UMT Education Review (UER)
Volume 9 Issue 1, Spring 2026
ISSN$_{(P)}$: 2616-9738, ISSN$_{(E)}$: 2616-9746
Homepage: https://journals.umt.edu.pk/index.php/uer



Title:	**Effect of the Cognitive Load Aware Scaffolded Program for Comprehension (CLASP-C) on Urdu Comprehension among Students with Learning Disabilities: A Quasi-Experimental Study**
Author (s):	Mehtab Hussain
Affiliation (s):	Allama Iqbal Open University, Islamabad, Pakistan
DOI:	https://doi.org/10.32350/uer.91.02
History:	Received: February 07, 2026, Revised: April 07, 2026, Accepted: April 20, 2026, Published: June 02, 2026
Citation:	Hussain, M. (2026). Effect of the Cognitive Load Aware Scaffolded Program for Comprehension (CLASP-C) on Urdu comprehension among students with learning disabilities: A quasi-experimental study. *UMT Education Review*, *9*(1), 39–71. https://doi.org/10.32350/uer.91.02
Copyright:	© The Authors
Licensing:	This article is open access and is distributed under the terms of Creative Commons Attribution 4.0 International License
Conflict of Interest:	Author(s) declared no conflict of interest

A publication of
Department of Education, School of Social Sciences and Humanities
University of Management and Technology, Lahore, Pakistan

Effect of the Cognitive Load Aware Scaffolded Program for Comprehension (CLASP-C) on Urdu Comprehension among Students with Learning Disabilities: A Quasi-Experimental Study

Mehtab Hussain*

Special Education Department, Allama Iqbal Open University, Islamabad, Pakistan

Abstract

Given the academic significance of comprehension skills, linguistic complexities of Urdu, and cognitive-processing limitations in students with learning disabilities (LD students), Urdu comprehension becomes a complex task for LD students. This study develops and investigates the effectiveness of the Cognitive Load-Aware Scaffolded Program for Comprehension (CLASP-C) to improve Urdu comprehension among LD students. CLASP-C is grounded in Cognitive Load Theory and scaffolding, and is designed to enhance Urdu comprehension, targeting the unique cognitive needs of LD students. Utilizing a quasi-experimental pre-test-post-test control group design, a purposively selected sample of 32 students was randomly assigned into two groups. The experimental group (n = 16) received CLASP-C intervention for 8 weeks, and the control group (n = 16) continued with traditional comprehension practices during this time. Data were collected using an Urdu Comprehension Assessment Rubric (UCAR) (α = .82; ICC(3,3) = .86) and analysed using descriptive and inferential tests. Parametric tests were employed after satisfying the assumptions of normality and homogeneity. The analysis revealed that baseline performance of both groups was similar (p = .885); however, while the control group did not improve significantly over time (p = .662), the experimental group exhibited significant improvement ($t(15) = -5.74$, $p < .001$) with a large effect size (d = 1.43). The experimental group performed significantly better than the control group at post-test ($t(30) = -5.56$, $p < .001$) with a large practical effect (d = 1.97); the effect of the group was large even after controlling for pre-test scores ($F(1, 29) = 29.86$, $p < .001$, partial $\eta^2 = .51$). Results indicate the effectiveness of CLASP-C to improve Urdu comprehension among LD students. Findings suggest the implementation of cognitively-aware and scaffolded instructions in Urdu-medium public-sector special-education schools.

*Corresponding Author: meh6336@gmail.com

Keywords: CLASP-C, cognitive load theory, learning disabilities, scaffolded instructions, Urdu comprehension

Introduction

Comprehension is a basic skill in academics that is essential across all domains of learning (Mallillin, 2020). It is the ability to provide meaning to words. It encourages learners to construct meanings from the written text and assists them to acquire knowledge and learn new skills, and participate in classroom activities enthusiastically. It is a foundational aspect of literacy and necessary for educational achievement across subject areas. Students with learning disabilities (LD students) frequently encounter issues with comprehension given their limitations of working memory and processing speed (Okur & Aksoy, 2025). Comprehension becomes challenging for these students since it poses a load on their processing abilities. The conventional strategies utilized by public schools frequently neglect to address these specific demands of LD students and as a result can't achieve the desirable outcomes. Under these circumstances these students persist with continuing issues in learning comprehension. Many studies have identified comprehension problems associated with LD, but existing evidence is mostly based on general literacy development instead of cognitively-informed and linguistically specific comprehension interventions.

The situation turns complicated in the case of Urdu comprehension since Urdu has particular linguistic complexities. Urdu is written right to left in cursive; characters have shapes that differ according to their placement in the word; and words have a morphologically complex structure (Sharif & Saleem, 2025). These particular features of the Urdu language make it challenging in terms of cognitive resources. While attempting to comprehend the text written in Urdu, it becomes increasingly challenging for the limited cognitive resources of the LD students. In Pakistani Urdu-medium schools, it is increasingly crucial to develop Urdu comprehension, since most of the subjects are taught in Urdu. Given the significance of learning Urdu comprehension in public educational institutions, the cognitive needs connected to the complexities of the Urdu language, and limitations of cognitive processing and working memory associated with LD students, these students continue to underperform, and their confidence level declines. Although most public schools in Pakistan are Urdu-medium, there is limited empirical evidence regarding the

effectiveness of interventions specifically designed for LD students in Urdu-medium classrooms.

Cognitive Load Theory (CLT) of Sweller (1988) proposes a framework for facilitating the creation of instructional design to improve the learning outcomes of students (Tricot et al., 2020). CLT describes three types of cognitive loads; first, that corresponds with the complexity of material, second is triggered by the methods of delivery, and third is credited for schema building. They are called intrinsic, extraneous, and germane cognitive loads, respectively. If an instructional plan succeeds to manage these loads effectively, it can enhance the learning outcomes.

Scaffolding takes its inspiration from socio-cultural theory and is built on the work of Vygotsky. It provides the notion that if support is given to learners at the beginning and then is gradually cut back, the learning outcomes are increased (Xi & Lantolf, 2021). Learners in such a situation begin functioning in the Zone of Proximal Development (ZPD) and progress into independent learners with the passage of time (Utomo & Santoso, 2021). Scaffolding is closely associated with CLT, and if both are integrated, they may yield notable outcomes.

The literature indicates that the synergic effect of CLT and scaffolding has significant potential for supporting the cognitive-processing needs of learners; still, the combined application of CLT and scaffolding in the context of Urdu-medium special education is not fully explored in the literature.

The current study creates and evaluates the effectiveness of the Cognitive Load Aware Scaffolded Program for Comprehension (CLASP-C). CLASP-C is an organized regimen firmly grounded in the principles of CLT and scaffolding. It was developed specifically to boost Urdu comprehension. The program goes after the distinct requirements of LD students, which they encounter while learning comprehension. CLASP-C, using its modular structure, manages the cognitive load triggered by the linguistic complexities of Urdu language to support the restricted working memory of LD students while stimulating schema building.

Variables of the Study

This study utilized a control-group pre-test-post-test design to examine the effectiveness of the intervention as compared to the traditional methods. Hence, there are two identified variables of the study. The independent

variable of the study is the comprehension instruction delivered to the LD students, which is the utilization of traditional methods of teaching comprehension in the case of the control group and the Cognitive Load Aware Scaffolded Program for Comprehension (CLASP-C) in the case of the experimental group. CLASP-C is a structured plan that was exposed to the participants of the experimental group in phased sessions. On the other hand, the control group was given the traditional comprehension teaching practices, without integration of CLT or scaffolding principles or any additional manipulation. The dependent variable of the study was Urdu comprehension performance of LD students. The Urdu Comprehension Assessment Rubric (UCAR) was used to gauge the comprehension performance of both groups, prior to and subsequent to the intervention.

