The Role of Teachers in Implementing Self Directed Learning in Senior Secondar Classess in Science Teaching

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Abstract
This Research investigates the role of teachers in implementing Sel Directed Learning (SDL) within Science education among senior secondary students (Grades 10 and 11) in Tamil medium schools in the Beruwala Education Division. In the 21st-century educational landscape, SDL defined as the process where students take initiative in planning, monitoring, and evaluating their own learning is critical for academic success. However, preliminary observations indicate that students in this region often lack these skills, remaining passive recipients of information rather than active learners.The study is grounded in Learner-Centered Theory, Constructivism, and Social-Cognitive Theory. It specifically examines how teachers facilitate time management, goal setting, and self-reflection within the Science curriculum. The objectives include identifying the current status of SDL in these schools, assessing the facilitating and updating roles of teachers, and identifying the challenges faced by educators in shifting from teacher-centered to student-centered approaches. The methodology utilizes a Stratified Random Sampling technique to collect data from Science teachers and principals using questionnaires and interviews.
Key findings from the data analysis indicate that teachers' subject knowledge, self-efficacy, and intrinsic interest are direct positive predictors of their ability to foster students' self-directed learning skills. Statistically, the study found no significant difference in the "updating role" of teachers based on demographic factors such as age or gender. However, the practical application of SDL is significantly hindered by five main themes: a lack of specific training and resources, student dependence on traditional teaching, parental expectations for teacher-led instruction, time constraints, and the rigid, examination-centric nature of the current education system. The research concludes by recommending that teachers transition from "information providers" to "facilitators" and suggests policy-level reforms to reduce curriculum density and improve infrastructure, such as smart boards and high-speed internet, to support independent learning.

Keywords: Self-Directed Learning (SDL), Teacher's Role, Science Education, Senior Secondary, Beruwala Education Division.

Chapter 1

Introduction Abstract

Background of the study

Tang (2023) Student centered teaching and learning approach What does it really mean? Key points of the study are: Shift from teacher-centered learning Student-centered approach is a popular term that refers to a major shift in education from traditional teacher-centered learning. In the traditional approach, the teacher is the provider of information and students are passive recipients.

In the context of Sri Lankan secondary education, the shift from "passive recipients" to "active learners" is not merely a pedagogical preference but a direct requirement of the National Science Curriculum. The Ministry of Education aims to move beyond rote memorization toward competency-based learning.

- **Active Learners as Inquiry-Based Investigators:** In the Sri Lankan Science syllabus, students are expected to engage in "Inquiry-led" activities. This transforms them from **passive recipients** who simply memorize chemical formulas or biological structures into

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active learners who develop "Scientific Literacy." This aligns with the curriculum's goal of producing citizens capable of making informed decisions about health, environment, and technology.

- **Linking SDL to Grade 10-11 Science Goals:** The curriculum specifically emphasizes "Learning to Learn." By fostering **Self-Directed Learning (SDL)**, students in the Beruwala Education Division can transition from waiting for teacher-provided notes to actively investigating local phenomena (e.g., environmental issues in the Western Province), thereby fulfilling the curriculum's objective of "applying scientific knowledge to daily life."

Key Improvements Made

1. **Contextual Alignment:** Specifically mentions the "Sri Lankan Science curriculum" and "National Science Curriculum" goals.
2. **Terminology Linkage:** Directly connects "passive recipients" to the local habit of rote memorization and "active learners" to "Inquiry-based learning" and "Scientific Literacy."
3. **Local Application:** Mentions the Beruwala Education Division and Senior Secondary level to ensure the literature review feels integrated with your specific study area.

Thomas (2000) A great way to practice the student-centered approach is through project-based learning. In this, students are expected to work on projects, such as community or design projects, and manage them or propose solutions to them. This develops problem-solving skills and practical experience. Problem-based learning (PBL) is a variation of project-based learning. In this, students focus on less detailed situations, cases, questions, or problems. Problem-solving is commonly used before lectures to encourage self-directed learning and facilitate support (Savery,2006).

Driver, Newton, kw;Wk; Osborne (2000) developed a discussion-based curriculum (Argument-Based Curriculum). This approach involves discussions and forums. It helps students discover different perspectives on a particular topic on their own. It develops critical thinking and analytical skills. The role of technology The student-centered approach is closely linked to the use of technology for research, idea exchange, gamification (playfulness), simulation (simulation), and exchange of ideas. Student-centered feedback refers to explicit feedback that is given with the aim of helping students learn systematically. Adaptive teaching involves students participating in the content creation process (Hattie & Timperley, 2007).

Fullan (2001) found that although students and teachers perceive the student-centered approach positively, there are challenges in teamwork and time management. It is important that teachers need support to transition from teacher-centered to student-centered learning and to overcome external challenges such as assessments and curriculum requirements. Changing students' conceptions of learning The approach changes students' conceptions of learning, which helps students become more engaged, self-directed and competent (Ramsden,2003).

The main points of the study Self-directed Learning and Performance: An Introduction and Overview by Zimmerman and Shang (2011) are the following Definition of Self Directed Learning is a process by which learners individually activate, maintain, and systematically direct the cognitions (cognitive), emotions (emotions), and behaviors (attitudes) necessary to achieve their learning goals. Importance in Learning Performance Self Directed learning plays a key role in learning performance and achievement. How well students manage their learning affects their academic success. Components of Self-Directed Learning Phases:Zimmerman and Shang view self-regulated learning as a cyclical process that involves several phases:

Precontemplation phase (Forethought Phase) is the phase that occurs before learning begins. It includes goal setting, planning, beliefs about self-efficacy expectations about learning outcomes, and selection of learning strategies.

Performance control phase This occurs during the learning process. It includes self-monitoring, self-control (focusing, organizing information), and using strategies (Pintrich,2000).

Self-reflection phase : This occurs after learning is complete. This includes self-responses such as assessing learning outcomes, self-assessment, (finding reasons), and corrective plans (adaptive inferences) (Schunk & Zimmerman, 1994).

The role of social-cognitive theory: Self-directed learning is strongly based on social-cognitive theory (SCT). It emphasizes the

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importance of observational learning, self-efficacy, and the interplay between personal, behavioral, and environmental factors (Bandurai 2001). Training and development Self-directed learning skills are not innate, they can be learned and improved. Educational systems and teachers should provide students with strategies and training to develop these skills. Application in various contexts: Self-Directed learning is applicable not only in the classroom environment, but also in various learning and performance contexts such as homework, sports, music, etc. (Zimmerman & Schunk, 2011).

Bailey (2016) Developing Critical Thinking Skills of Information Technology Students: Implications for Self-Directed Learning (SDL): The Key Findings of the Study Critical Thinking and Self-Directed Learning In today's information technology world, it is essential for students to critically evaluate information and improve their knowledge and skills to adapt to the ever-changing environment. For this, critical thinking skills and self-Directed learning skills are considered essential. In the information technology curriculum areas such as programming , Critical thinking is required. Nasri (2019) Self-regulated learning in teachers' perspectives. Key findings of the study Self-Directed learning is often seen as a complex educational concept. The main reason for this is that it is not adequately defined. However, it is continues to attract the attention of education experts. The role of teachers: This study explored two key questions: How do teachers see their role as adult educators in a self-Directed learning environment? How do teachers encourage their students to take responsibility for their own learning?

Facione (1990) reiterates the distinction between self-Directed learning and critical thinking that self-directed learning is a process in which an individual takes responsibility for identifying learning needs, developing learning goals, identifying learning resources, selecting and implementing appropriate learning styles, and evaluating learning outcomes. Critical thinking is a purposeful, self-directed process of understanding, analyzing, evaluating, and making decisions about information.

Lim, Yang, Chang, and Park (2024) found that self-study and discussion promote students' science learning. They examined the effectiveness of a combination of self-studyand discussion in improving students' learning outcomes in science subjects. While it has been proven to be effective in humanities subjects, the aim is to examine whether it is also applicable to science subjects.

In a study by Bolhuis and Voeten (2001) Teachers do not spend much time teaching students how to learn: In an early innovative process to promote self-directed learning, a study of teacher behavior in Dutch secondary schools found that teachers do not spend much time directly teaching students how to learn. More motivating than simply imparting knowledge Teachers should use teaching methods that are more motivating than simply imparting information. This encourages student participation and interest.

Winne (2011) process-oriented teaching is very limited. However, teaching that emphasizes the learning process, that is, how students think, plan, and evaluate their learning was found to be very limited , This is an essential part of self-directed learning.

The Role of teachers in promoting self-Directed learning is emphasized by the study of teachers as self-regulated learners and as agents for promoting students' self-directed learning, which helps in improving their cognitive abilities (Meta cognition) The results of Zimmerman (2000) showed that teachers' knowledge, self-efficacy, and intrinsic interest have direct positive relationships in promoting students' cognitive ability (innovation). That is, when these aspects are high in teachers, students' cognitive ability to learn improves.

The implicit relationship of self-Directed learning skills Teachers' own self-Directed learning skills and their attitude towards self-Direced learning (Mindsets) are indirectly related to the promotion of students' cognition through their self-efficacy and intrinsic interest (Schunk & Zimmerman ,2007).

Ryan and Deci (2000) found that although teachers have made some efforts to promote self-Directed learning in secondary classes, more attention needs to be paid, especially to teaching how to learn and process-based teaching, Teachers' own knowledge, self-efficacy, and interest play an important role in promoting self-directed learning in students. Self-efficacy is an important part of self-Directed learning (Bang> 2012). With self-regulated learning; scientific literacy can be improved. Self-directed learning is a process in which students independently plan, focus, and reflect on their thoughts, behaviors,

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motivations, and emotions (Raisanen, Postareff, Mattsson & Lindblom-Ylanne, 2020).

Therefore, this study emphasizes the need to bring about major changes in the field of education by fully utilizing the self-directed learning of school students in the teaching of science subjects through the medium of Tamil in the Senior Secondary classes of the Beruwala Education Division.

Statement of the problem

It has been found through preliminary observations that students' self-Directed learning skills are low in science subjects in senior secondary classes of Tamil-medium schools located in the Beruwala Education Zone. Students are less involved in planning, monitoring and evaluating their own learning process. This may affect their in-depth understanding and performance in science subjects (Li et al., 2020).

In this context, a clear understanding of the role of teachers in implementing self-Directed learning in science subjects in senior secondary classes is needed (Zimmerman, 2000). It is necessary to examine how teachers promote or fail to promote these self-Directed learning skills among students, what are the challenges they face, and how their teaching approaches affect this process (Pintrich,2004).

Despite the recognition of the importance of self-Directed learning, there is a gap in the existing literature on its specific impact on science subjects in senior secondary Tamil medium classes. Although studies have examined the relationship between self-direction and academic achievement in various fields, there is a need for literature research to clarify the application of self-Direction in science learning in senior secondary classes (Pintrich,2000). Although it is accepted by many educationists that the role of teachers is influential in implementing self-Direction in science subject learning in senior secondary classes (Hattie & Timperley, 2007).no studies have been conducted on this in Tamil medium schools in the Beruwala Educational Division. Therefore, this study assumes importance because it is necessary to identify the role of teachers in implementing self-Directed learning in students' science learning in schools, identify the factors that influence them, and present solutions to address these in order to improve learning.

Research objectives / Research questions

This study aims to identify the role of teachers in implementing self-directed learning in science subjects in senior secondary classes of Tamil-medium schools in the Beruwala Education Division.

1. To identify the current conditions of self-directed learning in science subject in senior secondary classes of Tamil medium schools in the Beruwala Education Zone.
2. To identify the facilitating role of teachers in implementing self-directed learning in science subject.
3. To identify the updating role of teachers in implementing self-directed learning in science subject.
4. To provide proposals for improving self-directed learning in science subject in senior secondary classes.

