applications of TRANT and its theoretical implications in classroom settings proposing that TRANS is “a neologism, it has come to stand for assumptions such as the following: that, for multilinguals, languages are part of a repertoire that is accessed for their communicative purposes; languages are not discrete and separated, but form an integrated system for them; multilingual competence emerges out of local practices where multiple languages are negotiated for communication; competence doesn’t consist of separate competencies for each language, but a multicompetence that functions symbiotically for the different languages in one’s repertoire”. He further claimed that proficiency focuses on repertoire building that has been developed via different functions served by different languages, rather than the total mastery of each and every language an individual processes (Canagarajah, 2011; P:1).

As a pedagogical practice, TRANS leverages the fluid act of languaging of learners in ways that deepen their engagement and comprehension of complex content and texts. García and Wei's define TRANS as “the dynamic process whereby multilingual language users mediate complex social and cognitive activities through strategic employment of multiple semiotic resources”(2014, p. 20). The emergence of such practice could be the outcome of regarding bilingualism as an advantage rather than a disadvantage in the early 21<sup>st</sup> century by shifting from “causing mental confusion to the benefits of dual language capability, from solitudes to synergies” (Lewis et al., 2012b, p.643). It takes us beyond the linguistics of systems and speakers to a linguistics of participation (Li 2018). TRANS pedagogy therefore cannot and should not be reduced to allowing the learners to use their non-language-of-instruction L1s in class, nor to mixing and switching between linguistic codes only. TRANS as pedagogy means that the teacher is aware that the linguistic capabilities of the students go much further than classroom language practices. According to Cenoz (2012 ), pedagogical TRANS is the integration of teachers’ planned language teaching strategies into students’ entire linguistic repertoire (García et al., 2017; Cenoz & Gorter, 2021). This concept implies that students require more cognitive stimulation because the process is quite demanding and strict, and involves choices regarding how and what to include.

Three favorable functions of pedagogical TRANS can be highlighted:

### **Fostering Engagement and Lowering Anxiety**

As a classroom practice, TRANS can foster greater engagement and lower anxiety among students, by allowing them to use their full linguistic repertoire and allowing teachers to create a more welcoming and supportive learning environment. As Canagarajah (2011) notes, "Translanguaging enables multilingual students to participate in academic discourses on their own terms" (p. 401), which can increase

their confidence and willingness to engage actively in the learning process. This, in turn, may lead to reduced anxiety and more meaningful participation.

### **Promoting Deeper Comprehension of Academic Content**

Pedagogical TRANS supports deeper comprehension of complex academic material. When students can draw on their entire linguistic toolkit, they can better understand and engage with challenging concepts. Cenoz and Gorter (2017) argue that "translanguaging pedagogies aim at leveraging students' entire linguistic repertoire as a resource for learning" (p. 904), which facilitates a more thorough understanding of the content. This deeper level of comprehension can lead to more meaningful learning and better academic performance.

### **Developing Metalinguistic Awareness and Linguistic Flexibility**

TRANS practices in classroom can foster greater metalinguistic awareness and linguistic flexibility among students. By comparing and contrasting features of different languages, students develop a more nuanced understanding of language structures and functions (García and Kleyn, 2016, p. 216). This heightened metalinguistic awareness can enable students to navigate academic discourse more effectively and adapt their language use to different contexts.

These three functions highlight how pedagogical TRANS can enhance students' engagement, deepen content comprehension, and develop valuable linguistic skills, and ultimately transforming the learning experience for emergent bilingual students.

## **2.2 Cognitive Load**

Cognitive load (CL) refers to the amount of mental effort or resources required to process information, perform tasks, or solve problems. It is a measure of how much information the working memory can handle at any given time. By understanding cognitive load, one can design more effective learning materials, improve user experience, and enhance productivity.

### **2.2.1 Cognitive Load Theory**

Cognitive load theory (CLT) is based on the interaction between information and human cognitive abilities applied to process information. As students move from schools to university, a significant decline has been observed in their motivation and engagement due to high cognitive demand (Eccles & Roeser, 2009; Wang & Eccles, 2012). This situation calls for interventions that may address the cognitive burden on students. These accommodational approaches are referred to as the "Load Reduction Instructions" (LRI) (Martin, 2016; Martin & Evans, 2018). The CLT proposed by John Sweller in the 1980s, focuses mainly on the way newly confronted information is processed in human cognitive system, particularly during learning.

