การสอนภาษาแบบเน้นภาระงานเพื่อการเขียนรายงานเชิงปฏิบัติการทางวิทยาศาสตร์สำหรับนักเรียนไทยระดับมัธยมศึกษาตอนปลาย

IMPLEMENTING TASK-BASED LANGUAGE TEACHING FOR SCIENTIFIC LABORATORY REPORT WRITING IN THAI HIGH SCHOOL STUDENTS

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หัวข้อวิทยานิพนธ์	การสอนภาษาแบบเน้นภาระงานเพื่อการเขียนเชิงปฏิบัติการทางวิทยาศาสตร์สำหรับนักเรียนไทยระดับมัธยมศึกษาตอนปลาย IMPLEMENTING TASK-BASED LANGUAGE TEACHING FOR SCIENTIFIC LABORATORY REPORT WRITING IN THAI HIGH SCHOOL STUDENTS
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บทคัดย่อ

การวิจัยครั้งนี้มีจุดประสงค์เพื่อ 1) ศึกษาผลการสอนภาษาแบบเน้นภาระงานเพื่อการเขียนเชิงปฏิบัติการทางวิทยาศาสตร์ 2) ศึกษาความคิดเห็นของนักเรียนที่มีต่อการสอนภาษาแบบเน้นภาระงานเพื่อการเขียนเชิงปฏิบัติการทางวิทยาศาสตร์ โดยใช้วิธีการวิจัยแบบผสมผสาน (Mixed Methods) กลุ่มตัวอย่าง คือ นักเรียนชั้นมัธยมศึกษาปีที่ 5 แผนการเรียนวิทยาศาสตร์และคณิตศาสตร์ โรงเรียนรัฐบาลแห่งหนึ่งในจังหวัดปทุมธานี จำนวน 35 คน ในภาคเรียนที่ 2 ปีการศึกษา 2566 โดยเลือกแบบเจาะจง เครื่องมือที่ใช้ในงานวิจัยได้แก่ 1) แผนการจัดการเรียนรู้การสอนภาษาแบบเน้นภาระงานเพื่อการเขียนเชิงปฏิบัติการทางวิทยาศาสตร์ จำนวน 8 แผน 18 ชั่วโมง 2) แบบทดสอบวัดความสามารถในการเขียนเชิงปฏิบัติการทางวิทยาศาสตร์ 3) เกณฑ์การประเมินความสามารถในการเขียนเชิงปฏิบัติการทางวิทยาศาสตร์ และ 4) แบบสัมภาษณ์ความคิดเห็นแบบกึ่งโครงสร้าง สถิติและการวิเคราะห์ข้อมูลที่ใช้ ได้แก่ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน การทดสอบค่าทีชนิดกลุ่มตัวอย่างไม่เป็นอิสระต่อกัน (*t*-test Dependent Group) และการวิเคราะห์เชิงเนื้อหา (Content Analysis)

ผลการวิจัยเชิงปริมาณพบว่าความสามารถในการเขียนรายงานการทดลองทางวิทยาศาสตร์ในรูปแบบภาษาอังกฤษเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติหลังจากได้รับการจัดการเรียนรู้ด้วยวิธีแบบเน้นภาระงาน โดยค่าเฉลี่ยคะแนนก่อนเรียน (M = 16.58, SD = 3.77) และหลังเรียน (M = 27.18, SD = 3.57) ซึ่งมีความแตกต่างกันอย่างมีนัยสำคัญที่ .001 ดั้งนั้น สมมติฐานทางเลือกจึงถูกยอมรับ และขนาดอิทธิพลของวิธีการสอนแบบเน้นภาระงานต่อคะแนนเฉลี่ยของนักเรียนอยู่ในระดับสูง โดยมีค่าอีตาสแควร์ (eta squared) เท่ากับ 0.81

ผลการวิจัยเชิงคุณภาพ พบว่านักเรียนส่วนใหญ่มีทัศนคติเชิงบวกต่อการจัดการเรียนรู้แบบเน้นภาระงาน ในการพัฒนาความสามารถในการเขียนรายงานการทดลองทางวิทยาศาสตร์ในรูปแบบภาษาอังกฤษ นักเรียนที่มีพัฒนาการระดับสูงและระดับปานกลางแสดงพัฒนาการที่ชัดเจน เนื่องจากการจัดการเรียนรู้แบบเน้นภาระงานมีขั้นตอนการเรียนรู้ที่มีรูปแบบที่ชัดเจน มีการให้ข้อเสนอแนะแบบสร้างสรรค์ และมีการเตรียมความพร้อมด้านคำศัพท์และไวยากรณ์ภาษาอังกฤษในวิทยาศาสตร์อย่างตรงจุด ส่วนนักเรียนที่มีพัฒนาการระดับต่ำ ได้รับการพัฒนาความสามารถในการเขียนรายงานการทดลองทางวิทยาศาสตร์ในรูปแบบภาษาอังกฤษเพิ่มเติมโดยอาศัยคำแนะนำจากผู้สอน การทำงานร่วมกันกับเพื่อนคนอื่นๆ และการท่องจำเพิ่มเติมเนื่องจากปัญหาเกี่ยวกับการใช้คำศัพท์ทางวิทยาศาสตร์ที่มีอยู่อย่างจำกัด ความซับซ้อนของการเขียนรายงานการทดลองทางวิทยาศาสตร์ในรูปแบบภาษาอังกฤษ และปริมาณงานที่ได้รับมากเกินไป อย่างไรก็ตามนักเรียนทุกระดับเห็นพ้องกันว่าการจัดการเรียนรู้แบบเน้นภาระงานมีส่วนช่วยในการพัฒนาส่งเสริมความสามารถในการเขียนรายงานการทดลองทางวิทยาศาสตร์ในรูปแบบภาษาอังกฤษ และสามารถนำไปใช้ต่อยอดในอนาคตได้