Research Questions

1. What is the current role of teachers in implementing self-directed learning in science subject in senior secondary classes of Tamil medium schools in the Beruwala Education Zone?
2. What are the challenges faced by teachers in implementing self-directed learning in science subject?
3. What are the opportunities available to teachers in implementing self-directed learning in science subject?
4. What suggestions can be made regarding the role of teachers to improve self-directed learning in science subject in senior secondary classes?

Hypotheses

1. There is no significant difference between the facilitation role of teachers and their gender in implementing self-Directed learning in science subject in senior secondary classes of Tamil medium schools in Beruwala Education Zone.
2. There is no significant relationship between the facilitation role of teachers and their age in implementing self-Directed learning in science subject in senior secondary classes of Tamil medium schools in Beruwala Education Zone.

Significance of the study

The implementation of self-Directed learning in senior secondary science subjects will create awareness among students and provide clarity to researchers in the field of education.

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Furthermore, this study will be a contribution to the education sector in Sri Lanka and will provide an opportunity for future educators and recommendations for improving self-directed learning.

Studies on self-Directed learning are scarce in Sri Lankan Tamil medium schools, especially in science subjects. The study area is geographically limited (Beruwala Education Zone) and there is a lack of clear research on the challenges faced by teachers and their role and the importance of self-Directed learning in the Sri Lankan curriculum has not yet been introduced. Therefore, the current teaching methods of science education in senior secondary classes can increase the opportunities for the examination-centered education system to incorporate self-regulated learning.

The UNESCO report on students for the 21st century emphasizes the importance of self-Direction in learning.Therefore, this study emphasizes the need to make full use of self Direction in the teaching of science subjects in the Senior Secondary School of the Education Department in Tamil Language to bring about major changes in the field of education. In order to improve learning, it is necessary to identify the role of teachers in self Direction in students' learning in schools, identify the factors that influence them, and present solutions to address these.Self Directed learning helps students plan and learn about their learning. Thus, they can improve their self-confidence. The process of learning responsibility keeps students responsible for their learning, through which they can monitor and improve their progress.

Skills related to learning are developed. It teaches skills such as planning, time management, performance evaluation, and performance improvement. Measurement skills enable students to assess their own progress. This helps them understand progress in comparison to other data. In an environment of self Directed learning skills development, students get the opportunity to develop their own strategies for learning.

Scope and Limitations (Brief)

Since the Master of Education is a part-time course, the period of data collection is limited. In addition, the location of data collection is limited, so this study was conducted during the period 2024-2025. Furthermore, since the study sampling method is a simple random sampling method, the study is limited. In addition, since the population is only considered senior secondary students, other primary students as well as gender and age are also limitations for this study.

The self-regulated learning of primary students has a great influence on the perception and learning transfer, and the role of primary teachers also has an influence here. Therefore, the lack of attention of primary teachers and students may affect the study results.; The gender difference and age difference from the selected population may have implications in obtaining the expected data.

When examining the factors that influence students' self Directed learning, there is a possibility that their personal economic and family background may also have an influence. Therefore, the study is limited in that regard. Political factors, social influences, and the nature of their influence on the study are seen as limitations.

Chapter 2
Literature Review

Literature review is the process of collecting, critically examining, and summarizing academic documents such as previous studies, articles, books, and journals on a particular research topic. Through this, the main concepts, theories, research results, and shortcomings identified so far in that field are clarified. This helps the researcher conducting a new study determine the direction of his or her research and compare and position his or her research with what has already been done. This literature review aims to identify the role of teachers in implementing self-regulated learning in students' science learning in schools, identify the factors that influence them, and present solution proposals to address these. In this chapter, theoretical and applied perspectives have been reviewed.

Conceptual / Theoretical framework

The theoretical literature review reviewed 10 key theories relevant to this study.

Self-Directed learning

Self Directed learning is the process by which students independently organize, monitor, and control their own learning activities and engage in self-reflection. This is considered fundamental to academic success and personal development. Developing self Direction in science subject learning at senior secondary

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level is relevant in areas where academic standards are lagging behind. The integration of self-Directed learning strategies within the framework of senior secondary science education lays the foundation for improving student motivation, developing deep conceptual understanding, and developing lifelong learning habits. Self Directed learning aims to develop essential skills such as time management, goal setting and planning, monitoring, controlling, and self-reflective learning (Korkmas, 2012).

Schunk (2012) Self-directed learning is a learning process that involves analyzing knowledge, setting goals, maintaining motivation, controlling and managing one's thoughts and feelings, monitoring oneself, and updating strategies. Self-directed learning has a direct impact on students' achievements and their intellectual activities. Many studies have been conducted internationally on self-directed learning (Zimmerman,2000).

The following are the theories underlying self-directed learning.

1. Learner-centered theory
2. Constructivist theory
3. Cognitive theory
4. Social-cognitive theory
5. Information-processing theories
6. Pinrich theory
7. Teacher-centered teaching theory
8. Student-centered teaching theory
9. Inquiry-based approaches and problem-solving theories in science learning
10. Ecological theory

1. Learner-centered theory

Learner-centered theory emphasizes that the teaching process should be designed according to the needs, interests, abilities and learning styles of the students. It differs from the traditional teacher-centered teaching approach Teachers act as guides, helping students set their goals, select appropriate strategies, and self-assess their progress (Dewey,2004). Bruner (1966) promotes active learning. The learner-centered approach emphasizes that students should be active participants in the learning process, not passive recipients. When students are involved in activities such as asking questions, solving problems, participating in discussions, and making plans, they understand more deeply.

Deci & Ryan (1985) found that when learning experiences are designed to meet students' interests and needs, their intrinsic motivation increases. Opportunities for autonomy and choice motivate students to be more engaged in the learning process (Csikszentmihalyi ,1990). Facione (1990) states that learner-centered environments encourage students to analyze information, evaluate it, and solve complex problems. Approaches such as project-based learning (PBL) and problem-based learning (PBL) enhance these skills (Thomas, 2000).

Gardner (1983) states that since each student has unique learning needs, abilities and styles, teaching methods should be adapted to them. Adaptive teaching and personalized learning are part of this aspect. The learner-centered theory emphasizes that students are not mere recipients of knowledge, but are active, responsible architects of their own learning journey. This approach is fundamental to the holistic development of students and the development of lifelong learning skills (Corno,2008).

2. Constructivist Theory

Piaget (1954) Constructivist theory is an important educational thought that emphasizes that learning is not simply the acquisition of information, but rather a process in which students actively construct new knowledge based on their own experiences and existing knowledge. It is based on the central idea that knowledge is not given from outside, but is constructed within the learner. The main findings of this theory are as follows:

Active participation of the learner, knowledge is not directly imparted to students, but rather they construct knowledge through active interaction with their environment. Students learn best when they are involved in activities such as exploring, experimenting, discussing, and solving problems (Vygotsky ,1978).

Social construction of knowledge Vygotsky (1978) Learning is not only an individual process, but also the sharing and construction of knowledge occurs through social interactions. Students gain new understandings by working together with peers, discussing, and exchanging ideas. Vygotsky's socio-cultural theory emphasizes this.

New information is interpreted and assimilated in terms of students' existing knowledge and experiences. The teaching process should be designed to take into account students' current understandings and help them connect new

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knowledge to existing knowledge (Ausubel,1968).

The Teacher's Role: Guide and Facilitator In constructivist theory, the teacher acts as a guide and facilitator of the learning process rather than as a provider of information. Teachers should set challenging tasks, ask questions, provide resources, and stimulate discussions to help students discover and construct knowledge for themselves (Brooks & Brooks,1999).

Problem-based and project-based learning (PBL) is a key application of this theory, which is that students construct knowledge by working on real-world problems or projects. This helps students to solve complex problems, work collaboratively, and gain practical experience. Constructivist theory emphasizes that learning is an individual, active, and often social process. It places students at the center of learning, giving them responsibility and the ability to self-discover (PBL, 2008). Knowledge is not passively acquired, but is incrementally constructed by individuals through their experiences and interactions with the world. Cognitive development occurs in stages, with each stage representing a qualitative change in thinking (Piaget, 1972). The main stages he proposed are:

1. Sensorimotor stage (0-2 years): Learning through physical interaction with the environment.
2. Preoperational stage (2-7 years): Developing symbolic thinking but lacking logical reasoning.
3. Operational stage (7-11 years): Beginning to think logically about objects and understanding safety.
4. Formal operational stage (12 years): Developing abstract and hypothetical reasoning. Piaget's theory emphasizes that children construct knowledge based on their developmental stage and previous experiences, emphasizing the importance of exploration and discovery in education. Routledge & Kegan Paul (1972) theory of knowledge (also known as epistemology) examines how individuals acquire, construct, and use knowledge over time. Knowledge develops through a series of stages that are influenced by interactions between biological maturation and environmental experiences.

Vygotsky (1978) argues that knowledge is not static, but develops through active interaction with the world, moving from simple sensory-motor understanding in childhood to complex, abstract reasoning in adulthood.

3. Cognitive theory

Children's cognitive development has had a revolutionary impact on the fields of psychology and education. Cognitive theory helps us understand how children understand the world and how they construct knowledge (Bruner, 1966). Children are not just recipients of information, but they construct their own knowledge through interaction with their environment (Vygotsky,1978).

Children's cognitive development consists of four distinct, qualitative stages that occur in a specific order. These stages occur in the same order for all children, and no stage is skipped (Piaget, 1970). Bartlett (1932) Schemas are mental structures that help children organize and understand information. As children grow, their schemas become more extensive and complex. Cognitive development occurs by fitting new information with existing knowledge There are two main processes involved (Flavell, 1963).

4. Social-cognitive theory

Social-cognitive theory was founded by Albert Bandura in 1953. It has guided much of the research on self-directed learning (Hoyle & Dent> 2018).Humans learn by observing the behavior of others and their outcomes. Behavioral information processing theory was first proposed by the American.

In 1956, psychologist George Armitage Miller and other psychologists used the metaphorical processing theory to explain how the human mind works. The human mind receives stimuli, processes them, stores them, locates them, and then responds. Social-cognitive and information-processing theories are related. Social cognitive theory suggests that how self-regulation learning and self-control generally develop, human functioning depends on individual (biological, affective, cognitive), environmental, and behavioral factors interacting (Bandura> 1986, 2001 in schunk & Greene, 2018).

Human actions, feelings, and thought patterns are influenced by external factors and reinforcements, as are theories of behavior (Skinner, 1987 in schunk & Greene 2018).

Individuals do not act on their own. Human life is determined by personal, behavioral, and environmental influences, as suggested by the

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psychological theories (Freud 1960 in Schunk & Greene> 2018)

Personal, behavioral and environmental influences determine human life. In learning institutions, the extent of learners' self-regulation, including their behaviors, is driven by internal and external influences. Scientific literacy is an important skill and should be developed because it is a medium for developing curiosity, initiative, perseverance, adaptability, leadership and social and cultural awareness (Kemdikbud> 2017).

According to Choi, Lee, Shin, and Kim, in 21st century education; the importance of science education consists of five dimensions, namely: content knowledge, habits of mind, character, and values, science as a human endeavor, and the interpersonal (anuwu) cognitive and self-direction dimension. Content knowledge focuses on the thoughts related to science so that individuals can understand various phenomena and problems. The interpersonal dimension includes communication skills, collaboration, and information management skills, identifying learning resources, and critically evaluating the quality of these resources. The scientific dimension includes understanding the collaborative and interdisciplinary nature of science. The interpersonal cognitive and self-direction dimensions are the main dimensions of science literacy worldwide. Self-directed learning refers to Bandura's social cognitive theory, which states that individual cognitive behavior is determined by environmental factors and This theory suggests that humans are self-regulating organisms that are shaped by external environmental influences or indirectly induced by hereditary factors. Student characteristics affect the effectiveness of the learning environment (Sha> Luie> San, & Ru Jane, 2012).