Statement of the Problem

LD students repeatedly encounter obstacles with comprehension and, as a consequence, their performance falls below the mark, and they suffer from issues with confidence and self-esteem (Khasawneh & Al-Rub, 2020). These challenges get worse and become more prevalent in the case of Urdu comprehension due to its linguistic complexities (Saleem & Ahmad, 2025). Traditional methods utilized in the Urdu-medium public schools of Pakistan typically neglect to tackle the distinctive cognitive needs of LD students and lack the ability to produce desirable outcomes. Available comprehension programs are created for general education classrooms and do not take the unique needs of LD students into consideration; and as a result, stay ineffective when implemented in special education classrooms. These conditions leave special education teachers unequipped to teach LD students smoothly.

CLT provides a framework for instructional planning to optimize learning outcomes by managing cognitive loads. Principles of CLT have been repeatedly verified to be effective in general education classrooms and multimedia education, yet empirical evidence about their usefulness for enhancing comprehension while concentrating on the unique needs of LD students remains scarce. Secondly, most of the studies have been carried out in alphabetical languages, and their effectiveness for the Urdu language has yet to be explored. Scaffolding is a widely adopted idea in general education studies and can be integrated with the framework stipulated by the CLT.

All these circumstances point towards the integration of principles of

CLT and scaffolding into a structured program that could enhance the Urdu comprehension performance among the LD students. This study fills this gap by developing and testing the effectiveness of CLASP-C, a structured program based on the principles of CLT and scaffolding; primarily intended for meeting the distinctive cognitive needs of LD students, particularly to improve Urdu comprehension.

Significance of the Study

The present study is significant both theoretically and practically. Theoretically, this study extends the utilization of CLT from general and multimedia education into special education institutes, and from alphabetic languages into Urdu-medium classrooms by embedding the principles of CLT and scaffolding into a structured program. It gives an increased awareness of how cognitive architecture can be leveraged to improve comprehension even in complex linguistic contexts. Practically, this theory suggests an evidence-based, structured, and resource-friendly program for special-education teachers that they might implement in their classroom effectively within the resources at their disposal, without requiring extra technology, to improve Urdu comprehension among LD students. The study also developed and validated UCAR, a teacher-rated scale that teachers can use in their classrooms to gauge the performance of LD students in terms of comprehension.

The study also holds significance at the policy level and suggests that curriculum developers integrate structured and cognitively-aware programs into special and inclusive education classrooms. The study invites researchers to further study the effectiveness of structured programs and the implications of CLT in other literary domains and subject matters in special education contexts.

Objective of the Study

The main objective of this study was to examine the effects of the CLASP-C on Urdu comprehension performance amongst LD students. The study was conducted to answer the following question:

- Does participation in the CLASP-C improve Urdu comprehension performance amongst LD students as compared to traditional instruction?

Research Hypotheses

- H_0: There is no significant difference in post-test Urdu comprehension performance between LD students receiving CLASP-C intervention and those receiving traditional instruction after controlling for pre-test scores.
- H_1: There is a significant difference in post-test Urdu comprehension performance between LD students receiving CLASP-C intervention and those receiving traditional instruction after controlling for pre-test scores.

Literature Review

The advancement of literacy skills is an essential goal of formal education. It assists students to navigate curriculum content, and develop knowledge (Forsling & Tjernberg, 2023). Students grow proficient academically, as well as socially (Kim et al., 2021). Comprehension is one of the key components of literacy (Duke et al., 2021). The term can be described as the capacity of a learner to make meaning out of a text (Kim & Cho, 2021). Studies disclose that comprehension is a crucial indicator of academic performance in all subjects (Hong & Lillard, 2020). These studies collectively suggest that comprehension is more than just a supplemental literacy skill; it is a key academic skill that is directly related to academic outcomes in all fields of study.

In the case of students with learning disabilities (LD students), comprehension is an ever-present issue. Learning disabilities are frequently tied to limitations of working memory and slower cognitive processing (Swanson, 2022). In certain instances, the conditions are related to an inability to integrate linguistic information (Hong & Lillard, 2020). In these circumstances, LD students might show essential decoding skills but lack the capacity to develop clear meanings (Hall-Mills & Marante, 2022). Previous studies have repeatedly revealed that LD students deal with obstacles in reading comprehension (Holloway & Brass, 2021). While LD students are known to struggle with comprehension, many current interventions focus on general reading achievement, and not the cognitive demands of comprehension processes.

Comprehension becomes exceedingly difficult in Urdu-based instruction. Urdu is written right-to-left in cursive style (Nabi et al., 2025). It has context-dependent letter shapes (Batool & Saleem, 2023), which elevate the cognitive load. Students are anticipated to concentrate on visual

shapes, lexical content, and syntax simultaneously (Altaf et al., 2023). Research on orthographically complex languages demonstrates that these characteristics negatively impact reading speed (Mousikou et al., 2020). Traditionally, Urdu comprehension is taught through rote reading and oral repetition in Pakistani public-sector schools (Afaq & Mehmood, 2025). Large classroom sizes and a scarcity of instructional resources are an additional obstacle in these contexts (Jokhio et al., 2020). Traditional instructional methods deployed to teach comprehension work mechanically and do not consider the cognitive limitations of the students (Moin et al., 2023). Empirical studies of cognitively informed comprehension intervention in Urdu-medium environments are limited, even though Urdu is the medium of instruction in many schools in Pakistan. Moreover, the effect of these alphabetic-language interventions cannot be directly applied to Urdu because of differences in the language and orthography.

Cognitive Load Theory (CLT) provides a framework for instructional design that corresponds to human cognitive architecture (Sweller, 1988; Surbakti et al., 2024). CLT asserts that learning capability is restricted by working memory capacity (Greenberg & Zheng, 2022). Productive instruction is one that is able to cope with three types of cognitive load (Paas & van Merrienboer, 2020). These cognitive loads include intrinsic load (the intricate nature of the task), extraneous load (insufficient instruction design), and the germane load (facilitating schema development) (Taylor et al., 2022). The scenario becomes more closely linked in the case of LD students who already contend with the limitation of working memory. Any instructional design that neglects the capacity of working memory may evoke cognitive overload in LD students.

Research has established that CLT-based instructional techniques e.g. segmentation (Chen, 2025), worked examples (Sozio et al., 2024), signalling (Beege et al., 2021), and the diminution of redundant information (Albers et al., 2023) are effective in enhancing learning. CLT-based instructions curated to improve comprehension consist of splitting texts into easy-to-comprehend chunks (Hornay, 2021), explicitly marking important information (Parveen, 2025), and instructing learners in generating meaning (Rohde et al., 2023). The majority of the existing evidence about CLT-based teaching comes from the field of multimedia learning and general education; however, the application of CLT in Urdu-medium special-education classrooms is a less explored area.

Scaffolding is closely associated with CLT. The term scaffolding was coined by Wood et al. (1976), which has its foundation in the work of Vygotsky (1920s to 1930s). It provides a learning mechanism that helps stabilize cognitive loads (Câmara et al., 2021). Scaffolding has its roots in sociocultural theory (Sarmiento-Campos et al., 2022). It claims that if support is provided and then faded out, the students start learning autonomously (Hensley & Cornelius, 2024). They become able to function in the Zone of Proximal Development (Vygotsky, 1978; Raslan, 2024). Scaffolding can be implemented in instructional design in multiple formats i.e. teacher modelling, facilitated questioning, prompts, and structured practice (Reiser & Tabak, 2014). The research points out that scaffolded comprehension instruction is an effective strategy for building up skills (Novita & Arifmiboy, 2023). Scaffolding holds significant instructional value across diverse contexts; however, its effectiveness remained less explored in Urdu-medium special-education contexts.

Although there is an extensive repository of literature on the effectiveness of both CLT-based and scaffolded programs, the overwhelming majority of these studies are done in alphabetic languages. On top of that, most of the interventions blend comprehension with writing skills. This method is also problematic for LD students. Another aspect is that CLT is typically employed in general education and multimedia learning with a rare commitment to special education settings (Duran et al., 2022; Sweller, 2020). This imbalance in the literature suggests that there is a gap in context and theory specifically about a cognitively based comprehension framework for Urdu-medium LD students.

