



Effectiveness of a Guided Self-Directed Instructional Model on Grade Eight Students' Mathematics Achievement

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Abstract

This study aims to find the effectiveness of a Guided Self-Directed Instructional Model on Students' Mathematics Achievement. It employs an experimental research design guided by the positivist philosophical approach. An innovative guided self-directed instructional learning model, designed by Pokhrel (2026), was implemented in a mathematics classroom. The specific instructional strategies in a structured, progressive set of stages were adopted to transform a teacher-dependent learner into a self-directed learner. It was implemented in two groups of grade eight students in basic schools; one was experimental, and the other was a control group consisting of 110 students from public and privately managed schools. Effectiveness of the GSDL was tested by using the Students' mathematics achievement test, and by using IBM SPSS Version 26 to analyze the quantitative data. The findings of the pretest analyses showed no significant differences between the control and experimental groups in mathematics achievement in both types of school. After implementing the GSDL model, the posttest of mathematics achievement of the experimental group of both types of school is greater than that of the control group. There was a significant difference in mathematics achievement between the experimental and control groups in both types of schools. Thus, it can be concluded that the structured stage-based GSDL instructional model shifts the pedagogical approach from teacher-directed to student-directed learning in the given stages of learning for improving mathematical achievement.

Keywords: Effectiveness, guided self-directed learning, mathematics achievement, model, school, shift

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Introduction

Since mathematics is contributing to the development of other disciplines and technology, it is known as the queen of science (Burton, 2003). Despite the crucial role of mathematics in both academic and practical contexts, many students perceive it as a challenging subject (Yadav, 2017). These prevailing concepts reflect the indifference towards learning mathematics (Pandit, 2007; Kunwar, 2021). The issue is of concern to all academicians throughout the globe. The ERO (2017, 2019) argued that poor teaching-learning environments, lack of qualified teachers, remedial classes, traditional didactic teaching methods, and ineffective communication between school staff, parents, and students are the main causes of failure of students in SLC examinations. Khanal (2015), Panthi & Belbase (2017) claim that the difficulties in understanding the mathematical situation is also the cause of the higher

failure rate. Acharya (2017) agrees that poor teaching-learning environments, lack of efficient teachers, absence of remedial classes, reliance on traditional didactic methods, and ineffective communication among stakeholders are the causes of failure in the examinations. To conceptualize the study, we have observed two secondary mathematics classroom environments were observed in primary settings. The teacher was found to be focused primarily on the board. The instructional approach was limited to a single method for solving problems. No teaching aids were used and the sessions lacked structured instructional planning strategies. Students' engagement methods including learner-centered activities were notably absent. The teacher acted more as a demonstrator rather than a motivator, and as a result, 60% of the students were seen to be lethargic in the class. They were either distracted, visibly tired, or unresponsive to the teacher. Thus, the classroom dynamics required a teacher-directed environment with meaningful engagement

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and interactive pedagogy. Therefore, we have realized the necessity of examining the effective teaching and learning strategies suggested by the ERO reports and the observed classroom scenarios. In such a context, self-directed learning strategy be useful for meaningful mathematical learning.

Borich (2011) defines self-directed learning (SDL) as an instructional approach that actively involves a learner in the educational process, promoting higher-order thinking skills, and nurturing creativity and intuition. The SDL fosters meaningful engagement by encouraging students to take ownership of their learning through self-planned, self-initiated, and autonomous activities (Hamlet, 2006). According to O'Shea (2003) and Odoom (2020), learners engaged in self-directed learning are characterized by goal-setting behavior, clear planning, self-confidence, self-regulation, initiative taking, and openness to new learning experiences. Supporting this view, grow (1991) contends that SDL often begins with teacher-directed instruction, gradually shifting the responsibility of learning to the students. The teachers evolve into a coach, facilitator, consultant, motivator, and encourager, guiding students toward greater autonomy and active participation in their learning process. Houle (1961), Tough (1971), Knowles (1975), Shinkareva (2006), Bouchard (2009), and Grow (1991) have advocated SDL, particularly in adult education. They argue that adult learners tend to be goal-oriented and actively engaged in their learning processes. Different SDL models developed by Long (1989), Candy (1991), Brockett and Hiemstra (1991), Garrison (1997), and Oswalts (2003) also focused on adult learners. Recently, Pokhrel & Sharma (2026) designed a guided self-directed instructional model with progressive stages to mathematics instruction in school education. None above discussed research primarily focused in adult learners school level. Recently Pokhrel (2026) has introduced the GSDL model for school mathematic, which was need test base on different methods and contexts. Therefore, this study addresses gap by examining the effectiveness of such a guided self-directed instructional model on students' mathematics achievement in a school setting.