ดังนั้น ผลการวิจัยในครั้งนี้ เผยให้เห็นถึงความเป็นไปได้ของการจัดการเรียนรู้แบบเน้นภาระงาน ในการสนับสนุนการเรียนรู้ภาษาอังกฤษผ่านองค์ประกอบสำคัญ เช่น การจัดการเรียนรู้เชิงรุก แผนการจัดการเรียนรู้ที่มีคุณภาพ แบบการฝึกเขียนจากสถานการณ์จริงอย่างต่อเนื่อง การให้ข้อเสนอแนะแบบสร้างสรรค์ โครงสร้างการเรียนที่เอื้อต่อการสอนภาษา การสะท้อนเนื้อหาที่เรียน กิจกรรมที่ส่งเสริมความตระหนักรู้ในไวยากรณ์ภาษา และการอภิปรายและนำเสนองานเขียน องค์ประกอบเหล่านี้ช่วยพัฒนาความสามารถในการเขียนรายงานผลการทดลองเชิงวิทยาศาสตร์ในรูปแบบภาษาอังกฤษของนักเรียน ผลการวิจัยนี้ยังชี้ให้เห็นว่า การประยุกต์การสอนภาษาแบบเน้นภาระงานในการสอนภาษา สามารถช่วยพัฒนาความสามารถในการเขียนเชิงปฏิบัติการทางวิทยาศาสตร์เป็นภาษาอังกฤษได้อย่างมีประสิทธิภาพมากขึ้นโดยเฉพาะอย่างยิ่งเมื่อมีการผนวกการสอนภาษาแบบเน้นรูปร่วมด้วย และเมื่อประยุกต์ A focus-on-forms ในการสอนแบบเน้นภาระงานจะเพิ่มประสิทธิภาพในการส่งเสริมความเข้าใจการใช้ไวยากรณ์ภาษาอังกฤษต่อการเขียนรายงานปฏิบัติการทางวิทยาศาสตร์ได้เพิ่มมากขึ้น

Thesis Title	IMPLEMENTING TASK-BASED LANGUAGE TEACHING FOR SCIENTIFIC LABORATORY REPORT WRITING IN THAI HIGH SCHOOL STUDENTS
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Thesis Study Advisor	Assistant Professor Dr. Thapanee Khemanuwong

ABSTRACT

This study aimed to investigate the effectiveness of Task-Based Language Teaching (TBLT) on students' scientific laboratory report writing in English and explore their opinions on TBLT. A mixed-methods design was employed with 35 Grade 11 science–mathematics students from a government high school in Pathum Thani Province during the second semester of the 2023 academic year, selected through purposive sampling. The instruments utilized in this study included: (1) eight lesson plans for TBLT-based instruction, comprising 18 hours of teaching; (2) a test measuring scientific laboratory report writing ability; (3) a rubric for assessing students' writing performance; and (4) a semi-structured interview protocol to gather students' opinions. Data analysis involved descriptive statistics (mean and standard deviation), a dependent-sample *t*-test, and content analysis.

The quantitative results revealed that students' scientific laboratory report writing abilities significantly improved after the TBLT intervention, with a statistically significant increase from the pre-test (M = 16.58, SD = 3.77) to the post-test (M = 27.18, SD = 3.57, indicating a statistically significant difference at the .001 level. The results of inferential statistics, alternative hypothesis was acceptable. The effect size of the TBLT method on students' mean scores was a large effect size, with eta squared = 0.81.

The qualitative findings indicated that most students had positive perceptions of TBLT in developing scientific writing skills. High- and moderate-level students showed clear improvement, benefiting from structured instruction, feedback, and

preparation in scientific language. TBLT introduced effective strategies that supported their writing in English. Low-level students, while appreciating teacher guidance and collaboration, struggled with technical vocabulary, task complexity, and workload. Despite these challenges, students across all levels agreed that TBLT-based science writing tasks were useful and relevant to their future academic needs.

Thus, the findings of the present study shed light on the feasibility of TBLT's major supports in language learning, such as active learning phases, structured learning plans, frequent authentic writing practice, constructive recommendations, language scaffoldings, learning content reflections, linguistic structure awareness-raising (Focus on Forms) activities, and writing products' discussion and presentation. These supports were helpful to enhance the students' scientific writing ability in English. The findings of this study suggest that the TBLT in language teaching can assist students in their science writing, and notably, a focus on forms in TBLT can provide a greater comprehension of linguistic and textual features in the composition of laboratory reports.