The roots of CLT can be traced back to 1982 (Sweller and Levine 1982), but a first full description of the theory was given in the 1988 article Cognitive Load During Problem Solving: Effects on Learning (Sweller 1988). In this seminal article, the theory stresses the importance of managing mental demand for learning by optimizing instructional design especially when it comes to handle complex tasks that falls within the

biologically secondary knowledge region like L2 language learning to avoid overwhelming working memory (Paas & Sweller, 2009; Paas & Sweller, 2012).

The theory provides influential instructional assumptions based on the knowledge of human cognitive architecture. It particularly relays on the characteristics of Working Memory (WM) and Long-term Memory (LTM). Therefore, the merit of CLT is to draw maps for instructional design reflecting on the specific characteristics of human cognitive architecture by developing appropriate instructional procedures (Sweller, 1988; Sweller et al., 1998; 2019; Paas et al., 2003). Thus, effective instructions in educational context should manage the CL executed on WM to facilitate schema formation and automation which results in effective learning (Mayer & Moreno, 2003; Sweller et al., 2011; Kirschner et al., 2018).

### **2.2.1 Types of Cognitive Load**

The CLT has identified three types of loads that use WM resources and are referred to as good (germane), bad (extraneous), or just there (intrinsic) (de Jong, 2010, p. 125).

#### **2.2.1.1 Extraneous Cognitive Load (ECL)**

This type of load lays out of the learning task that arises from suboptimal instructional methods that require the learner to engage in cognitive processes that do not contribute directly to the construction of cognitive schemata. It can be seen depending on how information is presented to learners (task design) and the activities they must do (task selection). Whenever mental resources are invested to process irrelevant elements for the task itself, like searching for or repressing information, this situation can cause a high CL which can hinder learning. The outcome of research has proposed principles that teachers can use to adapt instruction to reduce ECL ( Sweller, 1988; Paas, Renkl, & Sweller, 2003; Paas et al., 2004).

#### **2.2.1.2 Intrinsic Cognitive Load (ICL)**

This category usually arises from natural complexity or from the inherent complexity of learning task itself (Sweller, 1994; Sweller & Chandler, 1994). It is shaped by two main factors: the task's element interactivity and the learner's existing knowledge (Moreno & Park, 2010). It is determined by the number of interacting information elements that the learning task or the learning material comprises (Sweller, 1994; Sweller et al., 2011). Students, who have little if any prior knowledge of the task or material need to process the interacting elements in a linear way by selecting, processing, and integrating them for the task to be handled properly i.e. to be learnt. As learning progresses (knowledge increases), information elements become incorporated (or chunked) into cognitive schemata stored in LTM, which can be handled as one single element in working memory. Therefore, the ICL that is imposed by a learning task or learning materials is much higher for novices than for more advanced students. Complexity here refers to the characteristics of information that need to be learnt. Studies showed that it might be managed by adjusting the interactivity of elements in the presented material, such as simplifying or segmenting the task (Atkinson, Derry, Renkl & Wortham, 2000). Though full comprehension is required for the learner to eventually handle all elements simultaneously, this scaffolding can support learning (Sweller, 1994; 2010). But the case is different in the present study. While other

instructions mainly affect ECL, the TRANS model suggested for the current study can manage task complexity through instant scaffolding from L1.

### **2.2.1.3 Germane Cognitive Load**

The third type of CL is facilitated when cognitive resources from LTM are successfully engaged to support learning. It refers to the leveling of the mental processing dedicated to schema construction and automation in a learning task (Sweller et al., 1998). In other words, it results from learning mandatory activities that managing performance transfers to construct suitable mental models (Paas et al., 2003). Such techniques could be, for instance, taking notes while reading a text, coming up with memory hooks and imagination, or explaining the learned content to someone else. This may be dependent on a student's level of metacognitive skills as well as their levels of motivation. Contrary to the previous loads where minimization is cherished, high GCL is welcomed (Paas and van Gog, 2006).