Research Questions

This study aimed to evaluate the effectiveness of the Guided Self-Directed Learning (GSDL) approach for teaching mathematics achievements in basic-level schools. Based on the objectives flowing research questions guided this study.

1. Is there a significant difference between the traditional teaching method and the GSDL-based teaching method on students' mathematics achievement in public schools?
2. Is there a significant difference between the traditional teaching method and the GSDL-based teaching method for engaged learning on students' mathematics achievement in private schools?

Literature Review

For the basis of the study, some concepts related to self-directed learning models, like the concept of self-directed

learning, positioning GSDL among the theories of learning, the model of self-directed learning, and the conceptual framework, were studied for the designed GSDL model.

Concept of Self-Directed Learning

Self-directed learning (SDL) was conceptualized in the context of adult education, focusing on learners' experiences and needs through their active involvement. The students can make their decisions about the plan, and assess their educational experiences (Merriam et al., 2007). In the realm of education, self-directed learning (SDL) is a prominent teaching approach that plays a pivotal role in engaging students actively in the learning process. This pedagogical approach, highlighted by Borich (2011), encourages students' participation and facilitates the development of higher-order thinking skills for the stimulation of creativity. Supporting this view, Reatnawati and Apino (2016), emphasize how SDL encompasses both lower and higher-order thinking, thereby enriching students' cognitive abilities. During the process of knowledge transmission, the students are equipped with essential skills to handle the situation through critical thinking. According to Burke (2006), SDL empowers students to take an active role in constructing their own knowledge and meaning, promoting reasoning and problem-solving via critical thinking on the subject matter. Hence, SDL is a dynamic teaching approach advocating active engagement with the cognitive landscape of learners for the overall development of self-directed individuals. Huda (2014) suggests that self-directed learning (SDL) is a learning model that promotes learner autonomy and lifelong learning skills. Autonomous learners take control of their learning activities independently for meaningful outcomes. SDL encourages the students to take personal responsibility and cooperative control of cognitive and environmental processes, resulting in life satisfaction and meaningful learning in mathematics teaching. Thus, SDL can enhance students' self-confidence and learning abilities (Taylor, 2001).

Positioning SDL Among the Theories of Learning

The SDL model is brightening with the behaviorist, cognitive, and constructivist theories of learning. Behaviorist theory claims that knowledge is acquired through sensory impressions, behavioral changes, environmental influence, and reinforcement. It emphasizes imitation, rote learning, repetition, practice, stimuli, sensory perception, reinforcement, and the role of the environment (Acharya, 2007; Khanal, 2015). The behaviorist model supports a teacher-centered model where the teacher manipulates the learning environment to produce desired responses from the students. According to behaviorists, learning occurs primarily in response to external stimuli (Torre et al., 2006). In contrast, the self-directed learning (SDL) process is student-centered, and it emphasizes learner autonomy and responsibility (Bosch et al., 2019). In the implemented model, the direct instruction was given in the preparatory stage, aligning with the behaviorist approach. This theoretical legacy connects the Guided Self-Directed Learning (GSDL) model, especially in the preparatory and skill-gain stages, where instructional strategies are employed to shape students' learning behaviors and support gradual development of engagement and