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Sunai Singtong

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CHAPTER 1
INTRODUCTION

1.1 Background of the Study

Scientific literacy basically involves communicative abilities that enhance comprehension and explanation of scientific information and phenomena by using language as a means of communication (Stefani & Tsaparlis, 2009). It particularly, encompasses the ability to understand concepts in science and engage effectively in scientific writing. In the 21st century, science has a profound impact on the quality of personal lives, the environment, and the global economy. Similarly, the advance of modern technologies has facilitated the growth of knowledge, primarily grounded in scientific principles. Additionally, scientific advancements have served as the foundation for technological progress, providing a type of knowledge that is widely accessible to everyone. In schools, science contributes to the understanding of the surrounding environment as well as science knowledge in everyday life (Dragos & Mih, 2015). Given these developments, it is essential to encourage the students to familiarize with scientific concepts to foster structured knowledge and improve scientific literacy within the educational context.

Globally, scientific literacy is recognized as a key priority in education (Udompong & Wongwanich, 2014). Science education equips students to connect phenomena with scientific principles, pose questions, and construct explanations grounded in evidence—skills vital in an era of digital information and critical thinking (National Research Council, 2016). Bybee et al. (2009) further emphasize that scientific literacy supports informed decision-making, civic engagement, and economic participation. Therefore, understanding scientific laws and concepts is crucial for students to navigate various aspects of life effectively (Dragos & Mih, 2015).

In light of the significance of scientific literacy, particularly in writing, this study focuses on enhancing scientific writing in an English as a Foreign Language (EFL)

classroom. Scientific literacy in this context refers to students' ability to express scientific knowledge systematically through English writing. Integrating science process skills into learning activities helps students develop deeper understanding by actively constructing knowledge in working memory (Glynn & Muth, 1994). Writing tasks grounded in science content can activate prior knowledge and promote constructive learning, moving beyond memorization (Holliday et al., 1994; Keys, 1994). These approaches are increasingly relevant in 21st-century education.

To promote scientific literacy through writing, several educational policies have been implemented. In Thailand, science is a core subject taught from Grades 1 to 12. Students are encouraged to grasp scientific concepts as interconnected systems rather than isolated facts. Yuenyong and Narjaikaew (2009) highlight that Thailand's science education policy aims to foster scientific literacy and guide classroom practices. Students are expected to develop a solid understanding of complex concepts through classroom experiences (Glynn & Muth, 1994). These efforts align with Thailand's National Strategy (2018–2037), a long-term framework designed to develop citizens with scientific competence.

The National Strategy outlines six key goals, two of which enhancing national competitiveness and strengthening human capital emphasize scientific knowledge and English proficiency. The second strategy aims to prepare the population for future challenges by advancing science, technology, and digital systems. This goal underscores the importance of scientific knowledge in maintaining Thailand's global competitiveness. The third strategy focuses on developing high-quality individuals with strong communication skills, particularly in English, to foster logical thinking and 21st-century competencies. Hence, equipping students with both scientific knowledge and English skills supports national development and prepares them for academic and professional futures.

In summary, Thailand's National Strategy addresses current challenges in economic structure and workforce skills, highlighting scientific literacy and English proficiency as essential for competent citizenship. This perspective is reinforced by the Institute for the Promotion of Teaching Science and Technology (IPST), which has advocated since 2002 for scientific literacy in writing. These national and educational policies reflect Thailand's commitment to preparing students for global competitiveness. However, achieving scientific writing and linguistic competence

remains challenging for EFL Thai students due to language barriers and limited foundational knowledge, which may hinder their academic development.

1.1.1 EFL Students' Struggles with Writing

Writing is a fundamental skill in language development (Hyland, 2003), serving as an indicator of academic achievement and playing a crucial role in students' success in content-area learning (Qin, 2015). However, many EFL students struggle with constructing well-organized sentences, paragraphs, and essays due to limited comprehension and writing proficiency (Martínez et al., 2020). These challenges are compounded by various factors, including lack of interest and socio-attitudinal barriers (Ginting, 2023), as well as linguistic difficulties such as vocabulary limitations, pronunciation issues, and grammatical errors that hinder both oral and written expression (Aleb, 2017).

Moreover, insufficient exposure to authentic English materials is a significant obstacle for EFL students (Khamkhien, 2011), further limiting their ability to develop strong writing skills. Additionally, many students lack awareness of metacognitive writing strategies, which are essential for selecting relevant references, paraphrasing effectively, ensuring coherence and cohesion, and using language functions appropriately (Alnijres, 2018). As a result, deficiencies in background knowledge, practice, and motivation contribute to persistent struggles in English writing (Salima, 2012). Addressing these issues requires a comprehensive approach that fosters linguistic competence, writing strategy awareness, and greater engagement in English learning.

Concerning EFL learners' trouble with academic writing, Kongpetch (2006) and Demertriades (2002) both found that Thai students struggled with organizing ideas and using appropriate rhetorical style while also facing difficulties with grammar, vocabulary, and comprehension. Similarly, Laehnawang (2019) revealed that students lacked understanding of grammar, vocabulary, and correct structure, which is attributed to limited reading and writing practice. Sutinwong (2015) further noted problems with idea organization and tense consistency. Likewise, Fareed et al.(2016) stated that writing, as one of the four modalities in foreign language learning (listening, reading, speaking, and writing), can be a source of frustration and challenges for many EFL learners. Without appropriate feedback by teachers, these errors can be

discouraging for many EFL students (Hamp & Heasley, 2006). These scholarly insights showed the urgent needs amng EFL Thai students to improve and develop their writing abilities.