The focus in the present context needs to encompass the three types as all are related to WM. According to CLT's additivity hypothesis, "learning is compromised when the sum of intrinsic, extraneous, and germane loads exceeds available WM capacity and any cognitive load effect is caused by various interactions among these sources of cognitive load"( Plass et al. , 2010, p. 4). In the present study, TRANS is proposed to fill the gap and ease the load through providing resources funds existed in learners' repertoire.

### **2.2.2 Cognitive Load Principles**

Human cognition architecture that is available to handle biologically secondary information is constructed upon essential and biologically primary processes. These form the basis of CLT. Both types of processes represent what can be called a natural information processing system. Learning occurs when a change happens in the schematic structures of the LTM. When it is positively handled, a change in performance occurs because the learner becomes increasingly familiar with the material, and the cognitive characteristics associated with the material are altered so that it can be handled more efficiently by WM (Plaas, 2010). This process is governed by five essential principles that have been established by the CLT. These foundational principles inform the instructional strategies outlined by the theory.

#### **Information Store**

Human beings receive huge amount of information, every day in the nowadays complex world, that need to be processed and stored in the humans' cognition system. LTM functions as a repository or storage era that can handle large volumes of information in the form of schemas (Sweller et al., 2011). Learning occurs by transferring information from WM which is limited in capacity and duration into LTM in the shape of bidirectional schema where it can be accessed efficiently and effortlessly.

#### **Borrowing and Reorganizing**

This principle explains that most of the knowledge we possess is acquired indirectly. Following instruction, imitation, and/or interaction as a social creature, this skill is biologically Primary. Learners borrow existing knowledge and reorganize it into schemas appropriate for their cognitive context. CLT as an explicit instruction guideline, puts prominence on this principle.

### **Randomness as Genesis**

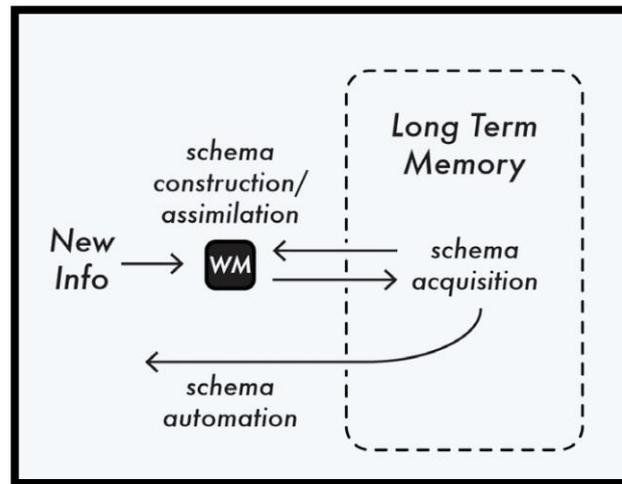
Randomness addresses the way learners generate new knowledge when borrowing is unavailable. This survival mode is activated when no existing schema applies. An example can be solving a problem with random trial-and-error procedure (Sweller, 2011, p. 42).

### **Narrow Limits of Change**

This item is central to CLT as it was clearly presented in 1998. A basic assumption of the principle has been that for any given individual, general working memory capacity is fixed. When dealing with human cognition, this principle refers to the severe limitations of working memory when processing novel information.