autonomy. The constructivism emphasizes on the knowledge constructed by learners through the integration of new experiences with their existing beliefs and understandings (Torre et al., 2006). The core assumptions of constructivist theory include social interaction, environmental and discovery-based inquiry learning, knowledge construction, self-regulation, self-management, cooperative learning, elaboration, and the role of prior experience (Khanal, 2015, p. 78). These principles closely align with the goals of self-directed learning (SDL), viewing learners as responsible agents in charge of their learning (Oyibe et al., 2015). Constructivism asserts on student's interaction with their experiences, beliefs, attitudes, and prior knowledge significantly influences learning outcomes (Acharya, 2007). It emphasizes cooperative learning environments where foundational concepts like positive independence, individual accountability, promote interaction, social skills, and group processing are vital. Cooperative learning enhances the effectiveness of SDL and enriches the quality of learning by fostering multiple active goals and perspectives. Vygotsky (1978) argues that learning is deeply embedded in social contexts and knowledge is created through interactions with others and the surrounding environment. Both constructivism and SDL emphasize the construction of new knowledge, autonomous motivation, self-monitoring, and collaborative learning. To develop SDL skills effectively, pedagogical strategies were applied in the implemented model. SDL involves learners independently managing their learning process, taking responsibility for setting goals, making decisions, and reflecting on progress as part of lifelong learning. Similarly, constructivist pedagogies provide collaborative, case-based, and problem-based learning opportunities that foster meaningful engagement. (Yeng & Hussain, 2010). Thus, both constructivism and SDL aim to engage students in active learning by integrating knowledge, skills, and experience. Tam (2000) argues that learners, in their context, should participate in the learning process as self-motivated, self-directed, interactive, and collaborative individuals. In a similar vein, Yildirim (2005) claims that the constructivist approach supports students in managing their learning collaboratively and encourages a student-centered instructional model. In this model, students identify their learning needs, set goals, monitor progress, and decide how to retain knowledge in a shared learning environment. Constructivist theory supports various aspects of SDL, namely self-management (goal setting, resource utilization, and collaboration), self-monitoring (cognitive and metacognitive processes, responsibility, and external feedback), motivation, and self-efficacy (Bosch et al., 2019). Thus, constructivist-learning assumptions meaningfully support the development of SDL. Thus, SDL is best understood as a collaborative, constructivist process that encourages learners to become autonomous, motivated, and reflective participants in their educational journey.

Model of Self-Directed Learning

Self-Directed Learning is fundamentally associated with three interrelated concepts: self-management, self-monitoring, and motivation (Garrison, 1997). The SDL paradigm integrates these elements and views learners as responsible

owners and managers of their learning processes (Brockett, 2002). Several SDL models have been developed by Long, Candy, Brockett and Hiemstra, Garrison, and Oswalt, all of which are primarily based on adult learning. Long's model is grounded in the concept of educational and psychological control. It suggests that the level of self-directed learning ability among students is influenced by the extent of control they are granted. Candy's model expanded our understanding of SDL by emphasizing that a student's self-direction can vary across different curriculum areas. It highlights the importance of individual variability in supportive environments of SDL. The PRO (Personal responsibility orientation) model integrates process, individual characteristics and social context, identifying the learning environment, schools, libraries, and museums as an essential component of SDL. Garrison (1997) equally emphasizes the roles of motivation, self-management, and self-monitoring. He argues that motivation facilitates both self-control and self-monitoring. Oswalt (2003) offers a more comprehensive perspective by integrating a wider range of SDL components into a unified framework. The existing SDL models designed for adult learners have not adequately addressed these diverse classroom variables. Additionally, the existing models partially address the existing required pedagogical strategies.

Recently, Pokhrel (2026) designed a Guided Self-Directed Learning (GSDL) model, which adopts the key concepts from their model in designing the instructional framework. Here, the components and progressive stages of the Guided Self-Directed Learning (GSDL) model are presented.

Conceptual framework of the GSDL model designed by Pokhrel (2026)

We have followed GSDL model, which is structured on progressive stages of engaged learning in which both teachers and students play their active roles.

Components of the Design GSDL Model

The core components of the Guided Self-Directed Learning (GSDL) are guided self-motivation, guided self-monitoring, guided self-management, and a self-directed learning environment, which are strategically designed to promote student autonomy and engagement in mathematics learning.

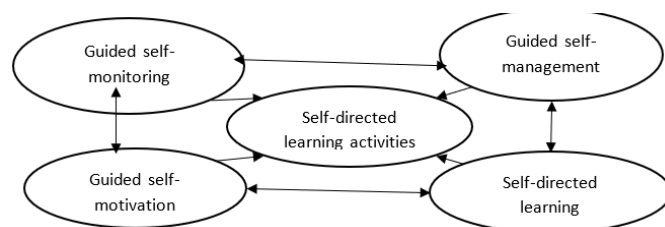


Figure 1: Components of the Design GSDL Model

Source: Pokhrel (2026)

Guided Self-Motivation

In the designed GSDL model, the knowledge and skills were developed progressively with teacher guidance. Teachers are responsible for raising self-motivation through a supportive learning environment, rewarding

systems for personal progress through various means and tools of SDL. Instructional methods included modeling, visualization of future success, storytelling, math quizzes and games, celebrating student achievements, and applying mathematics to real-life situations. These strategies helped to gain the students' motivation.