Self-directed learning is the active process of students to set goals, exercise self-control, manage time, and direct one's efforts to achieve learning goals (Tabuenca, Kalz, Drachsler, & Specht, 2015). Self Directed learning theory is based on three basic assumptions (Zimmerman & Schunk> 2001); first, students can improve their learning skills by using appropriate cognitive and motivational strategies. Second, students can select, organize, and create a learning environment that suits them. Third, students can control and choose the type and amount of instruction they need (Wang> Liue> Ki> & Siyan> 2019).

5. Information-processing theories

Miller (1956) was one of the pioneers of cognitive psychology (cognitive psychology). The magic number of his information-processing theory is seven, plus or minus two. This is Miller's most famous discovery. He found that the capacity of human short-term memory is about 7 units (plus or minus 2)That is, we can only remember about 5 to 9 pieces of information at a time.

Grouping is the ability to group information into larger meaningful units to overcome this limitation of short-term memory (Cowan,2001).

6. Pinrich's Theory

Pinrich (2000) is a major theory in the field of educational psychology. It focuses mainly on self-regulated learningand student motivation. Pinrich emphasized that learning is not simply the acquisition of information, but an active process in which students plan, monitor, control, and evaluate their learning processes. Key Features of Pinrich's Theory In his self-regulated learning model, Pinrich describes four main stages and four key areas that occur when students engage in their learning.

7. Teacher-Centered Teaching Theory

Biggs (1996) Teacher-centered teaching is a traditional approach to learning in which the teacher acts as the primary source of knowledge and the center of authority in the classroom. The teacher has full control over the content, teaching methods, and classroom management. The teacher delivers information to students through lectures, presentations, and direct instruction. This is a one-way communication method. Students are mostly recipients of information, silent listeners, and note-takers. Their participation is determined by the teacher (Biggs & Tang,2011). Students' learning achievements are often measured through objective tests. Planning and control: The teacher gets more opportunity to plan, monitor, and control the learning-teaching activities (Ornstein & Hunkins ,2018).

8. Student-centered teaching theory

Student-centered teaching is an approach that places students at the center of the learning process. In this, the teacher acts as a guide and

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facilitator of learning (Prince, 2004; Weimer, 2013). Freeman et al (2014) Students are actively involved in their learning processes. They are given the freedom to choose and act on their own. The teacher acts as a guide rather than a source of knowledge, providing the resources and opportunities necessary for learning (Bransford, Brown, & Cocking, 2000; Darling-Hammond et al., 2020).Review of global, regional, and local studies Activities such as group work, discussions, project-based learning, inquiry-based learning, and independent research are emphasized. This allows for the adaptation of learning experiences to the diverse needs, interests, and learning styles of students(Bonwell & Eison, 1991; Hmelo-Silver, 2004; Johnson, Johnson, & Smith, 2014).Social learning Social interactions (social learning) and collaboration play an important role in students' construction of their knowledge (Vygotsky, 1978; Palincsar, 1998).

Teacher-centered and student-centered approaches have their own unique advantages and limitations. In most effective classrooms, a combination of these two approaches (teaching and learning) is used to provide the best learning experience. Teachers must select the appropriate teaching strategy based on the needs of the students, the subject matter, and the learning goals (Weimer, 2013; Prince, 2004; Bonwell & Eison, 1991).

9. Inquiry-Based Approaches and Problem Solving in Science Learning

Inquiry-based approaches to science learning (IBA) and problem-solving (PBA) are key principles that help students become active learners. They encourage students to ask questions, explore, and think and solve problems rather than simply memorizing information(Hmelo-Silver, Duncan, & Chinn, 2007; Prince & Felder, 2006).

9.1 Inquiry-Based Approaches

Inquiry-based learning is a process in which students acquire knowledge by asking questions, collecting data, observing, analyzing, drawing conclusions, and sharing knowledge (Barron & Darling-Hammond, 2008; Bell, Smetana, & Binns, 2005). It originated from the educational philosophy of John Dewey and was heavily supported by educational reform movements (Bybee, 2000).

Student-centered learning places students at the center of the learning process. Students formulate their own questions and seek answers to them (Muthoka & Owino> 2015).The teacher acts as a guide and facilitator of learning.

The teacher's tasks include providing students with the necessary resources, refining their questions, and supporting their inquiry (Harfitt> 2015).

Students actively construct knowledge through observations, experiments, data collection, and analysis. This emphasizes learning by doing (Dewey, 1938; Kolb, 1984).Inquiry-based learning has different stages: Controlled inquiry The teacher presents the problem and procedures and the students draw conclusions (Bell, Smetana, & Binns, 2005).

Guided inquiry: The teacher presents the problem, but students devise their own procedures (Hmelo-Silver, Duncan, & Chinn, 2007).Open inquiry: Students develop their own questions, procedures, and conclusions. This is a very student-centered approach (Cavanagh, n.d.)

Students are encouraged to explore using questions based on real-world problems or events. This makes learning more relevant and engaging (Harfitt> 2015). It develops critical thinking, analytical skills and problem-solving abilities (Muthoka & Owino> 2015).It increases students' interest, engagement and motivation for learning (Harfitt> 2015). Critical thinking promotes deeper understanding and helps in remembering concepts for a long time. It helps in understanding the nature of science Science is not a fixed set of facts, but rather a method of inquiry (Bransford, Brown, & Cocking, 2000; Kuhn, 1999).

9.2 Problem Solving

Problem solving is a cognitive process of identifying, understanding, and finding solutions to an obstacle (problem) in order to achieve a goal (Newell & Simon> 1972). Hmelo-Silver (2004); Barrows (1996) In science learning, problem solving helps students use scientific principles to solve practical problems.

Students must first identify a problem, understand its nature and purpose, and gather relevant information needed to solve the problem (Jonassen> 2000).

Testing and evaluating solutions: Testing the solutions developed and evaluating their

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effectiveness. This is often done by creating experiments or prototypes (Jonassen>2000). Reflect on the entire process and apply lessons learned to future problem solving Problem solving often reflects the steps of the scientific method (observation, hypothesis, experiment, data analysis, conclusion) (OECD> 2017).

Develops students' analytical and logical thinking skills (Thuzhayaulana, 2000). Problem solving skills improve the ability to apply concepts in practical situations. Develops the ability to learn from mistakes and perseverance Provides the skills needed to approach and solve complex scientific problems (Hmelo Silver, 2004).

Duncan & Chinn (2007) In science learning, inquiry-based approaches and problem-solving work together. Inquiry often begins with a question or problem and then uses problem-solving skills to find solutions. Both approaches encourage students to think and act like scientists, thereby helping them to understand the nature of science in a deeper way.

10. Environmental Theory

Environmental theory explains how a child's development is influenced by multiple layers of environments, including the microsystem (the environment - the classroom, home), the mesosystem (the environment - the school-home relationship), the extrinsic system (the environment - social resources), the macrosystem (the environment - culture, politics), and the temporal system (the environment - changes over time) (Bronfenbrenner,1979).

Zimmerman (2002) The microsystem of the classroom environment (teacher-student relationships, peer interactions, teaching methods) directly influences students' self-directed learning. A supportive and motivating teacher can help students develop self-direction.

Inter-organizational communication between school and home can strengthen or weaken students' approach to learning. Parental support and school cooperation can enhance self-direction (Epstein 2011).

Bandura (2001) The societal perspective on education, educational policies, and cultural values shape the importance given to self-directed learning.

Tasks that are appropriately challenging encourage students to learn independently. Giving students the right to make choices and a certain degree of control over the learning process is crucial for self-regulation (Deci & Ryan> 1985).

Students benefit most when teachers adopt an approach that supports students' self-directed learning (Wentzel> 2002). Johnson & Johnson (2009) Positive peer relationships and cooperative learning opportunities help students learn from each other and share their strategies. Morris (2006) Environmental theory clearly shows that the school and classroom environment is not just a backdrop, but plays an active role in fostering or hindering students' self-directed learning skills.

Empirical Literature Review

The empirical literature reviews have been conducted on the topics of Facilitative Role of Teachers, Technical Knowledge Role of Teachers, Guiding Role of Teachers, Updating Role of Teachers, Importance of Self-Regulated Skills of Teachers, Teaching Approach of Self-Regulated Teachers, Challenges in Implementing the LUNUDU, Need for Teacher Development, Studies conducted in India, Environmental and Other Factors Affecting Self-Regulated Learning, and Benefits of Self-Regulated Learning. These can be seen as follows.

Facilitative Role of Teachers

It is not enough for teachers to be involved in learning and teaching. They must also teach students how to learn (Randi> 2004). Teachers can develop self-regulated learning skills in students (Delfino> 2010; Tilema & Kremer> 2002). Let and Lin (2003)> Xiaondong (2005) have stated that teachers must develop self-directed learning skills because it helps them to deepen their teaching and increase students' performance. It also helps in curriculum change and innovation according to the situation. Self-directed learning skills can balance teachers' professionalism, reflective thinking and adaptation.

In addition, teachers should also explore the answer to the question of how to self-directing students (Dembo> 2001). Teachers who have this search can easily develop self-directed learning skills in their students (Dembo> 2001; Uordo et al.> 2007). Therefore, if self-directed learning is to be improved in students, it is essential for teachers to improve it (Wehmeyer et al.> 2000).

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In addition, in the past, many studies have been conducted on how teachers can improve self-regulated learning skills in students (Miller et al., 2009; Romeo> 2004). Most researchers have studied the role of teachers in different ways. Only a few studies have directly examined the role of teachers in students' self-directed learning (Dembo>2001; Randi> 2004).Teachers play a vital role in promoting self-directed learning in students (Zimmerman> 2002; Peeters> 2014).

The Technical and intellectual Role of Teachers

The first thing that teachers who want to improve self-regulated learning in students should do is to acquire the relevant knowledge and skills. If teachers expect students to be self-regulated in their learning, then we also expect them from teachers (Tilema & Kremer 2002; Vonetal> 2005).Others say

Paris & Winograd (2003) Only teachers with self-directed learning skills can understand the needs and learning strategies of students and provide students with better self-regulated learning opportunities.

The guiding role of teachers

The teacher has become an important person who guides the learning process of students, rather than just a provider of information. Students have also become active participants in learning, rather than passive recipients. This emphasizes the guiding role of the teacher and the motivating role of the students (Shi et al., 2016).

Teachers should assume a leadership role in their teaching process and use it effectively, i.e., the role of the teacher is important in shaping the learning environment in the classroom and guiding students in the right direction (Shi,Zhang, Ren & Chao 2016). This study explains how the teacher can express his guiding role in school teaching in four main aspects and provides practical guidelines to help teachers improve their guiding skills (Shi et al., 2016). Harden & Crosby (2000) elaborates that a good teacher plays twelve diverse roles, beyond just being a lecturer. Although traditionally a teacher is seen as a lecturer who provides information, this study emphasizes that the teacher plays various roles to enhance the learning process of students. The central idea is that a good teacher is more than a lecturer (Crosby,2000).

The Twelve Roles of the Teacher

The guide identifies the role of the teacher into six main categories and twelve sub-roles within them. These are:

1. Informant: The person who provides information through lectures and in clinical settings.
2. Model: The person who acts as a role model for students in the workplace and in formal teaching settings.
3. Facilitator/Guide: The person who acts as a guide for students and facilitates learning.
4. Student Assessor: The person who assesses students' skills and knowledge.
5. Planner: The curriculum developer is involved in designing curricula and planning learning opportunities.
6. Researcher: The person who conducts educational research and improves teaching methods.