However, Hedge (1991) argued that the act of writing, by its very nature, may not provide enough intrinsic motivation for English learners to engage in consistent practice. Unlike speaking or listening, which often involve immediate interaction and real-world application, writing can feel solitary, abstract, and disconnected from immediate outcomes. Additionally, learners may perceive writing as challenging or even tedious due to its sustained effort, planning, and attention to detail. Without clear goals, engaging tasks, or external encouragement, learners may struggle to find the drive to practice writing regularly, especially in an EFL context where they may not naturally encounter opportunities to use the target language in meaningful ways.

In light of EFL Thai students' difficulties in English writing lessons, the stated major problems with language use and forms, linguistic features, writing patterns, and terminologies should be urgently alleviated. Therefore, fostering English writing and positive motivation toward a certain teaching methodology may improve students' understanding, knowledge, and critical thinking abilities. However, writing in English can be hard, especially in places where it is not the first language. This is due to the complexity of English writing often poses challenges for non-native speakers. For Thai high school students, these difficulties are further amplified by their struggles with grammar and writing conventions, which are critical components of effective communication. Previous research has shown that EFL students, especially Thais, do not get sufficient opportunities to practice the specific language skills needed for technical writing. This means that their proficiency is lacking in grammar or English as a whole. These challenges are highlighted in the next section, emphasizing the need to improve their ability to write accurately and effectively in English.

1.1.2 Difficulties and Challenges Faced by Thai High School Students in English Writing

Students in Thailand who were 15 years old took the PISA 2022 test, which focused on specific linguistic features and grammatical problems in English writing. The results showed what the school system did well and not so well, especially in science and writing, including English composition. This review analyzed existing research on

Thai students' performance in these key areas, focusing on insights from the PISA 2022 data.

Previous studies in Thai learning contexts indicated some difficulties in applying linguistic features, language use, as well as terminologies in English writing. Dang (2019) identified significant challenges, including a deficient vocabulary, limited grasp of grammar, and inadequate writing abilities. Noteworthy findings include grammatical errors concerning verb tenses, articles, and prepositions. Various factors, such as students' lack of enthusiasm for language teaching, may cause these problems. To address the problems, this study recommended the inclusion of explicit grammar instruction and metacognitive strategies in writing instruction. Yumanee (2016) noted on the significant learning factor that mistakes in using words together in English were affected by factors like transferring from one's first language, using words with similar meanings, and having weak skills in putting words together correctly. Furthermore, Nopmanotham (2016) highlighted that Thai student, particularly those at the secondary level, often struggle with writing due to a lack of experience and challenges related to grammar, vocabulary, generating ideas, sentence structure, and organizing their thoughts. In a similar way, Imsa-ard (2020) discovered that, even though students were eager to learn English, they felt that what they learnt in class did not match what they needed for everyday situations. In the 2011 writing assessment report, the proficiency level in writing among language learners was concerning, with only 1% of learners achieving the expected proficient level or higher, while a majority of 65% scored below the basic level (National Center for Education Statistics, 2011).

Previous studies have revealed that Thai EFL high school students' L2 writing lacked linguistic features or grammar, their comprehension of tense structures was low, and their word-choice length is inadequate. Additionally, Sundrarajun (2020) found that there is a high demand for effective ways to teach English writing in Thailand. These include giving students more chances to communicate in real English, making language learning more fun and relevant, and focusing on practical skills that improve students' ability to write clearly (OECD, 2021). These insights suggested that using suitable teaching methods can result in better English language learning achievement and foster innovative teaching strategies that engage students meaningfully, specifically in English writing. The findings indicate the need to foster scientific knowledge in writing literacy and English language forms and functions.

1.1.3 Difficulties in English Writing within Science Contexts

For many reasons, science writing has become popular among EFL learners in modern education. This includes the high demand for academic writing skills at the university level, the expanding use of the English language in professional careers, and the relevance of effective writing in industrial settings. Moreover, the significant expansion of the economy, technology, and all sorts of digital media platforms have greatly influenced Thai language learners. It implies that Thai students should possess digital literacy as well as knowledge of expressing ideas through writing. However, writing in English within scientific contexts presents challenges and difficulties for EFL students, as it requires not only a strong command of linguistic and grammatical structures but also the ability to use precise terminology, logical organization, and domain-specific conventions to communicate complex ideas effectively. These challenges were also recognized by the PISA 2022 assessment in Thailand, which highlighted those students struggled to understand both science and English writing, potentially leading to dissatisfaction with their learning outcomes. Additionally, the PISA 2022 assessment highlighted opportunities for enhancing writing literacy by emphasizing the need for a comprehensive review of writing instruction. This included increasing opportunities for practice, balancing the focus between writing mechanics and content, incorporating diverse genres, and equipping teachers with effective instructional strategies.

Science writing in English applies to a strong demand for academic language, which is a crucial skill for high school students, but many of them struggle to write due to various factors (Roxas, 2020). Science writing skills are necessary for EFL students to effectively articulate their ideas, aligning with their cognitive processes through the utilization of linguistic knowledge, such as organizing words, clauses, and sentences cohesively according to established syntactic principles (Hyland, 2003). There are several studies indicating that academic or technical writing has been recognized as a crucial skill for high school students. Research demonstrates that engaging in academic writing enhances high school students' comprehension of literature (Boscolo & Carotti, 2003). Furthermore, by implementing a model that specifically targets their challenges, their proficiency in academic writing can be further developed (Roxas, 2020). Cook and Bennett (2014) found that writing interventions, such as Self-Regulated Strategy

Development (SRSD), can improve written expression in students with disabilities. These results showed that English writing with scientific content enabled the students to use strong structures and patterns, such as specific linguistic forms and functions. Using these elements in writing is helpful for students to improve their English writing skills and critical thinking through science writing content.