Guided Self-Management

In the GSDL model, guided self-management is viewed as cooperative regulation of external learning tasks, which includes goal setting, goal achieving, and evaluating outcomes by through a mentor. Key components include planning, goal formulation, time management, learning agreements, environmental preparation, self-evaluation sheets, identification of learning needs, organization of activities, addressing learning challenges, and managing student engagement and skills. The teachers played a critical role in guiding students to develop self-management skills.

Guided Self-Monitoring

The GSDL model targets both cognitive and metacognitive processes. It encourages students to take ownership of their learning by tracking their progress, reflecting on their experiences, and engaging in collaborative learning tasks. Through guided self-monitoring, students are supported in recognizing their knowledge and skills, setting learning goals, applying collaborative strategies, and using teacher-assisted self-evaluation rubrics to monitor their progress. Teachers implement various student-centered strategies to develop self-monitoring skills, including collaborative and cooperative learning techniques such as KWL (Know, want to know, Learned), reciprocal teaching, brainstorming, the traffic light method, think-pair-share, jigsaw, games, one stays one stray, mix-freeze-pair, pyramid learning, learning centers, student conferences, and educational puzzles.

Self-Directed Learning Environment and Resources

In the Guided Self-Directed Learning (GSDL) model, students are given the freedom to choose their learning methods and manage learning resources, including libraries and self-assessment tools. Teachers assist students in selecting appropriate learning strategies based on course content, ensuring that each student can navigate their own path within a flexible and collaborative framework.

These components interact dynamically through four progressive stages: from preparatory to committed, to foster engaged, independent, and autonomous learning in mathematics. This conceptual framework guides the study in designing a GSDL-based pedagogical model tailored to the needs of school mathematics learners.

Stage of GSDL Model Designed by Pokhrel (2026)

Based on the learning ecosystem described above, the Guided Self-Directed Learning (GSDL) approach is fundamentally rooted in engaged learning pedagogy with four stages of progression from teacher-directed to student self-directed autonomous learning model conceptualized where teacher and student responsibilities are defined based on the level of engagement and autonomy in the instructional process, and named as the Guided Self-

Directed Learning model/approach. The implemented model on GSDL motivates the students successively towards an autonomous learner.

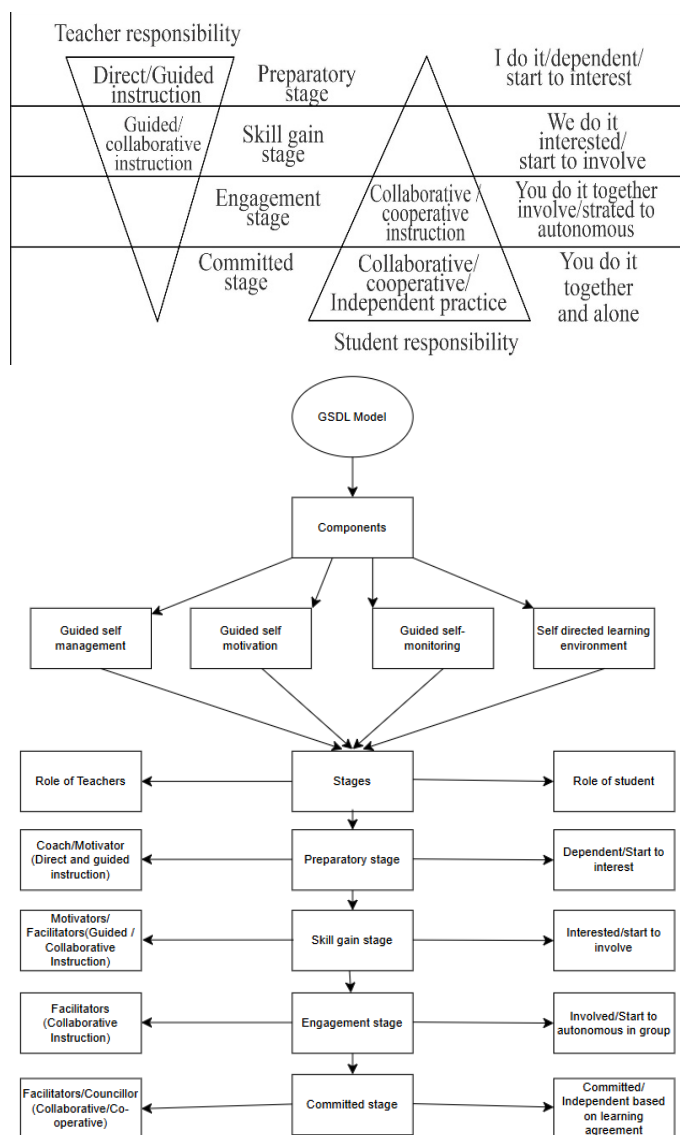


Figure 2: Implementing Stages of GSDL Model

Source: Pokhrel (2026)