This study developed and scrutinized the effectiveness of CLASP-C. CLASP-C takes root in CLT and scaffolding and is anticipated to enhance Urdu comprehension amongst LD students. CLASP-C encompasses several CLT principles and scaffolding into a structured program. It parallels the Urdu national curriculum in the Pakistani public-sector schools.

Research Gap

The literature review indicates that there are some significant gaps in research, especially when it comes to teaching Urdu comprehension to LD learners. First, comprehension has been treated as a secondary product of reading instruction instead of a domain (Afflerbach et al., 2020). This is particularly relevant in Urdu literacy, where reading is targeted through

decoding, oral reading, and memorization (Mirza & Gottardo, 2022). In such cases, the development of comprehension could receive only a little attention. Secondly, structured interventions are established to be effective in improving comprehension; most interventions have been done in English or other alphabetic languages. Their results cannot be applied to Urdu since Urdu has its own unique characteristics, e.g., orthographic richness and contextual letter forms. Another gap is in the theoretical foundation of the current comprehension interventions. Although CLT and scaffolding both have been proven to be effective in boosting learning outcomes, Urdu comprehension remains a rarely-explored area. Integration of CLT and scaffolding for enhancing Urdu comprehension is another gap that needs to be addressed.

The current research fills this gap by developing and examining the effectiveness of CLASP-C, which is a theory-based and curriculum-aligned intervention created to target the unique cognitive needs of LD students to improve Urdu comprehension.

Theoretical Framework

This study is grounded in CLT and scaffolding. CLT is the main theoretical foundation for CLASP-C. CLT states that learning and working memory capacity are related. An effective instructional design should be developed in a way to align with the cognitive architecture of the learners. CLT distinguishes between three types of cognitive loads: intrinsic, extraneous, and germane loads (Klepsch & Seufert, 2020; Zu et al., 2020). A good instructional plan manages these loads to make learning fruitful (Van Merriënboer & Sweller, 2005). The second theoretical foundation of the study is scaffolding. Scaffolding asserts that if the support is gradually decreased, the learners start to work independently (Zackariasson, 2019).

When we talk about the Urdu language, the intrinsic load is increased because of orthographic complexities of the language (Khan, 2023). When we talk about LD students, the scenario becomes more challenging due to working memory limitations of such children (Martínez-Briones et al., 2020). CLASP-C manages the intrinsic load by ordering the tasks according to difficulty and dividing the larger contents into manageable units. To manage extraneous load, several techniques are used e.g., clear instructions and a limited format of responses. To promote the germane load, guided and independent practices are used. CLASP-C uses several scaffolding

techniques, i.e., teacher modelling, guided questioning, prompts, and fading instructional support, which help optimize the working memory resources. Support is gradually faded out with the passage of time as the program moves ahead.

In short, CLASP-C is an instructional plan that uses different CLT-based techniques to manage the cognitive loads under the umbrella of scaffolding in order to achieve its objective, i.e., to improve the Urdu comprehension of LD students while taking the unique cognitive needs of LD students and unique characteristics of the Urdu language into account.

Methodology

Research Design

The study was conducted using a quasi-experimental pre-test-post-test control-group design to evaluate the effectiveness of CLASP-C to improve Urdu comprehension performance of LD students. The pre-test-post-test nature of the intervention served to measure the changes in performance in before and after intervention scores. At the same time, the control group helped to isolate the effects of the intervention on Urdu comprehension performance of LD students.

Population and Sampling

The population of the study is students studying in grades IV and V in Urdu-medium public special-education schools. The population was delimited to LD students enrolled in a public-sector special education school in Rawalpindi. A sample of 32 LD students (aged 11-14 years) was selected using a purposive sampling technique. Only those students who met the inclusion criteria, i.e., had identified learning disabilities as per school records, exhibited difficulties in Urdu comprehension as per teacher assessment, were studying in grades IV and V, and were willing to participate in the intervention, were included in the sample. Identification of students was based on the school records and prior psychoeducational evaluations maintained in school. The exclusion criteria were also defined, and those students were excluded who had comorbid sensory, motor, or intellectual disabilities or severe/profound learning disabilities, and were absent from the school during the intervention period. A purposive sampling technique was employed to make sure that only those students who best fit the inclusion criteria were included for a more accurate evaluation of the effectiveness. The sample was selected without gender

discrimination, and both boys (n =15) and girls (n = 17) participated in the study.

After the purposive selection based on the inclusion criteria, each participating student was assigned a code and was randomly allocated to either the control or the experimental group, using a simple random assignment procedure to increase internal validity and minimize selection bias, resulting in two equal groups, i.e., the control group (n = 16) and the experimental group (n = 16). The participants of the control group continued with traditional comprehension practices in the regular classrooms, whereas the participants of the experimental group received intervention for 8 weeks (24 sessions).

Table 1

Baseline Characteristics of Control and Experimental Groups

Group	*n*	Age (years)		Grade		Gender		Pre-test	
		M	*SD*	IV	V	Boys	Girls	*M*	*SD*
Control	16	12.31	0.87	8	8	7	9	7.88	1.20
Experimental	16	12.19	0.91	7	9	8	8	7.81	1.22
Total	32	12.25	0.89	15	17	15	17	7.84	1.19

Instrumentation

The study developed a teacher-rated Urdu Comprehension Assessment Rubric (UCAR). UCAR was the primary data collection instrument and was used to collect pre-test and post-test scores of participants in both groups. The scale was developed to align with the objectives of the study and was specifically designed according to the needs of LD students in grades IV and V in Urdu-medium public-sector schools.

UCAR assessed four domains of comprehension skills, i.e., literal comprehension, inferential comprehension, main idea identification, and meaning monitoring and interpretation. These domains were selected on the basis of the expectations of grade-appropriate curriculum, principles of CLT, and objectives of CLASP-C. Each domain was scored on a scale of 1 to 5, where 1 reflects basic and 5 reflects excellent. The interval between the scale points is assumed to be approximately equal. The sum of scores across the domains ranged from 4 to 20 and was composite, so it was treated as continuous. UCAR was used to rate the written text, such as short answers and sentences.

Once the instrument was developed, it was expert-reviewed by three independent experts from the field of Urdu language, special education, and research to establish content validity. Minor revisions were made to the instrument on the basis of feedback from the experts. After expert validation and revision, a pilot test was conducted where the UCAR was applied to a small but comparable sample. The score obtained from these samples were used for the calculation of internal consistency using Cronbach's alpha (α), which returned the value of coefficient α = .82, and it indicates a good internal consistency of the instrument (Izah, 2024). Inter-rater agreement validity was established at the piloting stage. Three independent raters from the field of Urdu language and special education rated the responses from the pilot sample following the UCAR guidelines. These scores were used to calculate a two-way mixed-effects Intraclass Correlation Coefficient (ICC), and the obtained coefficient value was ICC(3,3) = .86, indicating good inter-rater agreement (Xue et al., 2021).

Intervention Plan (CLASP-C)

This study developed and implemented the Cognitive Load Aware Scaffolded Program for Comprehension (CLASP-C) as an intervention. CLASP-C is a structured program that has been designed to improve Urdu comprehension skills among LD students. It is rooted deeply in the principles of CLT and scaffolding, and is designed specifically to target the unique needs of LD students. The intervention was provided over 8 weeks, with four 45-minute sessions each week (total 24 sessions). Instruction was provided in small groups so that monitoring and support could be provided adequately. The instructional material was aligned with the curriculum of LD students in public-sector schools in Pakistan. The program was designed in a way that it could be implemented alongside the school's schedule.