At many universities in Thailand, Khamkhien and Kanoksilapatham (2020) reported that science students must carry out scientific studies or experiments and present their findings through research papers or, at minimum, abstracts written in English. However, the lack of structured academic writing courses or explicit guidance on scientific and abstract writing poses a significant challenge for most students, as each section of the scientific laboratory report necessitates specific movements, language use, and technical terminologies to ensure meaningful writing. Along the same lines, a previous study on science writing in English revealed difficulties that Thai students have faced. Nuntasane (2020) identified that the development of scientific writing in grade eight students in a Thai government school conclusively showed that approximately 33 percent of the population struggled and urgently needed to improve scientific writing skills.

In summary, the difficulty of writing science-related tasks in English for Thai students spans from high school through university levels due to several interconnected challenges. First, English is not the first language for most Thai students, making academic English writing, particularly in specialized fields like science, even more complex. Furthermore, the lack of proficiency in essential linguistic components such as grammar, syntax, and vocabulary specific to scientific discourse exacerbates this issue. Therefore, Thai high school students should be encouraged to practice their writing in English, specifically in the science field; this could improve the ability to express the information through writing meaningfully and critically. In this regard, Hohenshell (2006) and Simon (2016) noted that writing-to-learn strategies and popular science writing can increase science literacy among the students. Therefore, high school students require systematic and authentic teaching instruction to enhance their scientific writing skills.

1.1.4 Students Enrolled in Science and Mathematics Programs within the Context of the Study: English Writing Challenges in a Science Context

Many science and mathematics programs in Thailand prioritize the development of students' critical thinking, theoretical knowledge, and inquiry-based learning, leading to high academic achievement in these subjects compared to other programs (NIER, 2018). Moreover, the curriculum in high school often emphasizes theoretical knowledge over practical application and real-world problem-solving, limiting students' opportunities in these areas (NIER, 2018). Consequently, the treatment of English as a secondary subject often results in a lack of emphasis on developing proficiency, especially in academic or scientific writing. Similarly, teachers also faced significant challenges in effectively conveying teaching content to the students when English is their second or foreign language (Raja & Selvi, 2011).

The core features of the science and mathematics program aim at encouraging the students to mainly master subjects' matter in scientific and mathematical fields and preparing the students to become literate in science and math. Specifically, students enrolled in the science and mathematics program primarily study science subjects using English as the medium of instruction. Scholars argued that EFL students find it challenging to learn subjects such as chemistry, physics, and biology in a foreign language because they need to comprehend a wide range of specific vocabulary, various concepts, and communicate them through specific writing, speaking, and presenting. Royle and Chaturongakul (2015) noted that the students of English as a second language in the field of science experienced difficulties with science-related content (Björklund et al., 2006). Phonlabutra, (2007) and Oliver (2017) also echoed the need for improved scientific terminology and subject comprehension.

Such problems coexist in this study, in which students registered for the Science and Mathematics program exhibited difficulties in constructing laboratory report writing in English. The students were taught using English as the medium of instruction. They were assigned to conduct laboratory experiments in science, such as physics, biology, and chemistry, and were required to write an English report of the experimental results. Through observations and interviews with foreign science teachers and students, it's evident that many students struggle not only with speaking, but also with formulating

ideas in writing. Specifically, they find difficulty with tenses, subject-verb agreement, and effective use of transition words. Notably, all foreign science teachers echoed their feedback that they had limited time to teach them how to write scientific laboratory reports systematically and grammatically after conducting experiments. Likewise, previous English teachers noted that most students in a science and mathematics program had difficulties with their English writing skills, including a lack of ability to appropriate grammatical structures.

Trying to determine how hard it was for students to write in English about science, Kruawong and Phoocharoensil (2024) found that science textbooks had a large number of technical terms, making things even harder for both elementary and secondary school students. These challenges highlighted the need for specific strategies to support the students' comprehension of terminologies and scientific language use to improve science writing ability.

The practical goal is to address these challenges and enhance students' scientific knowledge through lab report writing in English, targeting their linguistic forms and use, genre conventions, tense usage, and vocabulary. This goal also intends to ensure comprehensive and sustainable improvements in students' performance in laboratory report writing, thereby increasing their scientific literacy and preparing them for higher education in science fields. Due to the fact that science writing lessons were delivered in English, this study was recognized as the content and language integrated learning (CLIL) that this study was a content-based teaching. To successfully implement it, it was also essential to cooperate with science teachers to ensure the qualities in terms of learning contents, learning assessment, and learning activities. CLIL was used in this study as an extra way to get help from science teachers on how to plan learning topics and content for science writing in English language classrooms. In addition, the CLIL approach was used as a form of immersion education, collaborating with foreign science teachers and integrating scientific content to enhance opportunities for students to develop their writing skills within a scientific context. This approach seems to be helpful in designing suitable learning content and topics. Accordingly, the application of CLIL in the Thai educational context is significant as it focuses on enhancing learners' four metalinguistic skills while also boosting their motivation to engage in interactive learning activities (Khamkhien & Kanoksilapatham 2020). Building on the strengths of CLIL, the implementation of task-based language teaching (TBLT)