The successive stages of this model are formed in a ladder structure from a dependent to an autonomous learner. The teacher's role diminishes its role successively in each stage, but the student's responsibility increases. This transition enables the learners to develop the required skills and autonomy in their learning activities. The implemented stages (Preparatory stage, Skill gain stage, Engagement stage, Committed stage of GSDL, along with the shifting responsibilities of both teacher and student) are illustrated in Figure 2.

Preparatory Stage

Most students are accustomed to teacher-directed learning. Therefore, it is essential to gradually shift their beliefs and motivation from dependency on the teacher to active engagement in learning. Student engagement

is the consistent involvement from time to time. Student's engagement is required under guided instruction for the transition. During transition, the teacher directly instructs on the components of the GSDL model. Direct instruction is a major component of teacher-centered learning without precise content delivery. It stresses on well-defined and skill-specific lessons ensuring knowledge flow through guided modules (Rosenshine, 2012; Kinder et al., 2005). It involves lectures, discussions, and other structured techniques to present content systematically (Al-Makahleh, 2011). To make the instruction more fruitful, teachers incorporate practical examples and stimulate classroom interaction. The students are highly dependent on the teacher. Steps in the lesson episode in the preparatory stage of the GSDL model were introduction and activating prior knowledge, clear explanation based on related topic, modelling, guided practice, feedback and correction, and summarization. This stage is a fundamental phase to lay the foundational skills of the students to begin transforming from passive listeners to active, engaged learners within the GSDL framework.

Skill Gain Stage

In the skill gain stage, the students' interest rises and hence they participate actively in the learning process. The teacher remains a motivator, guiding the students into a more self-directed approach to mathematics learning. Guided instruction in this context is deliberate, responsive dialogue between teacher and student. Based on their current understanding and aimed at addressing knowledge gaps, this approach ensures that the students' responses are thoughtful (Fisher & Frey, 2010). The teacher supports the students in acquiring essential self-directed learning skills, including goal-setting, planning, self-motivation, self-confidence, time management, self-monitoring, self-evaluation, and self-reflection. Throughout this stage, the teacher follows a structured instructional flow to maintain consistency and effectiveness. Steps in the lesson episode in skill gain stage of GSDL model were classroom setup, minilecture/Socratic questioning/modeling, problem-based learning, and interactive activity, think pair share and closure, and reflective and feedback. The Skill Gain Stage equips students with the foundational skills and mindset necessary for self-directed learning. Through guided instruction and gradually increasing autonomy, students become more confident, collaborative, and capable of managing their learning journey.

Engagement Stage

During this stage, students work enthusiastically in a warm, collaborative environment, engaging with peers in friendly groups to address real-world problems through problem-solving tasks. They are encouraged to design learning objectives, create plans, collaborate effectively, and participate in cooperative learning. Guided and collaborative instruction methods are primarily used in this phase. As students' involvement increases, they will develop autonomy in their learning, while the teacher's role shifts to a facilitator, intervening only when necessary. Steps in the lesson episode in the engagement stage of the GSDL model were introduction and classroom setup, brainstorming and

KWL, TPS with cooperative learning in a group, project-based learning and gamification, reciprocal teaching with group presentation, assessment, and homework

In this stage, Students move freely within the classroom, consulting with one another and working in groups. Teachers observe the learning process, providing support and resources as needed to ensure a conducive and meaningful learning environment. Additionally, the students begin to develop critical thinking skills through collaborative work, questioning activities, and reflecting on their problem-solving approaches.