### **Environmental Organizing and Linking**

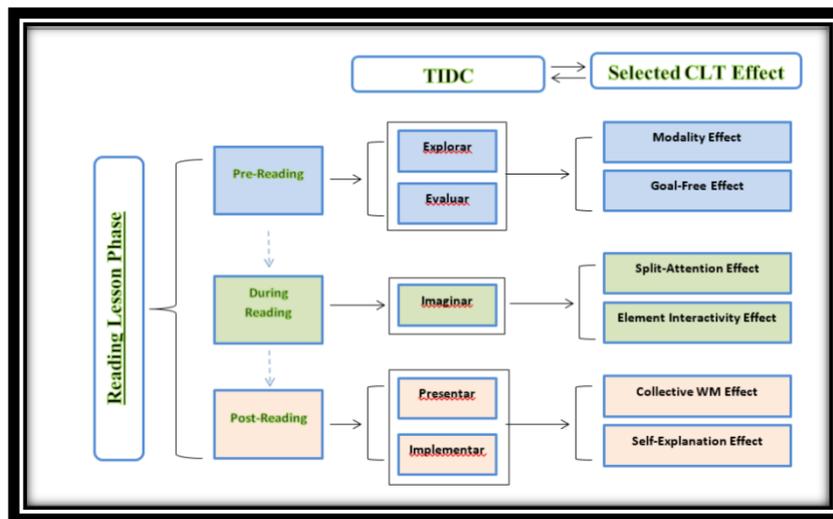
Building on the limitations of WM, no known limits occur when familiar, organized information from in a reversed manner i.e. from LTM is processed. Environmental stimulus can be used to generate actions appropriate to that environment depending of stored schema. Human cognition emphasizes the importance of explicit instruction when teaching biologically secondary, domain-specific content as the case in formal education. While learning through borrowing from others imposes less CL compared to creating knowledge independently, instructional design must provide ready-made frames for novel information to be stored in LTM. Once knowledge is successfully stored in LTM, as per the information store principle, it is no longer limited by WM constraints. It can then be retrieved and applied through environmental organizing and linking principles to guide appropriate actions. Therefore, designing instruction based on this cognitive framework is expected to enhance learning outcomes. (See figure.1) for schema formation visualization.



**Figure.1:** Schema automation process in CLT (extended from Howarth. J.,2015, p. 21)

### 3. Methodology

This study has used a quantitative, teacher centered, a process-product orientated approach. It has been designed to explore two aspects of language learning, the process through alleviating CL and the outcomes enhancement. The model adapted to design the intervention material is an eclectic one utilizing both García's, et. al. (2017) Translanguaging Instructional Design Cycle (TIDC) and Sweller's, J., et. al. (2011) selected effects. See figure 2.



**Figure 2: The Eclectic Model for the Intervention Design.**

#### 3.1 participants

The setting of the current research is University of Mosul, College of Education for Humanities, Dept. of English. The sample of the study comprised 120 freshmen students enrolled in 2024/2025 academic year. Students were randomly assigned to an experimental group (EG) and a control; group (CG). Participation was voluntary, and a consent form was obtained. All information was anonymized, and ethical approval was granted.

#### 3.2 Design

The current study adopts a quasi-experimental design (Creswell and Plano Clark 2007) to identify the effect of the intervention based on TRANS using pre/ post reading comprehension tests.

### 3.3 Instruments

1. Pre/post reading comprehension test comprising 25 multiple choices questions.
2. A self-reported survey, Leppink et. al. edited scale (2014). The instrument is a 13-item questionnaire, 5-Likert scale, tripartite items to measure the three types of CL perceived by the two groups during reading comprehension tasks.
3. Both groups were taught using the same chapters from the textbook “Selecting Readings” by Lee and Gundersen (2011) according to the department’s policy. The CG received traditional EFL instruction (i.e. Monolingual approach), while the EG were treated via TRANS instruction-based following the adapted model in figure 2.

### 3.4 Research Procedure.

The data collection phase started by the recruitment of the study sample. The research objectives were achieved by using two different methods to address the research questions. The following were the procedures conducted:

A) Pretest: Both groups sat to the pretest based on the teacher-constructed test baseline for identifying potential differences between the EG and CG on reading comprehension skills. It ensures that the comparison between both groups is valid prior to the intervention. Furthermore, it ensures that any subsequent post-test differences can be attributed to the intervention rather than initial group disparities. The test was tailored to specific learning objectives, classroom contexts, and particular components of the utilized reading comprehension material. It provides focused assessment on targeted skills such as vocabulary, inference-making, or text analysis. The multifaceted nature of reading comprehension involved complex interactions among word recognition, vocabulary knowledge, syntactic processing, and strategic skills (Grabe, 2009).

B) The CLDS questionnaire: It was conducted to capture students’ cognitive load during reading comprehension learning tasks. The instrument was administered to the EG and CG immediately after a reading comprehension task. The CLDS measured the three types of cognitive load: Intrinsic Load (IL), Extraneous Load (EL), and Germane Load (GL).

C) Posttest: After 10 weeks of implementing TRANS based instruction, a second test was administered to evaluate the development in the reading comprehension skills through assessing the post-test achievement of both groups.