further advanced the objectives of this study by offering a more focused framework for enhancing English writing skills within science education. It is imperative to introduce an effective teaching method for writing English within the framework of science education, and TBLT was revealed to be effective and productive in enhancing Thai high school students' science writing in English in this study. It could provide the students with opportunities to develop their writing skills through authentic tasks and to foster both students writing and communication skills in language teaching classrooms. Previous research has shown that TBLT can significantly improve students' writing ability and promote active learning sessions. With a focus on forms intervention in TBLT, the students were encouraged to familiarize themselves with specific linguistic features in writing scientific laboratory reports in English, leading to a wider understanding of scientific knowledge (Hawkes, 2012). In light of the numerous benefits of TBLT in fostering active learning and real-world application in language classrooms, this study implemented TBLT as a strategy to enhance students' scientific writing abilities. The approach focusses on engaging students in meaningful tasks that align with authentic scientific contexts, providing opportunities for them to effectively develop both their writing abilities and content-related skills.

1.1.5 Task-Based Language Teaching (TBLT)

TBLT is a framework that is utilized as a teaching methodology for acquiring a second language or foreign language. Task-based instruction (TBI), also referred to as TBLT, is a contemporary method commonly employed in teaching English as a foreign or second language (Durongbhandhu & Suwanasilp, 2023). This approach theoretically focuses on meaning-based and communicative tasks at the heart of the teaching procedure in the classroom (Van den Branden et al., 2009). Many scholars have proposed teaching methodological frameworks to design task-based instruction. Skehan (1996) and Willis (1996) proposed a TBLT teaching framework that consists of three phases: pre-task, during-task, and post-task. Van de Gucht (2015) defined pre-task as the stage of a teacher's exploring the topic with learners, breaking down essential words or sentences, and simplifying the instructions. Van de Gucht (2015) stated that the during-task is where the students perform the tasks as the way to acquire a target language. Willis (1996) noted that post-task is the final learning stage, where the learners reflected and repeated the task performance. Importantly,

feedback and guidance from the teachers are provided to support the learners in refining their English skills throughout the three active learning sessions.

Apart from TBLT's positive effects in language learning, this approach can foster positive motivation among the students in each learning stage. Nunan (2004) stated that TBLT contains a strong emphasis on encouraging students to interact with one another in the learning process, and the students are given authentic texts in the classroom, which could encourage students to pay attention to both language acquisition and the learning process. In this regard, the students could learn and experience the authentic learning resources. Similarly, Ahmed and Bidin (2016) explained that the TBLT method contains positive effects to enhance the writing skills of EFT students as well as improve in accuracy and fluency of writing products. Kalifour et al. (2018) also noted that applying TBLT to analytic writing in EFL classrooms resulted in a positive development of writing, hence promoting student-centeredness. These insights from applying TBLT in language teaching, particularly in writing lessons, can boost positive motivation for language learning.

Numerous studies supported the TBLT approach based on its potential to improve students' writing capacity. Ellis (2003) emphasized that the TBLT approach, when taught to students, can lead to improved writing outcomes. These improvements were evident in terms of fluency, accuracy, complexity, and overall engagement, compared to students who received instruction through traditional teaching approaches. This underscores the effectiveness of TBLT in fostering advanced writing competencies. According to Willis (1996) and Nunan (2004), TBLT is effective at helping students develop critical thinking and problem-solving skills, as well as in encouraging them to work together to learn, which improves their ability to understand what they are writing and remember it. Here is a detailed presentation of these benefits:

1. Fluency and Complexity: TBLT's learning sessions can enhance the students' fluency and simplify the lessons' complexity. Abrams (2019) observed that the integration of writing tasks in TBLT resulted in improvements in students' writing performance and the quality of their written texts. These improvements were the results of important learning factors of TBLT, such as focusing on meaning and teachers' support, which simplified the lessons. Warschauer and Healey's (1998) study demonstrated that the students who participated in TBLT activities finally exhibited positive effects in communication ability or fluency. In addition, the degree of lessons'

complexity in their writing was simplified so that they could gain a better understanding of the taught lessons when compared to traditional instructional methods. These collective findings demonstrate the potential of TBLT to enhance students' writing skills by promoting fluency and linguistic complexity during the language learning process.

2. Writing Accuracy: Apart from improving fluency, TBLT can also enhance writing accuracy or grammar accuracy in writing lessons, as evidenced by the studies of Doughty (2001) and Ellis and Shintani (2014). Their studies provided evidence for students' increased accuracy in writing, indicating a positive grammatical improvement over time. It was suggested that TBLT has the potential to enhance both accuracy in writing and understanding of grammatical knowledge because of the constructive feedback and instructional scaffolding provided throughout the learning process.

3. Motivation and Engagement: TBLT is an effective teaching framework that can additionally provide positive motivation and learning engagement in completing the assigned task. Kim (2015) and Van den Branden (2016) noted that the assigned task in TBLT in a language classroom offered myriad learning opportunities for students to engage in the target language. Along the same line, Dörnyei and Ushioda (1999) affirmed that the students exhibited greater engagement and motivation when they were in TBLT learning contexts compared to traditional grammar teaching methods. Moreover, TBLT has the potential to heighten learning engagement and enhance the learning experience, thereby enabling students to gain a deeper understanding of English writing. These findings revealed the TBLT's potential to foster positive motivation and engagement in language learning contexts.