Table 2

Structure and Instructional Components of the CLASP-C Intervention

Phase	Sessions	Primary Instructional Focus	Key CLT Principles and Techniques	Scaffolding Characteristics
Orientation and Cognitive Readiness	2	Concept of comprehension; task expectations; activation of prior knowledge;	Pre-training principle; goal clarity; reduction of extraneous cognitive load	Maximum support through explicit explanation, modelling, and guided

Phase	Sessions	Primary Instructional Focus	Key CLT Principles and Techniques	Scaffolding Characteristics
		familiarization with response formats		discussion
Guided Literal Comprehension	6	Identification of explicitly stated information; matching, yes/no, and fill-in-the-blank responses	Worked examples; segmenting; signalling; intrinsic load management	Very high scaffolding with teacher-led modelling and continuous cues
Supported Inferential Comprehension	6	Cause–effect relationships; inferential "why/how" questions; guided inference	Completion problems; fading worked examples; germane load enhancement	Moderate scaffolding with gradual fading of prompts
Independent Comprehension Monitoring	6	Self-monitoring understanding; identifying main ideas; short written responses	Reduced redundancy; self-explanation; schema consolidation	Low scaffolding with teacher acting primarily as facilitator
Transfer, Reinforcement, and Maintenance	4	Application of comprehension strategies to classroom texts; reinforcement and maintenance	Retrieval practice; variability principle; schema automation	Minimal scaffolding with independent application and delayed feedback

The program was designed in five phases. Each phase had its own distinct material, its own integration of CLT principles and its own level of scaffolding. The first phase was "Orientation and Cognitive Readiness", which had 2 sessions. This phase was focussed on the cognitive and motivational preparation of students. The students were provided with the awareness of the program. They were taught about the concept of comprehension and its importance, the task they had to perform, goals of the intervention, and the reward system of the program. The second phase was "Guided Literal Comprehension", which continued for 6 sessions. This phase aimed at the development of the ability to understand explicitly-stated information in Urdu text. Short and syllabus-aligned passages were presented to the students. The CLT rule of segmentation was applied to

manage the intrinsic load. Other CLT techniques were also applied, e.g. worked examples and signalling. Several structured activities were employed in this phase, e.g. column-matching, yes-no questions, and fill-in-the-blank responses. Scaffolding was used intensively in this phase. The third phase was "Supported Inferential Comprehension" which had 6 sessions. In this phase, students' understanding progressed from literal comprehension to inferential comprehension. Students were taught how to make inferences, identify cause and effect relationships, and answer "why" and "how" questions. Several CLT techniques were used in this phase, e.g. problem-completion and fading worked examples. The teacher provided support in the mean of sentence starters and guided prompts. Scaffolding was gradually reduced in this phase. The fourth phase was "Independent Comprehension Monitoring" that continued for the next 6 sessions. This phase was aimed at the boosting of independent comprehension monitoring and self-regulation. Students were trained for comprehension tasks of grade-appropriate texts. Several CLT techniques were employed in this phase, e.g. reduced redundancy, self-explanation, and schema consolidation. Students learned to identify main ideas and answer short questions. In this phase, scaffolding decreased to almost being diminished, and the role of the teacher turned into a mere facilitator, where the support was provided only if needed. The fifth and final phase was "Transfer, Reinforcement, and Maintenance" which lasted for 4 sessions. The main focus of this phase was the facilitation of transfer of skill into regular classroom activities. Students applied learned skills to regular classroom reading tasks. The use of scaffolding was minimal in this phase. Reinforcement activities were conducted and small rewards were given to motivate the students and boost confidence.

The whole intervention was developed and conducted by the researcher himself. The researcher is a qualified special education teacher, experienced in teaching LD students. To ensure the fidelity, the intervention was delivered based on a stepwise plan with clear objectives for each session, instructional procedures, and scaffolding. To ensure consistency in delivery, sequencing of instruction and use of CLT-related techniques across sessions, a session checklist and instructional notes were used by the researcher. Researcher expectancy bias cannot be ruled out as the researcher developed and implemented the intervention; however, attempts were made to standardize the delivery of intervention across the intervention period.

During this time, the participants of the control group continued with the traditional methods in their regular classroom. They were not provided instructions based on the principles of CLT, of scaffolding, or any other structured comprehension program during this period.

Data Collection and Data Analysis

Data collection was executed in a methodical sequence aligned with the quasi-experimental design of the study. After picking out participants through purposive sampling, students were randomly assigned to either the experimental group (CLASP-C) or the control group (traditional instruction). Before heading to the intervention, both groups underwent a pre-test using the UCAR to establish baseline equivalence in comprehension performance.

Following the pre-test, the experimental group underwent the Cognitive Load Aware Scaffolded Program for Comprehension (CLASP-C); meanwhile the control group kept continuing to receive regular Urdu instruction pursuant to the school's prescribed curriculum. Upon completion of the intervention, a post-test was administered to both groups using the same UCAR instrument under comparable conditions.

The researcher scored pre-test and post-test responses as per the UCAR scoring criteria. Because of the researcher's involvement in the intervention, it was not possible to be completely blinded to group membership. In order to reduce potential scoring bias, scoring was done using rubric descriptors, which were developed during instrument development and pilot testing.

Data analysis was undertaken using legitimate statistical procedures. Initially, descriptive statistics (mean, standard deviation, minimum, and maximum values) were computed to summarize comprehension performance. Assumptions for parametric testing were checked out prior to inferential analysis. Normality of data distribution was measured using the Shapiro–Wilk test, while homogeneity of variances between groups was verified using Levene's test.

To analyse within-group variations in comprehension performance, paired-samples t-tests were conducted. Independent-samples t-tests were used to contrast pre-test and post-test scores between the experimental and control groups. Additionally, Analysis of Covariance (ANCOVA) was employed, with pre-test scores entered as a covariate, to control for initial differences and to examine the adjusted effect of the CLASP-C intervention

on post-test comprehension accomplishments.

Ethical Considerations

All educational research ethical guidelines were strictly adhered to throughout the study. Before intervention, formal written approval was obtained from the school administration. Informed consent was obtained from parents/guardians of participants, and verbal assent was obtained from participants. Participation in the intervention was voluntary, and no pressure was exerted on students. The participants had the right to relinquish the intervention at any stage without having an adverse aftermath. Students were not exposed to any physical, psychological, or academic discomfort. The intervention synchronized with the school curriculum and focused exclusively on improving performance and not on distractions. Participants in the control group were not segregated, and they continued with regular classroom activities. Since the participants of the study were LD students, ethical guidelines of the research, both for the child participants and for persons with disabilities (PWDs), were on the agenda. Confidentiality and anonymity of the participants were not compromised. Codes were used as opposed to names on the dataset. The information that was gathered was archived privately, where only the researcher had access. The data were used exclusively for the research intention, and after the data analysis, all the raw data were wiped out. Names and identities were not disclosed in the data analysis or the paper. Only aggregate data analysis was reported instead of individual scores. Dignity and respect of the participants were maintained throughout the process. Since the participants were LD students, special care was given to ensure a supportive, non-threatening, and educationally appropriate environment during intervention and assessment procedures.

Results

Descriptive Statistics

The pre-test and post-test data were summarised using descriptive statistics.

Table 3

Descriptive Statistics Summary

Group / Time	*n*	*M*	*SD*	Variance

Control Group (Pre-test)	16	7.88	1.20	1.44
Experimental Group (Pre-test)	16	7.81	1.22	1.49
Control Group (Post-test)	16	8.06	1.39	1.93
Experimental Group (Post-test)	16	11.06	1.65	2.72

Table 3 shows the results of descriptive tests. The analysis shows that the mean score of both groups was almost the same in the pre-test (Control: M = 7.88; Experimental: M = 7.81). The control group did not show much improvement, whereas the experimental group demonstrated a significant improvement (M = 11.06). The data show a pattern of students who participated in CLASP-C making apparent gains in comprehension performance as compared to those who continued with traditional methods.