Each of these categories is divided into two sub-roles and describes the multifaceted contribution of the teacher (Crosby, 2000).

The role of teachers in updating their knowledge

Randi (2004) Teachers should be able to continuously learn and apply that knowledge in their teaching. It is important to be able to adapt quickly to changing circumstances, to continuously update their teaching skills and to work in a dynamic manner (Randi> 2004; Corno & Jonson> 2011). In addition, teachers should be knowledgeable about learning strategies and facilitate students' learning ; (Kramarski & Miohalsky, 2009). Teachers should be aware of students' abilities, personal progress and opportunities for self-development. When students learn through goals, they show a high level of structured learning ability (Meece> 1994).Students should be encouraged and guided for excellent learning (Schunk & Ertmer> 2000).The role of teachers is important in developing self-directed learning in students. For this, teachers should continuously update their teaching skills, develop new strategies and use them in their teaching. Teaching should be interesting and attractive so that students can manipulate objects, create formulas, answer real-life problems, and apply knowledge in appropriate places (Wiso and Jan> 2003).

Teachers play a crucial role in helping students effectively regulate their learning process. Although primary school teachers are keen to

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introduce self-regulated learning methods in their classrooms, various factors prevent them from fully promoting this (Peeters et al.,2014).

Importance of Teacher Self-Directory Skills

This study indicates that teachers' own self-direction skills are an important determinant of implementing self-Directed learning in primary schools. That is, if teachers themselves are capable of self-Direction, they will be more effective in teaching self-Direcion to students (Peeters et al.,2014).

Self-directed learning is the ability to set goals, exercise self-control, manage time, and make one's own efforts to achieve learning goals (Tabuenca, Kalz, Drachsler, & Specht, 2015). The theory of self-regulated learning is based on three basic assumptions (Zimmerman & Schunk> 2001). Scientific literacy is an important skill and should be developed because it is a medium for developing curiosity, initiative, perseverance, adaptability, leadership, and social and cultural awareness (Kemdikbud> 2017).

The results of Peter Burton's title Self-directed scientific learning as a method for developing thinking, students; Science learning has been shown to have great potential to enhance self-directed literacy, particularly developing strategies for students to become more scientifically minded (Peters Burton> 2013).

The advantage of self-directed learning is that it provides students with an active and constructive means of setting learning goals and then allowing them to monitor, regulate, and control their motivational and cognitive behavior in their environment with contextual goal guidance (Schnell, Rangeson, Roufeller,& Row Rohman,2015). Research by Cleary, Slemp, and Pavlov on linking students' self-directed learning profiles to achievement and engagement in mathematics has shown that self-directed learning influences achievement and engagement (Kleari, Slemp, & Pavlo,2022). Self-directed learning has been discussed in the past in terms of knowledge demand. Studies by Peters Burton and Cleary et al. describe self-directed learning. Panadero (2017) states that both cognitive and motivational strategies are important in self-directed learning. Mnemonic strategies, such as summarizing, noting key ideas, and creating mind maps (Conceptual map), help students understand and remember information. Bandura (1997) states that self-motivation, self-efficacy beliefs, goal orientation, and maintaining a positive emotional state help students face challenges and continue their efforts. Self-efficacy beliefs are a key motivator of self-directed learning.

Self-directed learners achieve better academic results by effectively managing their learning processes. They score higher marks, understand complex concepts better, and prepare themselves for new challenges (Zimmerman & Schunk 2011). Pintrich & De Groot (1990) Students with self-directed learning skills are more likely to excel in academic achievement.

Teaching Approach of Self-directed Teachers

Self-directed teachers adapt their teaching approach to their own self-direction skills. Thus, they have a better understanding of these processes and are more effective in promoting self-regulation (Peeters et al., 2014).

Hewitt Taylor (2001) examined teachers' and students' perspectives on self-Directed learning (SDL). The study found that when students plan their own learning, their self-responsibility, self-confidence, and skill development increase.

In particular, in nursing education, the need for students to develop self-learning skills necessary for future professional careers is emphasized.

In secondary education, it was examined how SDL can be implemented and what teachers do to achieve it. The study suggests that although teachers are information providers in traditional classrooms, they need to become guides, supporters, and facilitators of learning in order to promote self-regulated learning (Bolhuis & Voeten 2001). Grow (1991) presents a model for developing students as self-directed learners, in which learners are not all at the same level, but their self-learning ability should develop gradually.

Louws et al. (2017) examined the relationship between teachers' self-regulated learning and their teaching experience. In the study, teachers examined and explained what they want to learn, how they learn it, and why they want to learn it.

Challenges to Implementing Self-directed Learning

Schunk & Ertmer (2000) suggests that although teachers are positive about implementing self-

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directed learning in their classrooms, there are some barriers.

This study suggests that teachers' own lack of self-regulated skills or lack of training to improve them may be one of the reasons. Several challenges arise when implementing self-directed learning in an educational environment, such as low student motivation, lack of resources, lack of teacher guidance, and problems with assessment methods. They emphasize that teachers and educational institutions need to create a supportive environment that fosters students' self-directed learning skills, and for this, appropriate teaching methods, technological facilities, and training are necessary (Dahal & Bhat ,2023).

Morris (2019) Self-directed learning improves adaptability. That is, learners gain the ability to quickly adapt to new situations, new knowledge, and technological advances. This helps them in employment, lifelong learning (LLL) and personal development. He also recommends that educational institutions should design the learning environment in a way that encourages this self-directed learning.

Need for Teacher Development

The need for professional development programs to develop teachers' own self-directed skills to promote self-directed learning among students is implicitly revealed by this study (Kramarski & Michalsky 2009).The study by Peeters et al (2014) clarifies that teachers' self-directed skills are a fundamental factor for the successful implementation of self-directed learning practices in the classroom. When teachers use self-regulated strategies in their own learning and teaching practices, they can act as a good role model and guide for students to develop these skills as well. Therefore, teachers' professional development programs should focus on developing their own self-regulated skills, which will ultimately improve students' learning experience and achievement. It is widely believed that teachers should develop self-directed strategies among their students (Perry et al.> 2008).However, many teachers have difficulty implementing the principles of self-regulation effectively in the classroom (Spruce & Bol> 2015).

Teachers' self-efficacy plays a key role in promoting self-direction. Although many teachers are aware of its benefits, they lack the confidence to teach it in the classroom (Perry et al.> 2008). The authors emphasize that more research is needed to determine how much and what kind of guidance, focused reflection, and discussion are needed to learn self-regulated teaching practices (Perry et al.> 2008).

Self-direction involves metacognition, motivation, and strategic action, and this is how learners succeed in school and beyond (Winne & Perry, 2000; Zimmerman> 1990; 2008).Dignath, Dickhäuser, & Büttner (2013) This study emphasizes that it is important to use multiple perspectives (such as teachers, students, and classroom observations) to assess how teachers promote self-directed learning. Different perspectives provide unique information about its development.

Some studies suggest that the lack of literacy training in teacher training programs may be a reason why teachers neglect literacy in their classrooms (Panadero, 2017; Moos & Ringdal> 2012). Thus, systematic and in-depth training on literacy in teacher training is necessary.

Teachers play a crucial and central role in students' development and use of self-directed learning. Teachers' practices, beliefs, and knowledge significantly influence this development (Moos, 2012).

Peeters et al (2016) clearly shows that teachers' approach to promoting students' self-regulated learning is not one-sided, but is influenced by the individual characteristics of students and teachers' own beliefs and knowledge. This has important implications for teacher training and development programs, as it emphasizes how teachers should adapt their teaching to effectively promote it for all students.

Most teachers believe that students' characteristics influence their approach to promoting learning (Kindekens,2016). Lombaerts (2016) found that teachers' beliefs, their knowledge of self-regulation, and their attributional behavior play a mediating role in the relationship between student characteristics and teachers' support for self-regulation.

De Backer (2016) found that large differences in students' initial abilities to manage their learning processes require teachers to tailor self-regulation development to individual needs; students' self-regulated learning abilities play a significant role in their learning performance (Cheng, 2011). Cheng (2011) These four dimensions of motivation, goal setting, action regulation, and learning strategies positively and significantly affect students' learning performance. Teachers should help students think about how they learn

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and choose strategies that are appropriate for different learning situations (Paris & Paris,2003). Paris (2003) Self-direction is a combination of cognitive and motivational aspects that teachers can improve by developing students' self-efficacy and interest in and value of learning.

It emphasizes that there is a strong and complex relationship between classroom assessment practices and the development of students' self-learning skills.

Assessment is not just a scoring tool, but can also serve as a means of improving learning (Brandmo,2020). Panadero (2020) Effective and specific feedback provided by teachers to students helps them monitor their learning progress, make necessary changes, and set goals for the next stage of learning.

The assessment methods used by teachers directly affect students' self-regulation skills. For example, formative assessments provide students with the opportunity to continuously reflect on their learning and adjust their approach if necessary (Hopfenbeck, 2020).

Designing programs to suit teachers' experience levels and to meet their personal and practical needs can improve their learning motivation and outcomes (Louws, van Veen & van Driel 2017). Hewitt-Taylor (2001) used strategies such as providing a variety of learning resources, giving students freedom of choice, and providing constructive feedback to encourage teachers to learn.

In a self-directed learning environment, teachers become not just information providers, but guides, advisors, and supporters of the learning process. They help students take responsibility for their own learning, set goals, and choose strategies (Kazlauskiene, Gaucaite & Poceviciene 2015).

Direct and subtle interactions between teachers and students are crucial in developing students' learning skills. Through these interactions, students acquire knowledge about learning, practice their strategies, and improve their learning process (Perry, VandeKamp, Mercer & Nordby 2023).

Bakar et al (2005) The conversations that teachers engage in with students, the guidance they provide, and the constructive feedback they provide have a direct impact on students' learning skills. These help students set their goals, select strategies, and understand their strengths and weaknesses.

The complex relationship between teacher self-efficacy and teacher-student interactions and students' self-regulated learning skills at different levels of the classroom environment is explored (De Ruig, Zee & de Jong,2024).

De Jong (2024) found that rather than teacher self-efficacy directly affecting students' self-regulated learning skills, teacher-student interactions play a mediating role. That is, higher teacher self-efficacy leads to better interactions, which ultimately improves students' self-regulated learning skills.

Self-directed learning has been found to be an effective and feasible approach for teachers to improve their science content knowledge. It helps teachers identify their own learning needs, select resources to address them, and manage their learning process(van Garderen et al 2017).

Zimmerman (1990) examines the relationship between self-directed learning and academic achievement with a comprehensive perspective. This study highlights the key aspects of self-directed learning and how students effectively manage their learning processes.

Pintrich (2000) This study highlights that self-regulated learning is not simply an individual trait, but rather a set of contextual strategies, skills, and cognitive processes. This study highlights that when a student engages in an academic task, they operate in a cyclical manner of planning, monitoring, and evaluating their learning processes.

Self directed learning is a cyclical process Self-directed learning is a cyclical model with three main phases: planning, performance monitoring, and self-reflection (Panadero,2017).Schunk & DiBenedetto (2020) Precontemplation phase This phase involves students setting goals, planning learning strategies, and developing confidence in their own abilities. Monitoring phase This phase involves students implementing planned strategies, monitoring their progress, and adjusting strategies as needed.

Moylan (2009) Self-reflection phase This phase involves students evaluating their performance, examining the reasons for successes and failures, and making adjustments for future learning. This reflection provides information for the next learning cycle.