### 3.5 Data Analysis

Inferential and descriptive statistics were used to claim the results. Means and standard deviations were computed for the collected data. Paired-sample t-tests and independent-sample t-tests were used to measure within-group improvement and compared post-test performance between groups. These statistical procedures ensured reliable and valid insights into the effect of TRANS on students’ CL and performance.

## 4. Results

This section presents the findings obtained to answer the two research questions that guide the current study. The analysis draws on quantitative data resulting from analyzing data collected via the two data collection methods. The first statistical analysis was conducted to check the extent to which the two groups recruited for the study were equal. Table.1 presents the pre-test scores of both groups.

**Table 1: The Mean scores, Standard Deviation and Values of the EG and CGT on the Reading Pretest.**

Reading test	Group	N	Mean	Std. Deviation	T_cal.	T_tab.	Sig.
Pretest	EG.	60	11.2833	1.70832	1.873	1.98 (0.05) (118)	N.S.
	CG.	60	12.1500	150602.			

Table 1 presents the results of the Independent-samples t-test comparing pre-test scores of the EG and the CG on the reading comprehension test. The mean score of EG is 11.2833, while the CG has a slightly higher mean of 12.1500. On average, this suggests that the CG performed slightly better, indicating moderate performance of both groups with the CG marginally ahead. The results suggest that there is not a significant difference between the two groups in terms of the pre-test mean scores at the study's outset since the T-calculated value 1.873 is less than the T-tabulated value (1.980) at a 0.05 significance level with 118 df. After ensuring that both groups are equal based on the pre-test scores, findings will be presented sequentially for each research question.

**RQ1. Does TRANS have a direct impact on the CL during reading comprehension tasks?**

To address the first research question, analysis of the data obtained by means of the CLDS questionnaire is outlined in Table 2.

**Table.2: Mean scores, Standard Deviation and Values of the Eg and CG Groups**

Item	Group	N	Mean	Std. Deviation	T_cal.	T_tab.	Sig.		
IL	Exp.	60	8.4500	2.84292	19.282	1.980 (0.05) (118)	Con.		
	Con.	60	16.8333	1.80552					
EL	Exp.	60	11.7167	2.15573	14.210		1.980 (0.05) (118)	Con.	
	Con.	60	18.4333	2.95942					
GL	Exp.	60	15.8333	2.05159	14.436			1.980 (0.05) (118)	Exp.
	Con.	60	9.9833	2.37567					

To address this question, the data were analyzed separately according to the three load types of the two groups under the same conditions except for the intervention. Independent-samples t-tests were performed at  $\alpha = 0.05$  ( $df = 118$ ). Interpretation of the results is segmented as follows:

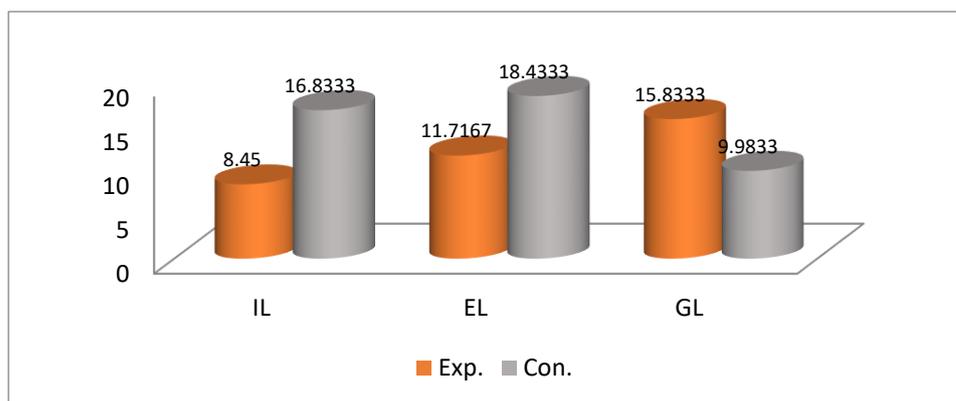
**Intrinsic Load (ICL):** The EG got a lower mean score of 8.45, while the CG scored higher at 16.83. Since the T-tabulated value 1.980 is far lower than the T-calculated value 19.282, the results are statically significant and are in favor of the CG who perceived the texts as significantly more complex than the EG.