Figure 1

Mean Urdu Comprehension Scores with Standard Error Bars

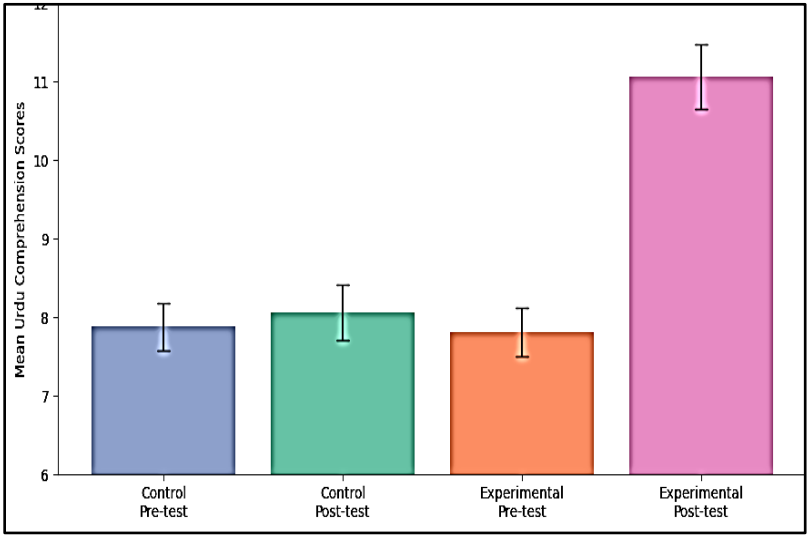


Figure 1 is a mean bar graph of scores of both groups across tests. It shows that both groups had similar scores at pre-tests. The scores of the experimental group increased over time, but those of the control group remained almost the same.

Normality and Homogeneity Assumptions

To establish whether the datasets meet the assumptions required for the parametric analysis, tests of data normality and variance homogeneity were

conducted, where normality of score distributions was assessed using a Shapiro–Wilk test, while homogeneity of variance was examined using Levene's test.

Table 4

Shapiro–Wilk Test Results

Group / Time	*W*	*p*	Interpretation
Control Group (Pre-test)	0.921	0.177	Normal
Control Group (Post-test)	0.910	0.118	Normal
Experimental Group (Pre-test)	0.923	0.191	Normal
Experimental Group (Post-test)	0.902	0.087	Normal

Table 4 shows the results of the Shapiro–Wilk test of the normality of the data. The results demonstrated that the data are normally distributed across the distributions (all $p > 0.05$).

Table 5

Levene's Test Results

Comparison	*F*	*p*	Interpretation
Control vs Experimental (Pre-test)	0.042	0.839	Variances equal
Control vs Experimental (Post-test)	0.449	0.508	Variances equal

Table 5 shows the results of Levene's test for the equality of variance. The results show that the variance of scores at both time-point comparisons was homogeneously distributed ($p > .05$).

These results of the Shapiro-Wilk test and the Levene's test confirm the normality of distribution and homogeneity of the variance in the data. Hence, the assumptions of the parametric tests were met, and further analysis was conducted using parametric tests.

Hypothesis Testing

To test the hypothesis, the mean scores of both groups across tests were compared using between-groups (independent-samples) and within-group (paired-samples) t-tests.

Table 6

t-tests Results Summary

Comparison	Test Type	*t*	*df*	*p*	Interpretation

Pre-test (Between Groups)	Independent	0.15	30	.885	Not significant
Control group (Across Tests)	Paired	−0.45	15	.662	Not significant
Experimental (Across Tests)	Paired	−5.74	15	< .001	Significant
Post-test (Between Groups)	Independent	−5.56	30	< .001	Significant

Table 6 illustrates the results of independent-samples and paired-samples t-tests. The comparison of pre-test scores revealed that there was no statistically significant difference in scores of both groups, $t(30) = 0.15$, $p = .885$. This confirms the baseline equivalence. This baseline equivalence helped to support a causal interpretation of the differences in performance later seen, as it is unlikely that they were due to pre-existing group differences. Within-group analysis for the control group reveals that there is no significant difference in scores across tests, $t(15) = -0.45$, $p = .662$. It confirms that the traditional instructions fail to produce a meaningful difference. The conventional comprehension instruction approach does not seem to be effective for the cognitive and linguistic needs of LD students. Another within-group analysis for the experimental group showed statistically significant improvement in the score over time, $t(15) = -5.74$, $p < .001$. This confirms that the CLASP-C intervention has effectively helped the LD students to improve Urdu comprehension, suggesting that cognitively informed scaffolded instruction may be an effective way to facilitate comprehension development in LD students. Post-test between-group comparison revealed a statistically significant difference in the scores of both groups in favour of the experimental group, $t(30) = -5.56$, $p < .001$. It confirms that participation in the CLASP-C intervention was more effective in improving Urdu comprehension among LD students than traditional methods. The incorporation of CLT principles and scaffolding strategies may have a positive impact in Urdu-medium special-education classrooms.

Effect Size Estimation

To estimate the degree of effectiveness of the intervention, paired-samples (within-group) and independent-samples (between-group) Cohen's *d* effect size tests were applied.

Table 7

Cohen's d Results

Comparison	Test Type	Cohen's d	Magnitude

Experimental group (Pre vs Post)	Paired-samples	1.43	Very large
Post-test (Control vs Experimental)	Independent-samples	1.97	Very large

Table 7 illustrates the results of independent-samples and paired-samples Cohen's *d*. The results of Cohen's *d* effect size test for paired-samples show a large within-group effect, $d = 1.43$. Likewise, the results of Cohen's *d* effect size test for independent-samples also demonstrate a large between-group effect, $d = 1.97$. Combined, these large effect sizes confirm that the effectiveness of the CLASP-C intervention is not only significant statistically but also meaningful practically.

Analysis of Covariance (ANCOVA)

Assumptions of homogeneity of regression slope, linear relationship between variables, and absence of extreme outliers were checked before performing ANCOVA.

Table 8

ANCOVA Assumption Testing Results

Assumption	Method/Test Used	Result	Interpretation
Homogeneity of regression slopes	Group × pre-test interaction	$F(1, 28) = 1.12$, $p = .298$	Assumption met
Linear relationship between covariate and DV	Quadratic regression component	$p = .603$	Linear relationship supported
Absence of influential extreme outliers	Cook's Distance	Max Cook's $D = 0.19$	No influential outliers detected

Table 8 shows the results of testing for assumptions of ANCOVA. The interaction term (group x pre-test) was not significant, which supported the assumption of homogeneity of regression slopes, $F(1, 28) = 1.12$, $p = .298$. The analysis of the quadratic regression showed that the relationship was linear, $p = .603$. No extreme outliers were identified based on Cook's distance values (maximum Cook's $D = 0.19$). The results indicated the appropriateness of the use of ANCOVA for the analysis of adjusted post-test differences between groups.

After that, the ANCOVA was conducted to establish the effectiveness

of the intervention after controlling for the pre-test scores.

Table 9

ANCOVA Results

Source	*df*	*F*	*p*	partial η^2
Group	1, 29	29.86	< .001	.51
Pre-test (Covariate)	1, 29	0.07	.796	.002

Table 9 demonstrates the results of ANCOVA. The results show that the effects of the group were statistically significant even after controlling the pre-test scores, $F(1, 29) = 29.86$, $p < .001$, partial $\eta^2 = .51$, indicating a large effect; and, the pre-test score was not a significant covariate, $F(1, 29) = 0.07$, $p < .79$. It confirms that the improvement in the score is due to participation in CLASP-C intervention and not because of baseline performance.

Figure 2

Boxplot Of Urdu Comprehension Scores

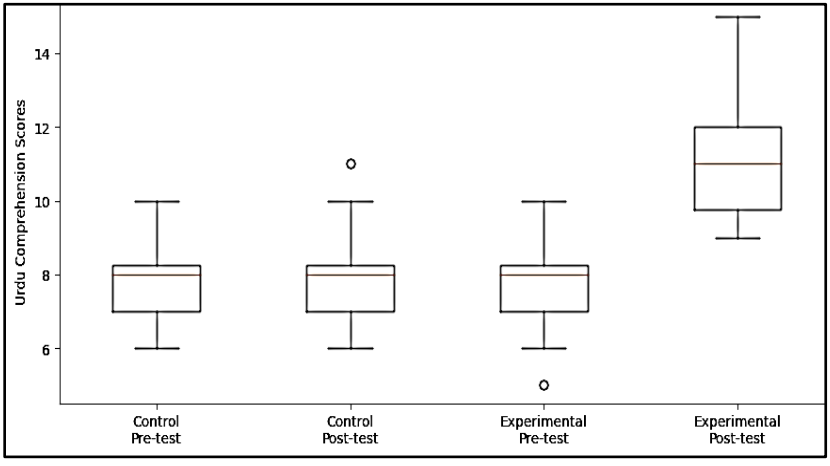


Figure 2 is a boxplot of the scores across the groups over time. The upward shift in the scores of the experimental group shows that CLASP-C produced meaningful and observable improvement in the performance.