Cleary (2004) Self directed learners are students who are actively involved in their learning processes. They do not view their learning as a mere instructional process, but

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rather focus on developing their own skills and strategies. They take responsibility for their learning, seek out information to achieve their goals, and use effective strategies to overcome their learning challenges. Self Directed learners not only possess deep knowledge in a particular field, but also have the meta-thinking skills necessary to apply that knowledge, select, and adjust their learning strategies (Winne, Hadwin, 1998).

Paris & Winograd (1990) emphasizes the importance of teaching students self-directed learning skills. These skills do not come naturally; they must be taught and developed. Teachers should not only provide students with information, but also teach them how to learn effectively. This includes meta-thinking skills such as planning, monitoring, self-evaluation, and adjusting strategies.

Zimmerman (2000) defines self-directed learning as an active, cyclical process that helps students achieve their educational goals. It emphasizes the importance of both cognitive and motivational strategies and how these skills lead to academic achievement, and it also emphasizes the need to teach these skills to students.

Over the past few decades, innovative educators and educationalists have made paradigm shifts in pedagogical reform efforts. Their goal has been to move beyond teaching methods in which the teacher is the transmitter of information and students are passive recipients of that information. Instead, active learning has been advocated, that is, students are given opportunities to actively participate in creating their own learning environment (Prince ,2004).

Studies conducted in Sri Lanka

Kugamoorthy (2016) describes how self-directed learning practices and cognitive skills are developed through activity-based learning. The study is the first study conducted in Sri Lanka on the subject of self-directed learning. Apart from this, self-regulated learning may be conducted in graduate studies. However, it must be said that there is not enough research on self-regulated learning in Sri Lanka.

Self-directed learning can be defined as a process of learning by analyzing knowledge, setting goals, maintaining motivation, controlling and managing one's thoughts and feelings, monitoring oneself, and updating strategies (Zimmerman,2000).

Jayawardena, van Kraayenoord & Carroll (2017) Self-directed learning has a direct impact on students' achievements and their intellectual activities Many studies have been conducted on self-directed learning internationally. However, such studies have not been conducted in Sri Lanka or have not been conducted sufficiently. Therefore, it is necessary to conduct a school-based study on self-directed learning by involving students and teachers.

Environmental and other factors influencing self-regulated learning

Environmental and behavioral factors interact (Bandura> 1986, 2001 in schunk & Greene,2018). Human actions, feelings, and thoughts are influenced by external factors and reinforcements, as are behavioral theories (Skinner, 1987 in schunk & Greene 2018).

Individuals do not act on their own. The internal drives and motivations (Freud 1960 in Schunk & Greene> 2018) that are described by psychodynamic theories determine human life through personal, behavioral, and environmental influences. In learning organizations, the degree of self-regulation, including the behaviors of learners, is driven by internal and external influences.

First, students can improve their learning skills by using appropriate cognitive and motivational strategies. Second, students can choose, organize, and create a learning environment that suits them.

Third, students can control and choose the type and amount of instruction they need (wang> liue> ki > & Ru siyan> 2019).

Akgunduz & Akinoglu (2016) shows that both blended learning and social media-supported learning are powerful tools capable of improving students' attitudes and self-directed learning skills in science education. Educators and policymakers should use these findings to create innovative learning environments that foster students' participation, motivation, and lifelong learning potential.

Benefits of Self-Directed Learning

Self-directed learning helps students plan and monitor their learning. This can help them improve their self-confidence.The process of learning accountability holds students accountable for their learning, allowing them to monitor and improve their progress (Zimmerman,2000). Skills related to learning

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are developed. Skills such as planning, time management, performance evaluation, and performance improvement are taught. Measurement skills enable students to assess their progress. This helps them understand progress in comparison to other data. In a self-directed learning skills development environment, students have the opportunity to develop their own strategies for learning (Pintrich,2000).

Zimmerman & Schunk (2001) Weaknesses Difficulty in the beginning Students who lack self-confidence or guidance may find it difficult to initiate self-directed learning. Without good guidance, they may get stuck in this mode. Difficulty in time management: Students may not be able to manage their time properly and may lose interest in their studies. Nelson & Narayanan (2014) Students may not be able to properly allocate the time needed for activities, which leads to poor progress.

This can isolate students and reduce group or social interactions. Slow learning pace Some students may have difficulty adapting to their learning style. They may have a very different learning style. Problems in assessing progress may cause confusion about how progress is assessed in a particular way, which may lead to low motivation to learn.

Self-direcion enhances a student's ability to identify academic efforts but also has difficulties in implementing it. To experience the benefits of self-regulated learning, educational guidance and support are essential (Pintrich, 2000). Self-regulated learning involves students planning, monitoring, and evaluating their own learning processes, which is crucial for academic achievement (Zimmerman> 1990).Formative assessment (formative assessment) aims to improve learning by monitoring students' understanding during the learning process and providing them with feedback (instructional feedback) (Black & Wiliam,1998). Louws (2017) contributes to understanding how teachers use self-directed learning for their professional development. Self-regulation is a process by which an individual identifies their own learning needs, sets learning goals, identifies appropriate learning resources, selects strategies, and evaluates their learning process (Knowles> 1975).

Self-direction studies the effects of self-assessment (self-efficacy) on learning and self-efficacy (self-efficacy). Four meta-analyses (analysis and meta-analysis) are conducted to understand how self-assessment impacts these two important academic aspects (Panadero, Jonsson, & Botella, 2017).

Hew (2016) provides students with opportunities for independence and choice to set their own learning goals, select learning activities, and manage their own progress, which promotes self-regulation, which increases their motivation and engagement.

It has been found that there is no single factor that is important, but rather many factors that work together to create a student-centered learning environment (Law et al,2016).

Ambaryani & Putranta (2022) Self-direction and problem-solving approach are inextricably linked. When students solve a problem, they naturally engage in a learning cycle. This approach also helps students take responsibility for their own learning process.

For educators who want to improve both problem-solving skills and problem-solving simultaneously, combining the scientific approach and quantum learning strategies is recommended (Sudirman, Fatimah, & Jupri 2017). There are no studies on self-regulated learning or the role of teachers in Tamil medium schools in Sri Lanka (especially in the Beruwala Education Zone), however, there are studies on self-directed learning or the role of teachers in Tamil medium schools in Sri Lanka. Teachers, students' intrinsic motivation, interest in learning new things and their activeness in the learning process are the most important factors for their self-directed learning readiness (Piratheeban & Bandara ,2025).

Jayawardena, Kraayenoord & Carroll (2017) The teacher used various strategies to develop students' learning skills in science. Some of these are explicit, some are subtle. This literature review indicates that there is a dearth of studies focusing on the role of teachers in this area. It is recommended that future research focus on providing additional guidance and support to teachers on how to effectively implement self-direction in their classrooms.

Chapter 3

Abstract

The theoretical and empirical studies reviewed above greatly contribute to this study and there is a research gap in the literature regarding the role of teachers in implementing self-directed learning, which has not been conducted nationally, especially in the Beruwala

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Education Division. This study aims to fill this gap. The sampling methods used in Jayawardena's study have been used for the study and some of the points mentioned in the literature review have been used to achieve the objectives of the study. In addition, this study has been conducted considering the most important points mentioned in the theoretical review.

Research gap identification

Several international studies have confirmed that Self-Directed Learning (SDL) is essential for raising students' achievement in science education. However, there are very few studies on this in the Sri Lankan educational environment, especially in Tamil-medium schools in the Beruwala Education Zone.

The existing literature mostly only explains the general benefits of student-centered learning. However, there is no clear data on the extent to which teachers promote students' self-directed skills (planning, self-monitoring, self-reflection) in Senior Secondary (G.C.E O/L, A/L) science subject learning. In particular, there is not enough research on the challenges that Sri Lanka's exam-oriented education system and rigid curriculum pose to teachers in implementing such modern learning strategies. Furthermore, there has been no statistical study examining the relationship between the Facilitation and Updating roles of teachers in this area and their age and gender. Therefore, there is a huge knowledge gap in deeply examining the role of Tamil medium science teachers in the Beruwala Education Division and proposing solutions to practical challenges. The main objective of this study is to fill this gap.

Methodology

Introduction

A research methodology serves as the backbone of a successful study. It refers to the overall plan and logical approach required to answer the research questions and achieve the objectives of the study. The research methodology describes how to collect data systematically and reliably, how to analyze them, and how to draw meaningful conclusions from the analyzed data. This methodology forms the basis for the validity and reliability of the study, and serves as a clear guide for others to understand and repeat the steps the researcher used for his study.

This study is based on the descriptive research design. This design aims to systematically describe the current state and characteristics of a particular population, phenomenon, or environment. It asks questions such as "What?" "Where?" "When?" and "How?", provides a deeper understanding of the central subject of the study. This allows the researcher to accurately portray the reality of a phenomenon and its various dimensions without attempting to establish cause-and-effect relationships (causal-effect relationships) between any variables. This approach is well suited to understanding complex phenomena and to laying the foundation for further in-depth research.

This chapter describes the methodology used in the study. To identify the current conditions of implementing self-regulation in science teaching in senior secondary classes of Tamil medium schools in the Beruwala Education Zone, to identify the challenges faced by teachers in implementing self-directed learning in science, to identify the opportunities available to teachers in implementing self-directed learning in science, and to provide suggestions for improving self-directed learning in science in senior secondary classes. The self-directed learning models used by teachers, their relationship with classroom teaching and the role of teachers in increasing student achievement levels were examined.

Method

This study used a mixed methods approach (Mixed-Intermediate) approach. It involves the collection and analysis of both quantitative data (Mixed-Intermediate) and qualitative data (Mixed-Intermediate). Quantitative data is collected from a large number of participants using defined criteria or measures and subjected to statistical analysis. Qualitative data, on the other hand, is collected from a small number of participants through interviews to gain in-depth insights. This mixed methods approach helps in fully achieving the objectives of the study and gaining a comprehensive and accurate understanding of various aspects of a phenomenon, and adds depth to the quantitative findings through qualitative data.

The researcher has used a mixed research method in line with the above research objectives. The quantitative data has been analyzed using descriptive statistics and one-

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way ANOVA method and the qualitative data has been analyzed using content analysis method. The mixed research method, which has been widely used in social sciences in recent times, helps to approach the research problem in many ways. Here, the researcher has tried to conclude by comparing the data on the role of teachers in implementing self-directed learning through a questionnaire and comparing it with the data of the principals.

Furthermore, the researcher uses various methods and sources to test his research to confirm its validity and reliability, which is called data triangulation. In the mixed research method, quantitative and qualitative data are triangulated. Thus, according to Creswell's (1999) classification, the analysis of quantitative data through the continuous clarification (sequential clarification) method in the mixed research methodology is compared with the analysis of qualitative data and data triangulation is described. His method is a process that uses qualitative results to describe data in quantitative studies. The researcher has used this method considering its ability to help develop and test hypotheses, its international application, and its relevance to the study.

Format

Best & Kahn (2006) Descriptive research design is a research method that systematically describes a particular event, group of individuals or situation in its natural environment. In this design, the researcher only records how it is without changing the object under study. That is, it does not try to prove cause-and-effect relationships, but rather describes the current situation, its characteristics, attitudes, habits, etc. For example, studying the academic performance and study habits of students in a school or recording health awareness in a community are examples of this. In descriptive research, instruments such as surveys, questionnaires, interviews and observations are widely used. The advantage of descriptive research is that it provides extensive information in a short period of time, but it also has its limitations; That is, it cannot explain why a situation arises, but in fields such as social science, education, and psychology, it is considered very useful as a first step in understanding structure and conditions (Gall & Borg, 2007).