4. Collaborative Learning and Critical Thinking: Tasks used in TBLT are an essential aspect of each learning stage, fostering teamwork and promoting critical thinking among students. As Willis and Willis (2007) noted, one of the key benefits of TBLT is to concentrate on using authentic language to ensure that students can receive real-world knowledge. Additionally, when the students complete the assigned tasks in the class, they are frequently encouraged to use language forms rather than focusing on a single form, and they are encouraged to reflect on their writing performance and its mistakes, which can enhance a more comprehensive understanding of language structure. Lee (2002) also pointed out that TBLT frequently assigned the students to work on their tasks collaboratively as problem-solving activities. This means that the

TBLT approach could meet the diverse needs of students by encouraging them to actively participate in each learning phase. Therefore, collaborative activities and critical thinking reflection sessions in the TBLT approach could contribute to the development of students' language abilities and cognitive skills.

5. Positive Effects on English Writing Capacity: TBLT has been used widely among English language teachers, being recognized as an effective teaching technique to foster the students' English writing. Tardy (2012) noted that tasks could be designed to draw the students' attention to the structural features of various genres, leading to the development of formal, genre-specific knowledge. Consistently, Larsen-Freeman (2006) stated that task repetition is an important aspect in TBLT which can foster writing ability. The task repetition is a form of task planning, where the students are encouraged to revisit and refine their outputs through repeated engagement with similar or identical tasks. In these regards, it is suggested that TBLT enhances writing as students are given opportunities to repeat the task and pay attention to linguistic features during its completion phase.

The benefits of TBLT above highlight its role as a pivotal approach for enhancing the students' English writing skills. Key features such as fluency, accuracy, motivation, collaboration, critical thinking, and positive effects for writing underscore TBLT's effectiveness in fostering language learning. By integrating these positive components, TBLT not only equips students with the necessary skills for scientific lab report writing but also cultivates a positive attitude toward English language acquisition. As a result, TBLT is a productive and impactful methodology for empowering students in their writing knowledge and linguistic use and forms.

1.1.6 Implementing TBLT with a Focus on Forms to Improve Thai School English Writing Skills

Based on the advantages of TBLT outlined above, it is strongly recommended as an effective teaching approach that can enhance students' writing skills by fostering engagement, encouraging communicative activities, and integrating form with meaning. Ellis (2003) further stated that a focus on forms intervention in TBLT could construct highly positive effects in writing accuracy, leading to a better comprehension of writing knowledge. In addition, integrating a focus on forms into TBLT in writing lessons could be applied in a during-task and post-task phase as the students are encouraged to pay

attention to the grammar forms and specific language use. Fang (2012) pointed out that employing the TBLT, coupled with a focus on forms in teaching English writing, could contribute to the students' language use, vocabulary acquisition, and knowledge retention. Similarly, Chanwaiwit (2017) also mentioned that the use of a focus on forms in TBLT for translation tasks was useful as it could improve grammar knowledge and accuracy. It is reasonable to assert that focusing on forms is an effective intervention that synergizes with TBLT to show how to combine learning content and language forms to improve students' writing skills.

However, there are not many real-world studies that examined how well TBLT works with a focus on forms when it comes to writing scientific laboratory reports for EFL Thai high school students in Thai high school classrooms. Although English is widely used as a medium of instruction in these settings, limited research has been conducted on how TBLT can address the unique challenges faced by students, particularly in enhancing linguistic accuracy and developing the scientific writing skills essential for academic success. This gap needed to be investigated more in order to give evidence-based information about how TBLT can be used in Thai lessons for writing scientific lab reports. Moreover, the anticipated outcome of this study is to gain a better understanding of the effect of TBLT with a focus on forms. In science writing classes where students are learning English, the results could help us understand how well TBLT with a focus on forms works in those classes. Moreover, this study could make a significant contribution towards enhancing scientific laboratory report writing ability, which could offer insights for English teachers and science teachers who were with the aim of promoting science writing in English.

1.2 Research Objectives

The research objectives for this study are as follows:

1. To investigate the effects of task-based language teaching (TBLT) on high school students' performance in scientific laboratory report writing in English.
2. To explore high school students' opinions of task-based language teaching (TBLT) for high school students' scientific laboratory report writing in English.

1.3 Research Questions

This study is aimed at answering the following questions:

1. To what extent does task-based language teaching (TBLT) improve high school students' performance in scientific laboratory report writing in English?
2. What are the high school students' opinions on task-based language teaching (TBLT) for scientific laboratory report writing in English?

1.4 Hypotheses of the Study

The hypotheses of this study are as follows:

1. H^0: There is no statistically significant difference in pretest and posttest mean scores on scientific laboratory report writing among high school students after the implementation of Task-Based Language Teaching (TBLT).
2. H^1: There is a statistically significant difference in pretest and posttest mean scores on scientific laboratory report writing among high school students after the implementation of Task-Based Language Teaching (TBLT).

1.5 Scope of the Study

The goal of the mixed-method within pre-experimental research, specifically using a one-group pretest and posttest design was to find out how well TBLT helped Thai high school students to write scientific laboratory reports. This study narrowed down the learning area to English for scientific laboratory report writing, with a focus on writing ability in English. TBLT was a teaching intervention that was viewed through the lens of Willis (1996) and Ellis (2003), with a particular emphasis on forms intervention during the during-task and post-task phases (Ellis, 2003). The participants of this study were purposively selected from a tactic section, which included 35 Thai high school students registered in the science and mathematics program.