Discussion

This study was conducted to evaluate the effectiveness of CLASP-C to improve Urdu comprehension skills of LD students. Data analysis showed

that the performance of both groups was equivalent at baseline. After the intervention, the participants of the experimental group displayed significant improvement across tests, as compared to the participants of the control group. On the other hand, the participants of the control group weren't able exhibit the significant improvement over time. These results suggest that students who underwent CLASP-C sessions performed better in comprehension. On the other hand, the ones who received routine classroom instructions did not demonstrate significant improvement. These findings suggest LD students are capable of improving their comprehension skills, but the traditional practices executed in the regular classroom may be insufficient to make it happen. Instead, that means of instruction may be used which are strategically planned in order to accommodate the cognitive needs of LD students. The large effect sizes could relate to the structured and intensive nature of the intervention, the instructional procedures that were aligned with the cognitive needs of LD students, and the small-group instructional setting. The effect sizes from smaller samples need to be interpreted with caution, though, as they might seem larger than those of larger studies.

The results of the study are in tandem with its objectives. Data analysis indicated that a scaffolded instructional program that uses principles of CLT may improve the Urdu comprehension of LD students. The improvement of the experimental group suggests that controlling cognitive load and scaffolding allowed students to perform better. The structured nature of intervention may have enabled them to read texts and construct meaning. The results of the study also suggest that comprehension should be treated as a distinctive cognitive-linguistic domain rather than a by-product of reading fluency.

Theoretically, the findings of the study support the stance of CLT that if the cognitive loads are dealt appropriately, the learning outcomes may be boosted (Skulmowski & Xu, 2022). Participation in CLASP-C intervention may have enabled students to effectively use the constrained availability of working memory. The intervention helped them by regulating intrinsic load, reducing extraneous load, and supporting the germane load. All this scenario suggests that the cognitive overload is the root cause of multiple comprehension challenges in LD students. The instructional designs constructed around the principles of CLT may alleviate these issues. The study may broaden the scope of CLT, from general and multimedia

education into a special education classroom and from alphabetical language into Urdu-medium settings. The results also suggest the significance of the scaffolded instruction (Acosta-Gonzaga & Ramirez-Arellano, 2022; Anggarini, 2024; Shin et al., 2020). The CLASP-C used structured support and gradual fading of the support which may have supported participants in developing autonomous meaning construction. These findings are consistent with sociocultural views of learning that structured support plays a role in cognitive development.

The findings are also in the same line with the studies that show the usefulness of structured interventions in special education (Odom et al., 2021); intervention studies that are based on Principles of CLT (Andaroon et al., 2020; Ghanbari et al., 2020); scaffolded instructions (Guo et al., 2023; Kusmaryono et al., 2020); and structured comprehension instructions (Hall et al., 2020; Magableh & Abdullah, 2020).

Practically, the intervention has multiple offerings. It delivers special education teachers with an empirically-informed resource-friendly instructional design that they might employ in their classroom within their available resources to improve the comprehension skills of LD students. CLASP-C may be implemented in the public-sector schools and is consistent with the present-day Urdu curriculum. Moreover, the UCAR may be endorsed by educators when tracking and evaluating the Urdu comprehension skills of students. It is an easy-to-use tool that may be effectively applied in a classroom environment.

In conclusion, this study provides preliminary evidence that CLASP-C may be an effective strategy to enhance Urdu comprehension in LD students. It is a relevant and theoretically-grounded program that targets the novel cognitive needs of LD students. The results suggest that the integration of principles of CLT and scaffolded instruction is a holistic approach for confronting the comprehension issues in the field of special education. The study encourages the use of structured and cognitively-informed literacy interventions among LD students.

Although the results are encouraging, they must be viewed with some caution because of the small sample, the purposive sampling design, the single school context, the absence of follow-up assessment, and the potential for researcher expectancy bias caused by researcher-led intervention and scoring methods. Further research is encouraged using

larger, more diverse samples and a variety of educational settings, blinded assessment methods, and follow-up of the results over time to better explore the effectiveness of CLASP-C.

Recommendations

The Following recommendations are being forwarded on the basis of the results of the study:

- Since the intervention produced significant results, cognitive load-aware teaching approaches may be included to teach comprehension to LD students.
- Given the effectiveness of the scaffolded nature of the intervention, the scaffolded comprehension instruction may be systematically applied in special education classrooms.
- The conventional methods of teaching comprehension could not prove their effectiveness so they may be substituted or supplemented by structured programs e.g., CLASP-C.
- The assessment of comprehension may be based on rubric based tools, e.g., UCAR.
- The modules on CLT and scaffolded instruction may be included in teacher training programs so that they can apply them in their classroom.
- The curriculum planners and policy makers may include structured CLT-based comprehension programs in the curriculum of LD students specifically and special education generally.

Limitations of the Study

The limitations of the study include, but are not limited to the following:

- The sample size was pretty small and taken from a single school and may not be very representative of broader populations.
- The quasi-experimental design was adopted which lacks random sampling and might have triggered the selection bias.
- Duration of the intervention was short, and long-term educational impacts cannot be concluded.
- Retention or transfer of the results over time cannot be claimed since no follow-up test was conducted.
- A teacher-rated rubric scale was implemented that ought to have

included the rater bias.

- The researcher is a teacher at the same school where the sample was taken from and the intervention was carried out at; although it strengthened the fidelity, it might have perpetuated the expectation bias. Future research may be executed using larger and more diverse samples. The longitudinal studies and follow-ups can be conducted to validate and extend the results. The intervention can be replicated across different subjects, grades, disabilities, and linguistic contexts.

Author Contribution

Mehtab Hussain: Sole Author

Conflict of Interest

The author of the manuscript has no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

Data of this study will be provided by the corresponding author upon formal request.

Funding Details

No funding has been received for this research.

Generative AI Disclosure Statement

The authors did not use any type of generative artificial intelligence software for this research.

References

Acosta-Gonzaga, E., & Ramirez-Arellano, A. (2022). Scaffolding matters? Investigating its role in motivation, engagement, and learning achievements in higher education. *Sustainability*, *14*(20), Article 13419. https://doi.org/10.3390/su142013419

Afaq, M., Mehmood, T., & Ayaz, M. O. (2025). Can artificial intelligence challenge universal grammar? A theory-driven empirical investigation. *Journal of Applied Linguistics and TESOL*, *8*(4), 1248–1254. https://doi.org/10.63878/jalt1681

Afflerbach, P., Hurt, M., & Cho, B. Y. (2020). Reading comprehension strategy instruction. In D. L. Dinsmore, L. A. Fryer, & M. M. Parkinson (Eds.), *Handbook of strategies and strategic processing* (pp. 98–118). Routledge. https://doi.org/10.4324/9780429423635-7

Albers, F., Trypke, M., & Stebner, F. (2023). Different types of redundancy and their effect on learning and cognitive load. *British Journal of Educational Psychology*, *93*(3), 604–621. https://doi.org/10.1111/bjep.12592

Altaf, A., Anwar, M. W., Jamal, M. H., Bajwa, U. I., Ahmad, S., & Khan, F. H. (2023). Exploiting linguistic features for effective sentence-level sentiment analysis in Urdu language. *Multimedia Tools and Applications*, *82*(27), 41813–41839. https://doi.org/10.1007/s11042-023-15216-0