Population

To ensure the study has sufficient statistical power to represent the Beruwala Education Division, the sample was drawn from 8 selected Tamil medium secondary schools. The total sample is categorized as follows:

Teacher Cohort ($n = 58$)

The population consists of 70 science teachers across the senior secondary sections. Following the Krejcie & Morgan (1970) table for a population of 70, a sample size of 58 teachers was selected using purposive sampling. This ensures a 95% confidence level, providing the study with robust reliability for analyzing teacher perceptions of Self-Directed Learning (SDL).

Principal Cohort ($n = 5$)

From a total of 16 principals in the division, 5 principals from Tamil medium secondary schools were selected via Simple Random Sampling to provide administrative context to the SDL implementation.

The Tamil medium schools in the Beruwala Education Division are structured as 1AB> 1C> Type 2 and Type 3. There are a total of twelve of them. Since this study is conducted in the senior secondary section, 8 Tamil medium secondary schools were selected from them. Out of these, seventy teachers teaching science subjects in the senior secondary section and 10 school principals were taken as the population.

Sample Selection

Selection of Teachers

In order to gain insight into the role of teachers in implementing self-directed learning, 58 science teachers were selected as samples through the purposive sampling method according to the Morgan table. This can be seen in Table 1.

Table 1

Teachers Selection

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School Name	Student Type	Total Science Teachers	Selected Teachers
A	1AB	10	10
B	1AB	10	10
C	1AB	10	10
D	1AB	10	10
E	1AB	10	10
F	1C	4	4
G	Type 2	2	2
H	Type 2	2	2

Among them, special attention has been paid to selecting non-biased samples that maintain gender equality. At the same time, eight of the schools under study are from disadvantaged areas and are found to have similar socio-economic conditions.

Selection of Principals

The Beruwala Education Division under study consists of 12 Tamil medium schools and 4 Sinhala medium schools. This study was conducted in Tamil medium secondary schools. There are 16 principals in the Beruwala Education Division. Out of them, 5 secondary school principals of Tamil medium schools were sampled through the random sampling method.

Instruments

Primary data and some secondary data have been used in this study. This study mainly uses primary data collected through questionnaires and interviews and secondary data due to the need for theories to build the concept.

Questionnaire for teachers

About the questionnaire, (Fowler & Floyd, 1995) said that the best questionnaire produces reliable and accurate answers to the situation to be described. Accordingly, it can be concluded that the purpose of the questionnaire is to provide reliable and accurate answers to the questions raised for the purpose of the study. Thus, the scientifically prepared A five-point Likert scale questionnaire has been used in this study.

The school teachers selected as the sample for the study have answered the questionnaire that reveals the perception. The questionnaire consists of thirty questions related to self-regulated learning. The questionnaire focuses on developing objectives related to self-regulated learning in schools, selecting self-regulated learning strategies, teacher role and promoting student self-regulation.

The questionnaire has the following rating points. 5 represents very high; 4 represents high; 3 represents average; 2 represents low and 1 represents very low.

Parts of the questionnaire

Part 1 includes the teachers' biographical information. It consists of five questions.

Table 2

Teachers' Biographical Information

NO	QUESTIONS
1	Grade
2	Age
3	Gender
4	Educational qualification
5	Job Role

Part 2 consists of five questions about the current status of self-directed learning in achieving the objective. A 5-point scale was used to obtain the answers to these questions. They are 1- Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, and 5- Strongly Agree.

Table 3

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Current status of self directed learning

No	Questions
1	You are familiar with the concept of self-regulated learning
2	Self-regulated learning is essential in science subjects
3	It will improve students' critical thinking
4	It will encourage students' research skills
5	The teacher should receive special training to implement this

Part 3 The third part consists of five questions on the role of teacher facilitation in implementing self-regulation in achieving both objectives. A 5-point scale was used to answer these questions. They are 1 - very little, 2 - little, 3 - somewhat, 4 - a lot, 5 - very much.

Table 4
Role of Teacher Facilitation in Implementing Self-direction

No	Questions
1	You guide students to set goals on their own.
2	You encourage students to search for learning resources on their own.
3	You provide students with opportunities to plan independently.
4	You provide research-based activities.
5	You encourage self-regulation through group discussions**.**

Part 4 consists of five questions about the role of teachers' updating in implementing self-regulated learning to achieve objective three. A 5-point multi-choice scale was used to obtain the answers to these questions. They are 1 - strongly disagree, 2 - disagree, 3 - neutral, 4 - agree, 5 - strongly agree.

Table 5
Teachers' Updating Role

No	Questions
1	You regularly attend trainings on new teaching methods
2	The school administration supports teachers' professional updating.
3	nformation technology helps to improve teaching skills.
4	You try to keep abreast of curriculum changes and educational developments
5	You believe that teachers' updating improves the quality of students' learning

Part 5 The final part consists of ten questions on providing suggestions and comments to improve self-regulated learning in a manner that achieves objective four. A 5-point scale was used to obtain answers to questions 1-8. They are 1- Not very necessary, 2- Not necessary, 3- Cannot say, 4- Necessary, 5- Very necessary.

Table 6
Proposals for improving self-regulated learning

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No	Questions
1	Special training camp is necessary for teachers
2	Self-regulated learning should be included in the curriculum
3	You recommend increasing learning resources
4	Activities that increase student motivation are necessary
5	More use of technological tools should be made
6	School administration should allocate special time
7	Parent awareness meetings are necessary
8	Research competitions should be organized for students
9	What are the methods for assessing self-regulated learning in your opinion
10	What is the best way to implement it

Interview form for Principals

The interview form for principals consists of a total of 12 questions. Out of these, the first 5 questions are designed to obtain basic information. The remaining 7 questions are designed to achieve the main objectives of the study. The interview form consists of three main sections.

Section A includes 5 questions aimed at obtaining personal details and professional information of the principals. These questions help to collect the gender, age, principal level, educational qualification and experience in working in school administration. This information is then coded and used to interpret the results of the qualitative analysis at the beginning of the analysis and to understand the nature of the model. Section B consists of five questions to identify the current status of self-regulated learning in science education and the facilitating and absorbing role of teachers. These questions ask principals about the concept and importance of process learning, its place in school policies, the opportunities for process learning to enhance students' research and critical thinking, the guidelines provided to teachers for implementing self-regulated learning, and the clear goals and plans implemented in the school. These questions strengthen the triangulation of the study by comparing the feedback received from the school's administrative level with the results of the teacher questionnaire.

Section C consists of two questions to achieve the fourth objective of the study, to understand the challenges for the overall study, and to elicit recommendations. This includes the question of what are the main challenges that principals face when implementing self-regulated learning in schools, as well as the question of what are their recommendations for improving self-regulated learning in science subjects. These challenges and recommendations are used as the main themes of the qualitative analysis and form the basis for developing the final recommendations.

Data Collection

Data collection instruments were used to collect the views and experiences of teachers, principals, and vice-principals on the role of teachers in implementing self-regulated learning in senior secondary science subjects. Thus, data were collected from teachers and students through questionnaires and from principals through interviews. The main data for this study were collected from teachers. Since these are the research sample, the questionnaire method is the best for obtaining information from a large number of people quickly and at a low cost. For this reason, the teachers were given a questionnaire method. The questionnaire consists of 05 parts.

In the first part, the basic issues and the other 04 parts, questions were prepared according to the objectives on a 5-point ligated scale. The questionnaires were copied to the teachers and given to them in person by visiting the relevant schools and collecting data. Many difficulties were faced while collecting this data. Some teachers were absent, and two days were given

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to complete the questionnaire and provide the data and the questionnaires were collected.

Since the questionnaires could be returned without being completed, it took more time than expected because each person's questionnaire was checked and received. Some teachers missed the questionnaire and were given copies again. However, the data collection from all 58 teachers was a great success.

The interviews with the principals were conducted in person at the schools. Half an hour was spent with each principal. The interview included the time, place, and name of the principal. The interview form consisted of 3 parts. In addition, 12 questions were asked covering 04 objectives and in-depth data was collected from the principals' experiences.

During the collection of this data, due to the absence of the principals, it was necessary to travel to the schools for 04 days.

Therefore, interviews and video conferences (video conferences) were conducted for the 03 principals who missed it. The necessary contributions and support from the teachers and principals for this week helped in the successful completion of the data collection.

Validity and Reliability of Instruments

Validity describes how well the data collected cover the actual area of investigation(Ghauri and Gronhaug, 2005). Validity basically means "measure what it is supposed to measure" (Field, 2005). In this study, the face validity, content validity and reliability of the instruments were examined.

Validity of Instruments

Criterion or construct validity refers to the extent to which a measure is related to an outcome. In this study, the face validity and content validity of instruments were examined.

Face validity

Face validity means that a test is face valid only if the content of the test appears relevant to the test taker. It assesses the appearance of the questionnaire in terms of feasibility, readability, consistency of style and design, and clarity of language used.

In other words, face validity refers to the subjective assessments of the researchers on the presentation and appropriateness of the measurement instrument, such as whether the items in the instrument appear relevant, fair, unambiguous, and clear (Oluwatayo, 2012). To examine face validity, two-dimensional scales can be used with categorical options of "yes" and "no", which indicate a positive and negative item, respectively. A positive item indicates that the item is objectively constructed and can be positively classified under the thematic category.

The collected data are then analyzed using Cohen's Kappa Index (KKI) to determine the face validity of the instrument. DM.et.al; (1975) recommended a minimum acceptable Kappa of 0.60 for interrater agreement.

Content validity

Content validity is defined as "the extent to which the items in an instrument reflect the content universe to which the instrument is generalizable" (Strap et.al.,2004).It is highly recommended to use content validity when developing a new instrument. Content validity was tested by using the VC (Content Validity Ratio) method proposed by Lawshe (1975) as a proportional scale of scores that indicate how many "experts" within a group rate an "essential" item.

Pilot Testing

In order to obtain the necessary information for the study on the role of teachers in implementing self-regulated learning in the senior secondary school, questionnaires and interviews were used as data collection instruments in this study. Therefore, in order to maintain its reliability and validity, the data collection instruments prepared for the study were administered to 10 teachers and 02 principals of schools not included in the study sample before being used for the study. Are the questions understandable? Are they understandable and answerable? Are they suitable for the study? Various checks were carried out to identify errors and corrections were made in them, and suggestions were obtained from them. The information obtained from them was checked in a systematic manner and the reliability was confirmed and maintained.

Data Analysis Method

In this case, all the quantitative data (i.e., descriptive data) obtained through the questionnaire were organized and the 28th version of the The scale range was set to describe the mean scores of the five-point

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Likert scale used in the questionnaire, with a range of 2.61 to 3.40 representing 'moderate' and a range of 4.21 to 5.00 representing 'very high'. Initially, in order to answer the research questions on the current status of self-directed learning and the role of teachers, the data were analyzed using descriptive statistics (Descriptive Statistics) methods such as mean, standard deviation (SD) and probability distributions and presented with the help of statistical graphs. Furthermore, the role of teachers in implementing self-directed learning and recommendations are discussed; In order to explore these in depth, inferential statistics techniques such as the Anova Analysis method were also used. Meanwhile, all the qualitative data obtained through interviews and observation forms were analyzed through thematic analysis method and relevant themes were identified. Finally, the results of both types of data were triangulated to confirm the reliability of the research results and reliable final conclusions were reached for the main research questions. This is shown in Table 10.