**Extraneous Load (ECL):** The EG again scored lower than CG with a mean of 11.72 compared to the CG mean score 18.43. The T- calculated value  $14.210 > 1.980$  outlines a statistically significant difference in favor to the CG. The experimental instruction also minimized the ECL for the EG, showing that the multimodal and bilingual scaffolds reduced unnecessary processing demands from the instructional format.

**Germane Load (GCL):** In this category (the wanted load), the EG mean is 15.83 which is higher than that of the CG mean 9.98 and the T-calculated value  $14.436 > 1.980$ . This underscores a significance difference in favor of the EG. The freed cognitive

resources are redirected toward constructive learning processes (schema building, elaboration, and self-explanation).

These differences are all statistically significant. In other words, TRANS has directly altered students perceived cognitive load. ICL and ECL were reduced significantly while GCL was boosted significantly in favor of the EG during reading comprehension tasks when compared to that of CG who received traditional (only English) instructions. The following figure visually represents the differences between the two groups in terms of CL.



**Figure.3: The differences between EG and CG in terms of the Perceived CL**

To address the second research question, **RQ.2: Can CL alleviation enhance university EFL students' performance?** the scores of the EG and CG groups on the post-test scores have been calculated and analyzed, as illustrated in Table 3.

**Table3: Mean scores, Standard Deviation and Values of the Two Groups in Reading Posttest.**

Reading test	Group	N	Mean	Std. Deviation	T_cal.	T_tab.	Sig.
Posttest	EG.	60	14.5500	736721.	2.348	1.98	Sig.
	CG.	60	13.4667	8233 1.0		(0.05)	

Table 3 compares the post-test scores of the EG and CG on the teacher-constructed reading comprehension test. The table displays the results of an Independent Sample t-test conducted to compare the post-test performance of the EG and CG. The Eg's mean score 14.5500 on the post-test is higher than that of the CG which reads (13.4667). This suggests that EG benefited from the instructional intervention. The SD for the EG is 1.73672, while it is 1.08233 for the CG. This indicates moderate variability in scores, with EG exhibiting slightly greater dispersion. The most important part in this table is the T-calculated value 2.348 that exceeds the T-tabulated value 1.98 at 0.05 and 118 df. This result confirms a statistically significant difference in favour of the EG, and outlines that the intervention has led to a meaningful improvement that is unlikely to be attributed to chance. Accordingly, the results show that strategically planned TRANS significantly enhances the EG students' reading comprehension achievement..

Conducting a comparison between the two groups in terms of the performance on the post-test, the results show statistically significant and practically meaningful improvements that are attributable to the intervention.

#### 4 Discussion and conclusion

The purpose this study serves to fulfill is to examine the pedagogical potentials that TRANS has when systematically planned and integrated with CLT principles to enhance EFL learners' achievement and alter cognitive processing. The findings reveal that the students exposed to TRANS instruction outperformed those exposed to traditional (only English) instructions during reading comprehension tasks. The TRANS instruction had a considerable effect on mitigating the three types of CL which consequently enhances student's performance. The TRANS model presented in the present research appears to optimize cognitive resources by reducing unnecessary processing, namely ECL through clear instructions and ICL through scaffolding complex material. Reducing irrelevant demands frees working memory for schema construction resulting from higher GCL which is clear in the findings of the present study (Paaset al., 2003; Sweller, 2011). These findings provide parallel insights into CLT studies in EFL contexts, especially Hassan and Abbas (2023) who established negative correlations between ICL/ECL and productive skills, and they proposed positive correlations between GCL and student outcomes. Furthermore, while prior CLT studies in EFL contexts (Hadi, 2022; Zhu, 2022; Ma, 2025) largely emphasized load reduction via well formatted instructional design, findings of the present study show that TRANS embodies a cognitive-design principle. It operates as both a sociolinguistic and cognitive-instructional process to optimizes learning efficiency through the dynamic distribution of cognitive resources across languages. This can mark a paradigm shift in understanding how bilingual pedagogies can function not only as communicative enablers, but also as cognitively regulative systems grounded in language learning theories.