Andaroon, N., Kordi, M., Kimiaee, S. A., & Esmaeili, H. (2020). The effect of individual counseling on attitudes and decisional conflict in the choice of delivery among nulliparous women. *Journal of Education and Health Promotion*, *9*, Article 35. https://doi.org/10.4103/jehp.jehp_472_18

Anggarini, I. F. (2024). Speaking challenges in research class of non-English student: A case study. *JETLEE: Journal of English Language Teaching, Linguistics, and Literature*, *4*(1), 89–100. https://doi.org/10.47766/jetlee.v4i1.2494

Batool, R., & Saleem, T. (2023). Comparative construction morphology of diminutive forms in English and Urdu. *Cogent Arts & Humanities*, *10*(1), Article 2238998. https://doi.org/10.1080/23311983.2023.2238998

Beege, M., Nebel, S., Schneider, S., & Rey, G. D. (2021). The effect of signaling in dependence on the extraneous cognitive load in learning environments. *Cognitive Processing*, *22*(2), 209–225. https://doi.org/10.1007/s10339-020-01002-5

Câmara, A., Roy, N., Maxwell, D., & Hauff, C. (2021). Searching to learn with instructional scaffolding. In *Proceedings of the 2021 ACM SIGIR Conference on Human Information Interaction and Retrieval (CHIIR '21)* (pp. 209–218). Association for Computing Machinery. https://doi.org/10.1145/3406522.3446012

Chen, I. S. J. (2025). Making bilingual learning work: Cognitive load and segmented instruction in Taiwan's life curriculum. *Secondary Education*, *76*(2), 58–73. https://doi.org/10.6249/SE.202506_76(2).0011

Duke, N. K., Ward, A. E., & Pearson, P. D. (2021). The science of reading comprehension instruction. *The Reading Teacher*, *74*(6), 663–672. https://doi.org/10.1002/trtr.1993

Duran, R. S., Zavgorodniaia, A., & Sorva, J. (2022). Cognitive load theory in computing education research: A review. *ACM Transactions on Computing Education*, *22*(4), 1–27. https://doi.org/10.1145/3483843

Forsling, K., & Tjernberg, C. (2023). Intentions and flexibility: Navigating

complex literacy practices in primary education. *Educational Research, 65*(3), 301–319. https://doi.org/10.1080/00131881.2023.2209580

Ghanbari, S., Haghani, F., Barekatain, M., & Jamali, A. (2020). A systematized review of cognitive load theory in health sciences education and a perspective from cognitive neuroscience. *Journal of Education and Health Promotion, 9,* Article 176. https://doi.org/10.4103/jehp.jehp_643_19

Greenberg, K., & Zheng, R. (2022). Cognitive load theory and its measurement: A study of secondary tasks in relation to working memory. *Journal of Cognitive Psychology*, *34*(4), 497–515. https://doi.org/10.1080/20445911.2022.2026052

Guo, Y., Wang, Y., & Ortega-Martín, J. L. (2023). The impact of blended learning-based scaffolding techniques on learners' self-efficacy and willingness to communicate. *Porta Linguarum: Revista Interuniversitaria de Didáctica de las Lenguas Extranjeras*, *40*, 253–273. https://doi.org/10.30827/portalin.vi40.27061

Hall, C., Vaughn, S., Barnes, M. A., Stewart, A. A., Austin, C. R., & Roberts, G. (2020). The effects of inference instruction on the reading comprehension of English learners with reading comprehension difficulties. *Remedial and Special Education*, *41*(5), 259–270. https://doi.org/10.1177/0741932518824983

Hall-Mills, S. S., & Marante, L. M. (2022). Explicit text structure instruction supports expository text comprehension for adolescents with learning disabilities: A systematic review. *Learning Disability Quarterly*, *45*(1), 55–68. https://doi.org/10.1177/0731948720906490

Hensley, K. K., & Cornelius, K. (2024). Does scaffolding support or stifle students? In A. L. Sullivan & M. A. Kennedy (Eds.), *The practical guide to high-leverage practices in special education* (pp. 217–228). Routledge. https://doi.org/10.4324/9781003525844-19

Holloway, J. H., & Brass, J. N. (2021). Supporting teachers through instructional coaching: Effects on instructional practice and student outcomes. *Preventing School Failure: Alternative Education for Children and Youth*, *65*(4), 305–314. https://doi.org/10.1080/07380569.2021.1953362

Hong, S., & Lillard, A. S. (2020). Pretend play, creativity, and emotion regulation in children. *Child Development*, *91*(3), 876–890. https://doi.org/10.1111/cdev.13241

Hornay, P. M. A. (2021). Cognitive load theory and the English language

instruction. *Accentia: Journal of English Language and Education*, *1*(1), 43–55. https://doi.org/10.37598/accentia.v1i1.1015

Izah, S. C., Sylva, L., & Hait, M. (2024). Cronbach's alpha: A cornerstone in ensuring reliability and validity in environmental health assessment. *ES Energy & Environment*, *23*, Article 1057. https://doi.org/10.30919/esee1057

Jokhio, A. A., Raza, S. S., Younus, M., & Soomro, A. H. (2020). Teaching writing skills in university large classes in Pakistan: Issues, challenges and solutions. *Journal of English Education and Linguistics Studies*, *7*(1), 25–47. https://doi.org/10.30762/jeels.v7i1.1355

Khan, T. A. (2023). An orthographic analysis of sound changing rules in the Urdu language. *Linguistics and Literature Review*, *9*(2), 158–188. https://doi.org/10.32350/llr.92.07

Khasawneh, M. A. S., & Al-Rub, M. O. A. (2020). Development of reading comprehension skills among the students of learning disabilities. *Universal Journal of Educational Research*, *8*(11), 5335–5341. https://doi.org/10.13189/ujer.2020.081135

Kim, J. S., Burkhauser, M. A., Mesite, L. M., Asher, C. A., Relyea, J. E., Fitzgerald, J., & Elmore, J. (2021). Improving reading comprehension, science domain knowledge, and reading engagement through a first-grade content literacy intervention. *Journal of Educational Psychology*, *113*(1), 3–26. https://doi.org/10.1037/edu0000465

Kim, Y. S., & Cho, E. (2021). Relations of reading motivation and cognitive skills to reading comprehension in elementary school children. *Reading Psychology*, *42*(7), 636–655. https://doi.org/10.1080/02702711.2021.1888348

Klepsch, M., & Seufert, T. (2020). Understanding instructional design effects by differentiated measurement of intrinsic, extraneous, and germane cognitive load. *Instructional Science*, *48*(1), 45–77. https://doi.org/10.1007/s11251-020-09502-9

Kusmaryono, I., Gufron, A. M., & Rusdiantoro, A. (2020). Effectiveness of scaffolding strategies in learning against decrease in mathematics anxiety level. *Numerical: Jurnal Matematika dan Pendidikan Matematika*, *4*(1), 13–22. https://doi.org/10.25217/numerical.v4i1.770

Magableh, I. S. I., & Abdullah, A. (2020). Effectiveness of differentiated instruction on primary school students' English reading comprehension achievement. *International Journal of Learning, Teaching and Educational Research*, *19*(3), 20–35.

https://doi.org/10.26803/ijlter.19.3.2

Mallillin, L. L. D. (2020). Different domains in learning and the academic performance of the students. *Journal of Educational System*, *4*(1), 1–11. https://sryahwapublications.com/article/abstract/2637-5877.0401001

Martínez-Briones, B. J., Fernández-Harmony, T., Garófalo Gómez, N., Biscay-Lirio, R. J., & Bosch-Bayard, J. (2020). Working memory in children with learning disorders: An EEG power spectrum analysis. *Brain Sciences*, *10*(11), Article 817. https://doi.org/10.3390/brainsci10110817

Mirza, A., & Gottardo, A. (2022). The effects of second language literacy instruction on first language literacy: A comparison between Hindi–English and Urdu–English Canadian bilinguals. *Journal of Cultural Cognitive Science*, *6*(2), 229–248. https://doi.org/10.1007/s41809-022-00100-4