Table 10
Data Analysis Techniques

Research Objective	Data Collection Instrument	Nature of Data	Data Analysis Technique
1	Questionnaire Interview Form	Quantitative Qualitative	Descriptive Statistics Thematic Analysis
2	Questionnaire Interview Form	Quantitative Qualitative	Descriptive Statistics Thematic Analysis
3	Questionnaire Interview Form	Quantitative Qualitative	Descriptive Statistics Thematic Analysis
4	Questionnaire Interview Form	Quantitative Qualitative	Descriptive Statistics Thematic Analysis

Research Ethics

Research ethics refers to a special branch of knowledge, which is based on the principle of truthfulness and the collection of data in this research is done with care and responsibility. Personal and opinions obtained in the research are treated confidentially and the research-related information is not disclosed to third parties. The data were collected without any sharing with the department without permission and with clear and informed consent from the participants; their full explanation of the purpose and role of the research. Everyone was given equal rights and the selection of data was carried out without any discrimination. Since the agreement, role or results in the research should be equal, responsible data handling was followed and the data was collected, processed and handled safely. It is wrong to use the data without acknowledging and acknowledging the work of others. All accepted research activities were carried out without causing any kind of harm and did not cause any harm to the participants, communities or climate. This research was conducted in a way that the participants could easily understand the methods and results of the research using their skills and knowledge. Furthermore, the unique contributions of each participant have been considered and the production of false articles has been avoided here.

Chapter 4

Abstract

This study describes a mixed method and descriptive research design. Data were collected through a questionnaire for teachers and interviews with principals. Data were analyzed using SPSS and thematic analysis techniques. The reliability of the instrument was confirmed through pilot testing, and the research ethics codes were strictly followed and the real data were handled responsibly.

Results / Findings

Based on the data obtained through the study, the background information of the teachers and principals of the Beruwala Educational

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Institution is formed. Teacher quality and experience: Out of the 58 teachers who participated in the study, the majority (29.3%) were in the teacher quality level of grade 3(1)A and grade 3(1)C. Notably, no teachers with grade 1 qualification were included in this study. The rest were in grade 2(2) and other levels. Looking at the age distribution, 50% of the teachers (29 people) belonged to the 31-40 age group. This shows that the contribution of middle-aged and experienced teachers in the study is high. The contribution of senior teachers above 51 years of age (8.6%) is very low.

Analysis of Teacher Facilitation Roles by Demographic Factors

The study hypothesized that teacher experience and age might influence their role as facilitators in Self-Directed Learning. However, the data reveals a high level of consensus (SD < 0.730).

- **Hypothesis Testing:** An ANOVA test was conducted to compare age groups. The results (F = 0.062, p = 0.804) indicate that there is **no statistically significant difference** in how different age groups perceive their facilitation roles.
- **Visual Representation:** (below figure 1). The bar chart shows nearly equal heights across all age groups(except 31-40), visually confirming that both early-career and senior teachers in the Beruwala Division share a similar positive outlook on guiding students to set independent goals.

Table 1

Age-based details (N = 58)

		Frequency	Percentage
	20-30	12	20.7
	31-40	29	50.0
	41-50	12	20.7
	51-60	5	8.6
	Total	58	100.0

Figure 1

Age-based details (N = 58)

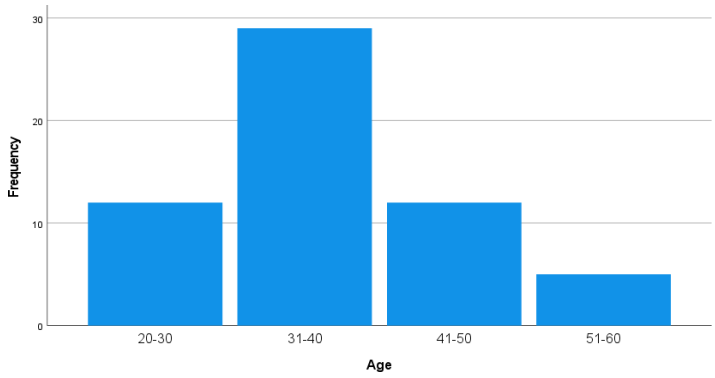

Table 2

Gender-based information(N = 58)

		Frequency	Percentage
	Male	5	8.6
	Fenale	53	91.4
	Total	58	100.0

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Figure 2
Gender-based information(N = 58)

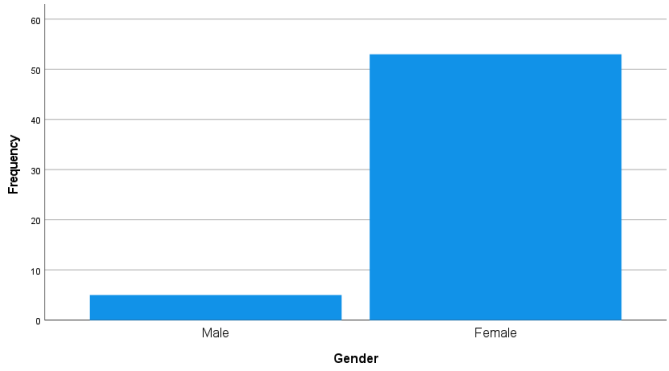

Table 3
Educational qualification based details

		Total	Percentage
	Graduate	23	39.7
	Master	10	17.2
	GCE AL	20	34.5
	Diploma	3	5.2
	Other	2	3.4
	Total	58	100.0

Figure 3
Educational qualification based details

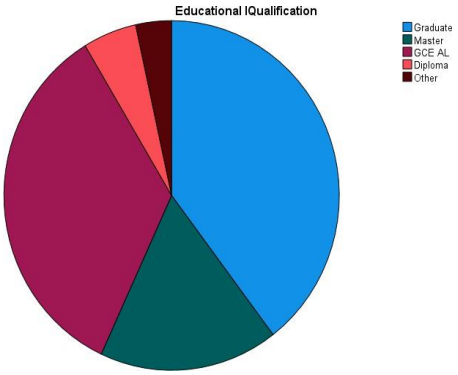

Table 4
Job Role based details

		Frequency	Percentage
	Teachers	54	93.1
	Volunteer	4	6.9
	Total	58	100.0

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Figure 4
Job Role based details

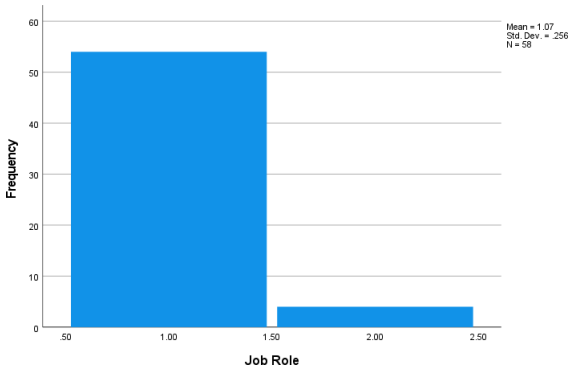
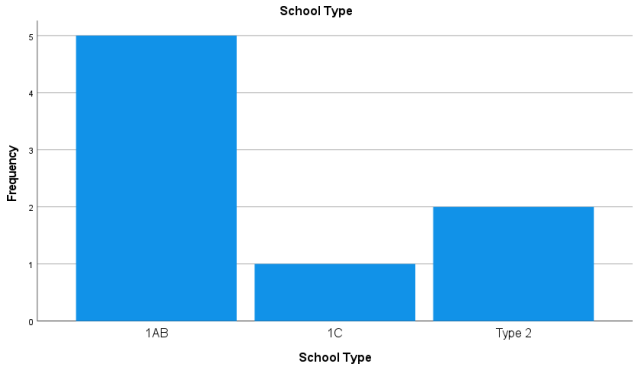


Table 5
School based details

		Frequency	Percentage
	1AB	5	62.5
	1C	1	12.5
	Type 2	2	25.0
	Total	8	100.0

Figure 5
School based details



Basic information about the principals
Table 6
Educational qualification based details

		Frequency	Percentage
	Master	1	20.0
	Graduate	3	60.0
	GCE AL	1	20.0
	Total	5	100.0

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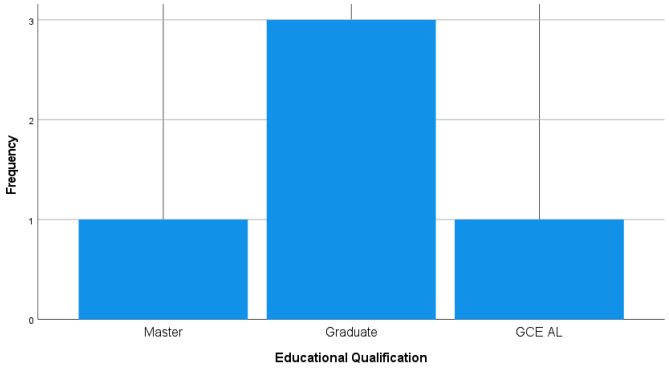
Figure 6
Educational qualification based details



Gender and Educational Qualification: The study shows a high female predominance. 91.4% (53) of the participating teachers were female. The contribution of male teachers is 8.6%. In terms of educational qualification, the majority of the teachers (39.7%) have completed a bachelor's degree (graduate). Furthermore, 93.1% are formally appointed teachers and the remaining 6.9% are volunteer teachers.

Five principals who participated in the interview, 60% are female and 40% are male. Of these, 60% are in the 41-50 age group and have graduate qualifications. In addition, 60% of the principals have 11-15 years of long-term experience. In terms of principal level, 40% are at the grade 2 and grade 3 levels each, and 20% are at the grade 1 level.

School Type: The majority of the teachers who participated in the study were from type 1AB schools (62.5%). This shows that the higher level schools are more represented in your study sample. The contribution of teachers from type 1C and type 2 schools was recorded as low at 4 teachers each.

Self-directed learning in science subject

Most of the respondents are well aware of the concept of self-directed learning (SDL). The standard deviation is less than (0.93804) indicating that there is a high level of consensus among the teachers.

The study also confirms that they are well aware of the need for self-regulated learning in science subject. The standard deviation is less than (0.86279) indicating that there is a high level of consensus among the teachers. Similarly, the data analysis confirms that self-regulated learning improves the critical thinking of the students. The standard deviation is less than (0.56970) indicating that there is a high level of consensus among the teachers. Furthermore, the data analysis data confirms that most of the respondents responded that self-regulated learning promotes the research capacity of the students. The standard deviation is less than (0.59337) indicating that there is a high consensus among the teachers. Finally, although the data analysis confirms that most of the respondents are well aware of the need for special training, the standard deviation is higher than (1.41175) indicating that there is a disparity in the consensus among the teachers.

Self-directed learning based on the quality of teachers

According to the results of the SD analysis conducted on the current status of self-regulated learning based on the quality of teachers, the obtained k-value is 0.818. The (p-value) or P-value for this is found to be .519. The value of .519 obtained is higher than the critical value of 0.05 (.519, 0.05) (Chapter Four, Table 4.16). This confirms that there is no statistically significant difference in the basic concepts of teacher quality regarding the current state of self-regulated learning.

Results of qualitative data

Self-regulated learning is an active process in which a student identifies his/her own learning needs, plans and manages them, and achieves goals. Based on these data, the importance of self-regulated learning can be divided into three main components. First, self-management and planning (self-management and planning); students decide for themselves when, how and what to learn.

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Second, independent learning without direct teacher intervention; This refers to students conducting research and developing learning strategies on their own without the direct support of teachers in schools. Third, achieving future goals; This learning method forms a foundation for students to act consciously and set goals to face future challenges. In short, it is clear from these data that the basis of self-regulated learning is for students to realize their abilities and gain the ability to make their own decisions.

Facilitating Role of Teachers

In the facilitating role of teachers, they guide students to set their own goals; They also said that this statement is only short. This shows that most of them consider this statement as positive. The standard deviation is less than (0.73046) indicating that there is a high level of consensus among teachers.