Committed Stage

At this stage, students are fully independent and deeply committed to their learning. They no longer seek assistance to solve problems; instead, they take full ownership of their learning process. The learners make their plans in their own, execute them, evaluate the outcomes, and reflect on their understanding to confirm the accuracy and depth of their knowledge. These learners engage meaningfully with the content and validate their solutions through critical self-evaluation and reflection. Students operate under a learning agreement and demonstrate a strong commitment to the subject. They understand how to explore content independently and meaningfully. The primary instructional approaches used in this phase are collaborative and cooperative instruction, supporting students' growth into fully autonomous learners. Teachers serve as facilitators, serving as a guide only when necessary. Steps in the lesson episode in the committed stage of the GSDL model were introduction, learning based on the learning agreement using collaborative and cooperative strategy in a group, and reflection and reciprocal teaching in the whole class. This change in the learner's attitude reflects the independent growth and self-regulation of the learners. Here, the teacher follows a sequential instructional path from direct instruction to guided motivation through cooperative incubation. The series supports students in developing the skills and confidence in autonomous learning.

Thus, the Guided Self-Directed Learning (GSDL) model provides a structured, stage-based pedagogical approach. It is grounded in engaged learning that shifts students progressively from teacher-dependent to an independent learner of mathematics, fostering autonomy, motivation, and meaningful mathematics learning in basic school classrooms.

Methods

The methodology is a quantitative design following a positivist philosophical paradigm. Result analysis was done by SPSS based on descriptive and inferential statistics. A quantitative research approach was employed using a quasi-experimental design to examine the effect of Guided Self-Directed Learning (GSDL) on students' mathematics achievement. The design involves the use of control and experimental groups. The data were collected from a mathematics achievement test adopted by Pokhrel (2026).

Population and Sample

This study is a form of experimental research design and aimed to analyze the effect of the GSDL model on mathematics achievement at the school level. The population for this research includes all students of grade eight enrolled in basic schools in Pokhara metropolitan city. The samples were purposefully selected to facilitate the implementation of the intervention. Specifically, two private public schools from the Pokhara Metropolitan City (Ward no 1 & 2) were chosen. Purposeful sampling was used to ensure practical access and the ability to implement the intervention effectively. As Maxwell (1996) notes, it is advisable to select research sites that are easily accessible. A critical aspect of quasi-experimental research is the use of pre-tests and post-tests in the quasi-experimental model to assess the conditions of the experimental and control groups. To ensure group equivalence, prior achievement

scores and classroom variables were analyzed (Ross & Morrison, 2003). Based on these variables, two groups in each school category (public and private) were randomly assigned as either experimental or control groups.

Although the schools were purposefully selected, equivalence was established for experimental validity. Four schools (two public and two private) were selected based on prior achievement data and classroom-related variables to form the experimental and control groups. In each school type, one of the schools was designated as the experimental group, and the other as the control group, to be randomly. The schools were selected based on prior achievement data and classroom-related variables to form the experimental and control groups. In each school type, one school was designated as the experimental group, and the other as the control group.

Table 1: Group Profiles

School	Class	Students	Test type	Treatment	Test type
Public School	8	Experimental group(28)	Pretest	GSDL model	Posttest
	8	Control group(28)	Pretest	Conventional	Posttest
Private school	8	Experiment group(28)	Pretest	GSDL model	Posttest
	8	Control group (26)	Pretest	Convention	Posttest

The sample was the basic education level (Grade 8) students. Four groups were involved in total: two control groups and two experimental groups. The teachers were trained in experimental groups in accordance with the GSDL model, while the control groups were taught via conventional methods. Pre-tests and post-tests measuring students' achievement were administered before and after the intervention to determine the effectiveness of the GSDL model on student outcomes.

Implementation of the guided Self-Directed Learning model and the Traditional Approach

The teachers implemented the GSDL model in mathematics classrooms, in accordance with the Grade 8 curriculum. The GSDL model was implemented for three months and consisted of four key stages: preparatory, skill-gain, engagement, and commitment. The researcher developed lesson episodes based on the conceptual framework of the GSDL model, which were then implemented in the experimental groups. To ensure the Guided Self-Directed Learning (GSDL) model was implemented as intended, teachers followed carefully designed lesson episodes developed by the researcher. Throughout the intervention period, the researcher visited classrooms daily to observe instructional practices, monitor adherence to the model, and document teacher-student interactions and the evolving learning environment. The traditional approach refers to a teacher-centered method of instruction. Within this approach, teachers primarily lead the learning process. In the control groups, both public and private school teachers followed commonly used teaching methods, such as solving problems on the board while students imitate them. These teachers were not familiar with the GSDL model during the study.