Moin, M. A., Patteti, A. P., & Ansari, M. T. A. (2023). Impact of blended instruction on reading comprehension for Urdu language students. *Asian Journal of Education and Social Studies*, *49*(2), 62–67. https://doi.org/10.9734/ajess/2023/v49i21118

Mousikou, P., de Jong, P. F., & Rastle, K. (2020). Orthographic consistency influences morphological processing in reading aloud: Evidence from a cross-linguistic study. *Developmental Science*, *23*(6), Article e12952. https://doi.org/10.1111/desc.12952

Nabi, F. G., Khan, B. S. A., & Saleem, T. (2025). The structure of inflected Urdu nominals: Insights from distributed morphology. *Cogent Arts & Humanities*, *12*(1), Article 2464383. https://doi.org/10.1080/23311983.2025.2464383

Novita, D., & Arifmiboy, A. (2023). Students' satisfaction on scaffolding strategy by teacher in teaching reading comprehension. *Journal of Educational Management and Strategy*, *2*(2), 166–182. https://doi.org/10.57255/jemast.v2i2.287

Odom, S. L., Hall, L. J., Morin, K. L., Kraemer, B. R., Hume, K. A., McIntyre, N. S., Nowell, S. W., Steinbrenner, J. R., Tomaszewski, B., Sam, A. M., & DaWalt, L. (2021). Educational interventions for children and youth with autism: A 40-year perspective. *Journal of Autism and Developmental Disorders*, *51*(12), 4354–4369. https://doi.org/10.1007/s10803-021-04990-1

Okur, M., & Aksoy, V. (2025). The effect of verbal working memory intervention on the reading performance of students with specific

learning disabilities. *Behavioral Sciences*, *15*(3), Article 356. https://doi.org/10.3390/bs15030356

Paas, F., & van Merriënboer, J. J. G. (2020). Cognitive-load theory: Methods to manage working memory load in the learning of complex tasks. *Current Directions in Psychological Science*, *29*(4), 394–398. https://doi.org/10.1177/0963721420922183

Parveen, N. (2025). Evidence-based practices of cognitive load management to enhance learning. *Psychological Studies*, *70*(2), 374–386. https://doi.org/10.1007/s12646-025-00841-6

Raslan, G. (2024). The impact of the zone of proximal development concept (scaffolding) on the students' problem-solving skills and learning outcomes. In K. Al Marri, F. A. Mir, S. A. David, & M. Al-Emran (Eds.), *BUiD Doctoral Research Conference 2023* (Lecture Notes in Civil Engineering, Vol. 473, pp. 59–66). Springer. https://doi.org/10.1007/978-3-031-56121-4_6

Reiser, B. J., & Tabak, I. (2014). Scaffolding. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (2nd ed., pp. 44–62). Cambridge University Press. https://doi.org/10.1017/CBO9781139519526.005

Rohde, N., Flindt, N., Rietz, C., Chang, Y. K., Stracke, E., Kasymova, G., & Sabaliauskas, S. (2023). Reflection of individual theories of cognitive load in digital learning from a pedagogical perspective: An empirical investigation of the influence of language skills in e-learning programs. *Statistika, Uchet i Audit*, *91*(4), 64–83. https://doi.org/10.51579/1563-2415.2023-4.09

Saleem, T., & Ahmad, S. (2025). From structure to meaning: A lexical semantic framework for Urdu compounding. *Humanities and Social Sciences Communications*, *12*(1), Article 676. https://doi.org/10.1057/s41599-025-04982-x

Sarmiento-Campos, N. V., Lázaro-Guillermo, J. C., Silvera-Alarcón, E. N., Cuellar-Quispe, S., Huamán-Romaní, Y. L., Apaza-Apaza, O., & Sorkheh, A. (2022). A look at Vygotsky's sociocultural theory (SCT): The effectiveness of scaffolding method on EFL learners' speaking achievement. *Education Research International*, *2022*, Article 3514892. https://doi.org/10.1155/2022/3514892

Sharif, A., & Saleem, T. (2025). Extending construction morphology: Typological and pragmatic challenges from Urdu compounding patterns. *Cogent Arts & Humanities*, *12*(1), Article 2587876.

https://doi.org/10.1080/23311983.2025.2587876

Shin, S., Brush, T. A., & Glazewski, K. D. (2020). Examining the hard, peer, and teacher scaffolding framework in inquiry-based technology-enhanced learning environments: Impact on academic achievement and group performance. *Educational Technology Research and Development*, *68*(5), 2423–2447. https://doi.org/10.1007/s11423-020-09763-8

Skulmowski, A., & Xu, K. M. (2022). Understanding cognitive load in digital and online learning: A new perspective on extraneous cognitive load. *Educational Psychology Review*, *34*(1), 171–196. https://doi.org/10.1007/s10648-021-09624-7

Sozio, G., Agostinho, S., Tindall-Ford, S., & Paas, F. (2024). Enhancing teaching strategies through cognitive load theory: Process vs. product worked examples. *Education Sciences*, *14*(8), Article 813. https://doi.org/10.3390/educsci14080813

Surbakti, R., Umboh, S. E., Pong, M., & Dara, S. (2024). Cognitive load theory: Implications for instructional design in digital classrooms. *International Journal of Educational Narratives*, *2*(6), 483–493. https://doi.org/10.70177/ijen.v2i6.1659

Swanson, H. L. (2022). Specific learning disorders as a working memory deficit. In J. W. Schwieter & Z. E. Wen (Eds.), *The Cambridge handbook of working memory and language* (pp. 749–775). Cambridge University Press. https://doi.org/10.1017/9781108955638.040

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285. https://doi.org/10.1016/0364-0213(88)90023-7

Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, *68*(1), 1–16. https://doi.org/10.1007/s11423-019-09701-3

Taylor, T. A. H., Kamel-ElSayed, S., Grogan, J. F., Hajj Hussein, I., Lerchenfeldt, S., & Mohiyeddini, C. (2022). Teaching in uncertain times: Expanding the scope of extraneous cognitive load in cognitive load theory. *Frontiers in Psychology*, *13*, Article 665835. https://doi.org/10.3389/fpsyg.2022.665835

Tricot, A., Vandenbroucke, G., & Sweller, J. (2020). Using cognitive load theory to improve text comprehension for students with dyslexia. In A. J. Martin, R. A. Sperling, & K. J. Newton (Eds.), *Handbook of educational psychology and students with special needs* (pp. 339–362).

Routledge/Taylor & Francis Group. https://doi.org/10.4324/9781315100654-17

Utomo, D. P., & Santoso, T. (2021). Zone of proximal development and scaffolding required by junior high school students in solving mathematical problems. *The Education and Science Journal*, *23*(9), 186–202. https://doi.org/10.17853/1994-5639-2021-9-186-202

van Merriënboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review*, *17*(2), 147–177. https://doi.org/10.1007/s10648-005-3951-0

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press. https://doi.org/10.2307/j.ctvjf9vz4

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, *17*(2), 89–100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x

Xi, J., & Lantolf, J. P. (2021). Scaffolding and the zone of proximal development: A problematic relationship. *Journal for the Theory of Social Behaviour*, *51*(1), 25–48. https://doi.org/10.1111/jtsb.12260

Xue, C., Yuan, J., Lo, G. G., Chang, A. T. Y., Poon, D. M. C., Wong, O. L., & Chu, W. C. W. (2021). Radiomics feature reliability assessed by intraclass correlation coefficient: A systematic review. *Quantitative Imaging in Medicine and Surgery*, *11*(10), 4431–4460. https://doi.org/10.21037/qims-21-86

Zackariasson, M. (2019). Encouraging student independence: Perspectives on scaffolding in higher education supervision. *Journal of Applied Research in Higher Education*, *12*(3), 495–505. https://doi.org/10.1108/JARHE-01-2019-0012

Zu, T., Hutson, J., Loschky, L. C., & Rebello, N. S. (2020). Using eye movements to measure intrinsic, extraneous, and germane load in a multimedia learning environment. *Journal of Educational Psychology*, *112*(7), 1338–1352. https://doi.org/10.1037/edu0000441