These findings align theoretically with recent studies highlighting TRANS's pedagogical potential in enhancing comprehension especially in classrooms where the medium of instruction is not their native language. Students in this situation navigate complex linguistic and cognitive demands. Wei and García (2022) emphasize that TRANS allows students to mobilize their entire linguistic repertoire that helps them facilitate deeper understanding by serving as a scaffolding entity, TRANS enables students to incrementally construct knowledge, particularly in cognitively demanding tasks, and foster both linguistic and cognitive engagement. Although the direct relation between TRANS and CLT has not been established before, the present study's findings both align with and diverge from previous studies through its demonstration of proficiency gains and positive impact on EFL learners' language skills. It has also been found out that Yuzlu & Dikilitas's study (2021) is highly relevant to the present study for several reasons. First, exploring TRANS effects on the development of EFL learners' language skills. Second, it provides insights into students' perceptions of TRANS as a pedagogical approach. Elashhab (2020), found that using Arabic in academic English classes enhanced comprehension and engagement among Saudi learners. Nevertheless, unlike Qureshi and Aljanadbah (2022) who doubted the effect of TRANS on learner's outcome, but they highlight that TRANS supports effective communication in EFL settings through the dynamic use of linguistic repertoires that enhancing meaning-making to overcoming language barriers. The present study

attributes the enhanced performance of students to the planned strategies and integration of CLT-informed instructional design. Thus, the structured and theory-guided TRANS practices surpass spontaneous unplanned TRANS in enhancing learner's performance.

Considering the quantitative evidence, the study concludes that TRANS exerts a measurable, and cognitively grounded impact on EFL student's performance. It also lowers ICL and ECL free resources enhancing GCL engagement which yields on substantial improvements in comprehension outcomes. Thus, TRANS has a pedagogical potential into two directions. First, it optimizes CL faced by students in demanding reading comprehension tasks, and second it enhances their performance empirically tested. Moreover, the process-product model, wherein TRANS → CL redistribution → enhanced performance is a newly proposed paradigm for Bilingual EFL Instruction. This model offers a scalable and evidence-based alternative to English-only instruction in L1-dominant context. Finally, rather than viewed with shame or guilt, teachers can intentionally integrate L1 to reduce load sources while simultaneously prompting deeper conceptual elaboration. Classroom applications may include bilingual annotation, L1-based problem framing, and cross-linguistic summarization to enhance reading comprehension and working-memory transfer.

#### المستخلص باللغة العربية

تهدف الدراسة إلى استكشاف الإمكانيات التربوية لاستراتيجيات التناوب اللغوي المخطط لها، وتحديدًا النهج المتمركز حول المعلم لتخفيف العبء المعرفي الذي يفرضه التعليم أحادي اللغة وتعزيز التعلم العميق من خلال التكامل الاستراتيجي مع مبادئ نظرية التعلم المعرفي لتحسين أداء طلاب الجامعات الذين يدرسون اللغة الإنجليزية كلغة أجنبية في مهارات فهم القراءة. ولتحقيق هذا الهدف، تم استخدام تصميم شبه تجريبي ونسخة معدلة من استبيان ليبكين الذاتي لعام 2014 مع عينة من طلاب الجامعات الذين يدرسون اللغة الإنجليزية كلغة أجنبية خلال العام الدراسي 2024-2025. توضح النتائج الفعالية التربوية للتنقل اللغوي في تخفيف العبء المعرفي مع تأثير ذي دلالة إحصائية على أداء الطلاب بفارق متوسط قدره 1.0833 نقطة لصالح المجموعة التجريبية. بالنظر إلى هذه الأدلة الكمية، خلصت الدراسة إلى أن التنقل اللغوي تأثيرًا قابلاً للقياس ومستندًا إلى المعرفة على العبء المعرفي لطلاب اللغة الإنجليزية كلغة أجنبية، مما يُحقق تحسينات جوهرية في نتائج الفهم. وهذا يميز أيضًا برنامج التنقل اللغوي المُخطط له عن أساليب الدعم التقليدية، إذ يُقدم نموذجًا قابلاً للقياس للكفاءة المعرفية ضمن بنية نظرية العبء المعرفي. ويبرز أن التنقل اللغوي، كمفهوم معرفي، يُتيح للباحثين تجاوز قياس النتائج (الأداء) إلى دراسة الآليات الداخلية (العملية) التعلم. لكلمات المفتاح: التناوب اللغوي، العبء المعرفي، فهم القراءة، النهج المُركز على المعلم.

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