According to the SD statistical results, the value of F is 0.062, and its significance level (p-value or p-value) is .804. Statistically, since this p-value is greater than 0.05, it can be concluded that there is no statistically significant difference between the compared groups in terms of teacher gender and facilitation role (the difference is not significant).

Self-directed learning in science is mainly based on five themes. First, students are encouraged to explore and discover content related to the subject on their own. Second, through experimental learning in science subjects (innovative learning), students independently test the explanations they receive in the classroom, thereby developing their innovative and critical thinking. Third, it provides a platform for increasing students' innovation and creativity (innovative learning). Fourth, they get the opportunity to create new things with innovative thinking when they engage in hands-on experiments, field trips, and exhibitions.

Finally, when they learn practical life activities and practical matters, students develop a deeper understanding of the relationship between science and life.

Teachers' Informal Role

Most teachers supported the statement that they regularly attend trainings on new teaching methods regarding teachers' informal role, and most of them considered this statement positively. These data confirm that teachers are more interested in promoting students' independent learning.

The standard deviation is less than (0.65929) indicating that there is a high level of consensus among teachers. According to the SD statistical results, the F value is 0.466, and its significance level (p-value) is .708. Statistically, since this p-value is greater than 0.05 (Chapter Four, Table 4.18), there is a significant difference between the compared groups in terms of teacher; age and; It can be concluded that there is no statistically significant difference between the update role

Results of qualitative data

Various constructive projects have been undertaken to improve the teaching and learning process of the school. Mainly, under the theme of improving learning resources and infrastructure facilities, the use of smart boards, science laboratory facilities, library use and storage facilities have been ensured.

Secondly, with a view to teaching management and teacher development, steps have been taken such as appointing substitute teachers, implementing the handover system In addition, the guidelines for promoting students' self-learning and career guidance seminars conducted with their future in mind, etc., demonstrate the school's concern for student personality and self-development. Overall, these statistics indicate that all these goals are integrated through a systematic annual plan.

Suggestions and Comments

The statement that more use of technology tools is needed for suggestions and comments is answered equally by 20 people (34.5%) and not very much by 17 people (29.3%). However, approximately the same number of 18 teachers (31.0%) also emphasized the need for the use of technology tools. The standard deviation is less than (1.66428) (Chapter Four, Table 4.16) and from this, the need for the use of technology tools is emphasized through this study rather than the need for more use of technology tools. According to the results of the ANOVA statistics, the value of the F is 1.031, and its significance level (p-value or p-value) is .400. Statistically, since this p-value is greater than 0.05 (Chapter Four, Table 4.19), it can be concluded that there is no statistically significant difference between the compared groups in terms of teacher; educational

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qualification and; proposal to improve self-regulated learning.

Results of qualitative data

The study divides the challenges faced in implementing self-directed learning in schools into five main themes. First, the lack of teachers and resources is a major obstacle; in particular, teachers are not sufficiently knowledgeable about self-regulated learning and do not have the necessary learning tools. Second, the lack of student engagement, their dependence on teachers for learning, and their lack of interest in exploring new things on their own is a challenge. Third, the expectations and involvement of parents is a barrier. These include parents expecting teachers to teach all subjects and their limited involvement in students' learning activities. Fourth, time management and the examination-centered education system pose a barrier. The current education system, which emphasizes only marks, leaves students with little time to engage in research-based learning. Finally, the problem of information exchange and achieving learning goals is mentioned; the difficulties students have in sharing information among themselves prevent self-regulated learning from being fully successful.

The Results of the Study

Awareness of self-regulated learning There is a clear understanding of self-regulated learning among teachers. They unanimously believe that it will improve students' critical thinking Challenges and Suggestions for Improving Learning Teachers have realized that the use of technological tools is necessary. There is a strong demand for the improvement of smart boards, modern science laboratories and library facilities to encourage students' self-learning. The challenges include the lack of sufficient in-depth knowledge and equipment on self-regulated learning, the mentality of students who are always dependent on the teacher and lack of interest in self-learning, the old way of thinking of parents that teachers should teach everything, the problems in sharing learning-related information among students. And the lack of sufficient time for practical and research-based learning due to the examination-centered education system.

When we summarize the data obtained through this study, it can be said that 'self-regulated learning' is not a new thing among science teachers in the Beruwala Education Division. Most of the teachers deeply believe that this method will develop students' critical thinking and curiosity. However, the results of the study show that there is some reluctance to transform this into a practical strategy in the classroom rather than a theoretical one. Teachers are more inclined to see themselves as 'learning facilitators'rather than as 'information providers.

In particular, teachers are interested in helping students set learning goals and identifying the resources they need. However, there is still room for improvement in promoting students' independent decision-making. It has been confirmed that self-directed learning is not possible in the modern educational environment without the use of technological tools. Although teachers are trained in the use of digital resources, there is a gap in how they should be integrated with students' independent learning. According to the ANOVA analysis of the study, teachers' age, gender, or grade (level) did not significantly influence the implementation of self-directed learning. This gives a positive conclusion that teachers of all categories are ready to embrace this new change.

Discussion

This chapter Analyzes the findings of the study in relation to previous research and global educational philosophies.

Background of Teachers and Self Directed Learning

The study sample showed that 91.4% of female teachers are found, indicating a high female dominance in the general education sector in Sri Lanka. This is consistent with the findings of a study conducted by Sandika (2018) in Sri Lanka.

Furthermore, the high participation of experienced teachers (50%) in the 31-40 age group indicates that they have the maturity and experience required to implement self-directed learning in the classroom.

Awareness of Self-Regulated Learning

According to the results of the study, most teachers have a clear knowledge of self-regulated learning (SD 0.93804). As suggested by Knowles (1975)'s self-regulated learning theory, teachers have accepted that the basis for

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this is for students to identify their own learning needs.

The conclusion of this study that self-regulated learning in science subjects improves students' critical thinking is fully consistent with the study of Loyens et al. (2008) who confirmed that there is a positive relationship between self-regulated learning and students' higher-order thinking skills. However, the disagreement among teachers on the need for "special training" for this emphasizes the need for formal professional development training.

Relationship between Teacher Quality, Gender and Learning

The study found that there were no statistically significant differences between teacher quality (p .519), gender (p .804), and age (p .708) and learning implementation through the UNAU analysis. This result is in contrast to the findings of Pintrich (2000). Piwechai had stated in his study that teacher experience and quality can make a difference in learning facilitation (co-facilitation).

However, in the case of the Beruwala education system, this suggests that the school environment and resources, rather than teacher quality or gender, determine learning. This confirms the idea that self-regulated learning is more dependent on the learning environment than on the individual characteristics of the teacher, as suggested by Hiemstra (1994).

Facilitation and Innovation in Science Subjects

Teachers have confirmed that 'experiential learning' in science subjects stimulates students' creativity. This goes hand in hand with the experiential learning theory of Kolb (1984).

The desire of teachers to transform themselves from a 'teacher' to a 'facilitator' reflects the success of the student-centered learning approach of Rogers (1969).

Challenges and Barriers: A Global Comparison

According to the qualitative data (1), lack of resources, lack of time and examination-based education (1) are identified as major barriers. As Candy (1991) noted in her study, the idea that institutional structures (1) affect student autonomy (2) is also relevant to the field of education. The expectation of parents that the teacher should teach everything is a common cultural barrier in many Asian countries. This reflects the "High Power Distance" as stated in Hofstede (1986) theory of cultural dimensions; that is, students and parents expect knowledge from an authority figure (the teacher).

Need for Technology Tools

The finding that the use of technology tools is necessary (1.66428) confirms the idea that technology acts as a key enabler in the learning model of Garrison (1997). However, the reluctance or inconsistency in its use points to the need to improve digital literacy (Digital Literacy) among teachers.

In summary, although teachers in the tertiary education system accept the importance of self-directed learning in principle, in practice they face challenges due to resource constraints and the examination system.

This is a common educational problem found in developing countries worldwide. The consensus among teachers indicates that there is a readiness for a change in science education.

Recommendations

Based on the findings of the study, practical possible changes should be proposed here. This can be categorized into three levels:

Recommendations at the school level

Continuous professional development (CPD) for teachers is only a theoretical concept for teachers. Practical exercises should be organized on how to transform it into a practical strategy Recommendations for teachers include: To improve the facilitator role, teachers should reduce the direct teaching of the lesson in goal setting and train students on how to create learning goals for themselves. Students should be encouraged to ask the question, "What am I going to learn today?". Based on the use of the Scaffolding method, when students initially struggle to learn on their own, they should be provided with small amounts of help and then gradually reduce the teacher's intervention. In terms of introducing information sources, students should be trained on how to find reliable websites, scientific journals and videos, rather than relying solely on the textbook. Student-centered assessment should praise students' self-learning efforts and provide them with the opportunity to learn from their mistakes(Self-reflection).

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Recommendations For Policymakers

The current education system is focused only on examination marks. Instead, assessment methods should be changed to award marks for students' search and research skills. The excessive content of the science curriculum should be reduced and sufficient time should be allocated during the lesson for students to conduct independent experiments and read in depth.

As indicated by the results of the study, modern science laboratories and libraries with high-speed internet access should be ensured in every school. It is necessary to provide smart boards and e-learning resources

Suggestions For Parents and Community Organizations

Parent-Teacher Association Meetings: Awareness meetings should be held to change the old mindset of parents that "teachers should only teach". They should be made aware of the importance of parental support in encouraging students to search and learn independently at home.

In addition, parents should be encouraged to provide a quiet environment for students to study independently at home and provide internet facilities with supervision if necessary.

Limitations Of the Study

Various practical challenges had to be faced while conducting this study. In particular, the time allotted for data collection was very limited. Since the teachers were busy with their teaching and examination duties, it was difficult to collect the questions from them. Another limitation is the challenges in data collection. Some teachers may have responded with a social desirability bias rather than revealing their actual classroom barriers to 'self-directed learning'. In addition, since this study relied primarily on the questionnaire method, there was no opportunity to observe the actual classroom activities of the teachers. The inability to contact many schools due to financial and transportation constraints also limited the scope of the study.

This study focused only on science teachers in the Beruwala Education Division. Therefore, the results obtained here may not reflect the situation of teachers in other education divisions or provinces in Sri Lanka. Awareness and challenges regarding self-regulated learning are likely to vary in areas with different geographical and cultural backgrounds.

Furthermore, the study only included science teachers, which hinders generalizations about the attitudes and practices of teachers in other subjects.

Finally, this study is primarily based on self-report data obtained from teachers. Although the information provided by teachers about their classroom activities is positive, the extent to which they are used in the actual classroom environment could not be verified through direct observations (i.e., observations). Furthermore, the time frame was not sufficient to examine the direct effects of this method on student learning outcomes. Although these limitations limit the findings of the study, they provide valuable guidance for future research.

Suggestions for Future Research

This study focused on teachers. Future research could examine students' attitudes and readiness for self-directed learning. Furthermore, beyond science subjects, we can compare and study the impact of self-regulated learning in mathematics or language education. We can also train self-regulated learning for a specific period of time and study the changes in students' achievement levels over a long period of time.

To conclude, the findings from the Beruwala Education Division necessitate a strategic shift from theory-based professional development to a localized "SDL Integration Policy" that prioritizes practical teacher autonomy and resource equity. It is recommended that the Zonal Education Office move beyond traditional lecture-based instruction by implementing a mandatory Scaffolding & Digital Literacy Framework, where science curricula are streamlined to allow time for independent inquiry and marks are formally allocated for research-based competencies. For this transition to be sustainable, the province must bridge the digital divide by equipping rural Beruwala schools with high-speed internet and modern laboratories, while simultaneously launching community awareness programs to realign parental expectations with a student-centered, self-regulated learning model.

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