Data Collection Tools

This study adopts an experimental research design to assess the effect of the GSDL model on mathematics achievement. The mathematics achievement test was adopted from Alreshidi (2016) and Pokhrel (2026) and divided into three categories: knowing, applying, and reasoning. The knowing domain focuses on the basic recall of facts, concepts, and procedures, representing foundational understanding. The applying domain assesses the ability to apply learned knowledge in various problem-solving contexts, requiring students to connect their understanding with real world or mathematical tasks. Finally, the reasoning domain involves solving multi-step problems, addressing unfamiliar situations, and engaging in higher-order and complex thinking processes. The researcher has also developed a 30-item multiple-choice achievement test with a total score of 60 points, adopted from Pokhrel (2026). These categories offer a structured approach to evaluating students' cognitive development and problem-solving skills in mathematics. The reliability and validity of the achievement test were established through expert judgment for face validity and the Cronbach's alpha method for internal consistency. The prepared tools were reviewed by three experts, who provided feedback and suggestions. Their remarks were carefully incorporated into the revised instruments. The revised achievement test was then piloted among the students, and the internal consistency of the sub-scales was assessed to determine reliability. A Cronbach's alpha with a range between 0.70 - 0.90 was considered to be acceptable (Alreshidi, 2016). Its values for the achievement test were 0.74 and 0.78 in pre- and post-test, both lying within the acceptable range.

Data Analysis Techniques

All data collected from the mathematics achievement test were analyzed through descriptive, inferential, and explanatory approaches. Moreover, we had used the Mann-Whitney U test for testing the significance difference to compare the two average scores of the control and experimental group because of the small sample size, and the data were not properly normal. All quantitative data analyses were performed using IBM SPSS version 26 at a 5% level of significance.

Results

The results are interpreted as follows:

Mathematics Achievement of Private School Students

The descriptive analysis of under table and the pretest result of mathematics achievement were similar, with mean scores (control = 30.21, experimental = 30.86) having similar standard deviation. After the intervention of the GSDL model, posttest score of the experimental group for mean in mathematics achievement was 50.43 then control group score (37.54). Similarly, in all domains, knowing, applying, and reasoning in the experimental group was greater than controlled group with similar variability across the groups. Hence, the GSDL intervention had a positive impact on the mathematics achievement in the experimental groups across different cognitive domains of private schools.

Table 2: Mathematics Achievement of Private School Students

Test	Group	N	Mean	S.D.
Math Achievement (Pre-Test)	Control	28	30.21	7.74
	Experimental	28	30.86	8.33
Math Achievement (Post-Test)	Control	28	37.54	6.77
	Experimental	28	50.43	7.35
Post-Test Score (Knowing domain)	Control	28	14.11	3.11
	Experimental	28	17.86	2.43
Post-Test Score (Applying domain)	Control	28	10.71	3.38
	Experimental	28	13.67	2.69
Post-Test Score (Reasoning domain)	Control	28	13.34	2.18
	Experimental	28	15.64	3.03

The rank-based result (table 3) showed that the pretest result of both groups was equivalent, showing comparable initial achievement. However, after intervention, the experimental group achieved a greater mean rank (39.36) compared to control group (17.64). Similarly, all components, knowing, applying, and reasoning domains of the experimental group obtained greater mean rank than the control group. It can therefore be concluded that the GSDL intervention had a positive effect on the mathematics achievement of students in the experimental groups across different cognitive domains of private schools.

Table 3 : Mean and Sum of Rank of Mathematic Achievement of Private School Students

Variable	Mean achievement of Rank		Sum of Rank	
	Control group	experimental group	Control group	Experimental Group
Pretest of mathematics achievement	27.88	29.13	780.50	815.50
Posttest of mathematics achievement	17.64	39.36	494.00	1102.00
Post knowing achievement	19.34	37.66	541.50	1054.50
Post applying achievement	16.50	40.50	462.200	1134.00
Post-reasoning achievement	21.82	35.18	611.00	985.00

The Mann-Whitney test results show that there is no significant difference in mean rank between the experimental and control group in the pretest, indicating similar baseline achievement. After intervention in posttest, there was a significant difference in mean rank between the experimental and control group as well in all three domains. Results are presented in Table 4.

Table 4: Mann-Whitney U test result of Mathematic Achievement of Private School Students

Variables	Mann-Whitney U	P value (2- tailed)	Significance
Mark pre-test	474.500	0.773	Not Significance
Mark post test	88.000	0.000*	Significance
Post knowing	135.500	0.000*	Significance
Post applying	56.000	0.000*	Significance
Post reasoning	205.000	0.002*	Significance

Therefore, it can be concluded that the GSDL intervention had a positive effect on the mathematics achievement of students in the experimental groups across different cognitive domains of private schools.

Mathematics achievement of public-school student

The descriptive analysis of Table 5, pretest result of mathematics achievement, gave similar mean scores (control = 20.23, experimental = 19.11.86) with similar standard deviation. After the intervention of the GSDL model, the experimental group posttest score of mean mathematics achievement was a greater score (50.86) than the control group's score (25.92). Similarly, in all domains, knowing, applying, and reasoning in the experimental group was greater than in the control group with similar variability across the groups. It can therefore be concluded that the GSDL intervention had a positive effect on the mathematics achievement of students in experimental groups across different cognitive domains of private schools.

Table 5: Result of the achievement of public school students

Test	Group	N	Mean	S.D.
Math Achievement (Pre-Test)	Control	26	20.23	5.581
	Experimental	28	19.11	5.439
Math Achievement (Post-Test)	Control	26	25.92	5.8
	Experimental	28	50.86	3.28
Post-Test Score (Knowing domain)	Control	26	9.23	2.88
	Experimental	28	15.43	1.62
Post-Test Score (Applying domain)	Control	26	9.08	3.45
	Experimental	28	19.21	1.66
Post-Test Score (Reasoning domain)	Control	26	7.47	2.8
	Experimental	28	16.21	1.75

Table 6: Mean and sum of the ranks of mathematical achievement

Variable	Mean achievement of rank		Sum of rank	
	Control	Experimental	Control	Experimental
Pretest of mathematics achievement	29.04	20.07	755/00	730.30
Posttest of mathematics achievement	13.50	40.50	351.00	1134.00
Post knowing achievement	14.52	39.56	377.50	1107.50
Post applying achievement	14.19	39.86	369.00	1116.00
Post-reasoning achievement	13.65	40.36	355.00	1130.00

According to Table 6, the rank-based result showed that the pretest result of both groups had nearly equal showing comparable initial achievement. Moreover, after intervention, the experimental group achieved a greater mean rank (40.56) compared to the control group (13.50). Similarly, all component knowing, applying, and reasoning domains of the experimental group obtained a greater mean rank than the control group.

It can therefore be concluded that the GSDL intervention had a positive effect on the mathematics achievement of students in the experimental groups across different cognitive domains of public schools.

According to Table 7, the Mann-Whitney test results show that there was no significant difference in mean rank between the experimental and control group in the pretest, indicating similar baseline achievement. After intervention in posttest, there was a significant difference in mean rank between the experimental and control group as well in all three domains.

Table 7: Mann-Whitney U test result of Mathematic Achievement

Variables	Mann-Whitney U	P value (2-tailed)	Significance
Mark pre test	324	0.479	No significance difference
Mark post test	0	0.000*	Significance difference
Post knowing	26.5	0.000*	Significance difference
Post applying	18	0.000*	Significance difference
Post reasoning	4	0.000*	Significance difference

Therefore, the GSDL intervention had a positive effect on the mathematics achievement of students in the experimental groups across different cognitive domains of public school.

Conclusion

This research is based on quantitative method under experimental design to find the effect of GSDL model on mathematics achievement. We have used GSDL instructional model and mathematic achievement test design by Pokhrel (2026). This study was set up in the context of Nepal, where students often demonstrate indifference, passivity, and a lack of engagement in learning mathematics, which ultimately contributes to low achievement. To address this issue, the study used an innovative GSDL model aimed at enhancing student performance promoting learner autonomy. After the intervention of the GSDL model, mathematical achievement and all cognitive domains of experimental groups in both school types were significantly greater than those of the control group were.

Limitation and Implication of the Research

This research was limited to a small sample size from selected schools based on the GSDL model designed by Pokhrel (2026), so the result may not be fully generalizable to all contexts. It offers a practical basis for using the GSDL model to develop engaging learning to be used in schools, colleges, and teacher training programs. Furthermore, this research offers a curriculum design to incorporate the GSDL approach to promote student engagement and reduce students' indifference toward learning mathematics from the school level to the university level.

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Conflict of Interest

The authors declare no conflict of interest for the publication of this article.

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