The participants were required to do a pre- writing test and a post-writing test before and after they were given the treatment to investigate the effectiveness of TBLT for scientific laboratory reports writing performance. Their previous laboratory

experimental results and findings from science classes were applied to construct the pre-writing test and post-writing test, including the teaching contents. To enhance reliability, three independent raters evaluated the students' pre- writing test, and a post-writing test ensure objectivity and consistency in scoring. In exploring the students' opinions concerning the treatment, the participants were asked to join a semi-structured interview at the final phase of the study.

The study's duration was approximately nine weeks with eight learning lessons, and each lesson was a 2-hour session. Eight lesson plans were designed under the functions of TBLT with a focus on forms, which aimed to provide the students with constructive learning experiences and essential learning topics such as rhetorical patterns in constructing lab reports, language use in a scientific context, essential vocabulary and language style in scientific report composition, and particularly linguistic features or grammatical usage in scientific writing. The researcher, as an English language teacher, delivered these learning topics through English communication.

1.6 Delimitations

This study solely attempted to investigate the effectiveness of TBLT in Thai high school students' performance in scientific laboratory report writing and explore their opinions concerning the teaching approach. It did not aim to evaluate speaking, reading, or listening skills. Rather, it focused on assessing the scientific laboratory report writing performance of Thai high school students in English through a pre-writing test and a post-writing test. This study was implemented in a single school context in the second semester of the academic year 2023, approximately from 1st January to the end of February 2024. The scoring components of scientific laboratory reports in this study consisted of two main elements of assessment: the organization of the rhetorical moves and the linguistic features. The tasks and activities used in this research were related to writing patterns and language use in science contexts. The scores obtained during the research, such as pre-test and post-test results, were solely for research purposes and would not contribute to the students' official grades. This research utilized a purposive sampling method recruiting through specific criterion with only

one group of students in science and mathematics program. Therefore, the findings of this research cannot be generalized to all high school science students' writing performance in scientific laboratory reports in other public schools in Thailand and globally.

1.7 Significance of the Study

The primary objective of this research was to enhance the scientific laboratory writing ability in Thai high school students in English subject context, applying teaching framework of TBLT coupled with a focus on forms intervention. The findings of this study can shed light on the potential of TBLT to enhance scientific laboratory writing performance in English, leading to an improvement in scientific literacy in writing among Thai high school students. Adding TBLT with a focus on language features was also important for improving scientific experimental writing and learning more about language features, such as becoming more aware of rhetorical moves, language style, and vocabulary in writing scientific laboratory reports.

Another goal that was planned was to make the research methods clearer when it came to the TBLT learning method, with a focus on templates for writing English reports of scientific experiments. This study specifically concentrated on Thai students who used English as a foreign language (EFL) and whose English proficiency levels may differ. The course incorporated the fundamental aspects of language use in scientific experimental report writing, as well as the critical role of grammatical functions in science writing. This can shed light on the use of TBLT to assist students in enhancing their comprehension of linguistic features and applying it to science writing tasks. Importantly, this study aligned with the policies of the learning program, the program's curriculum, and the visions of the school. In these regards, the results of this study could contribute to fulfilling the objectives stated by the school and the policies of the Ministry of Education of Thailand (MOE), including the goals of the National Science and Technology Development Agency (NSTDA). The primary focus of these policies is to enhance knowledge management in the fields of science, mathematics, and technology.

1.8 Definition of Terms

Key terms employed in this study are defined as follows:

1. Task-Based Language Teaching (TBLT)

It is an instructional approach that pertains to both language teaching (LT) and second language teaching and learning. It is centered around the utilization of tasks as the central unit for planning and instruction in language teaching. The primary emphasis is on the learners actively engaging in tasks and serving as the means to accomplish the task objectives. The TBLT instruction utilized in this study was adopted from the works of Willis (1996) and Ellis (2003). It encompassed three primary stages: pre-task, during-task, and post-task. These learning stages aim to enhance the students' performance in writing scientific laboratory reports, encompassing science literacy.

2. A Focus on Forms

Ellis's (2003) focus on forms was instructional procedures used as a clear way to teach grammar in TBLT. The goal is to help students understand certain linguistic features better and get them to use what they have learnt in certain writing tasks. This approach emphasizes the importance of grammatical forms, lexical items, tenses, sentence patterns, and word choices in the teaching and learning of a language. The approach also involves directing the students' attention to the forms and functions of language and the rules of language. In explicit teaching of forms in this study, the researcher followed Parkinson's (2017) study as it can foster students' grammar knowledge and essential terminologies in the during-task phase. As a result, the students were able to handle the science writing assignments by using language skills like sentence structure, tenses, subject-verb agreement, linkages, scientific vocabularies, and rhetorical moves and patterns.

3. Scientific Laboratory Report Genre

In English for Specific Purposes (ESP) writing, the term "genre" pertains to the identifiable and recurring patterns of structure, style, and content observed in written communication within a particular field or profession. Moves are 'semantic and specific patterns of texts that contain a specific language discipline (Biber, Connor, & Upton, 2007). It requires specific elements of ESP writing as follows:

1. **Communicative Function**: Each genre fulfils a distinct purpose within its respective field, whether it involves reporting, persuading, instructing, or other communicative functions.
2. **Structure:** Genres exhibit unique and identifiable structures, featuring distinct sections that serve specific functions within the overall composition.
3. **Style:** Specific language features and stylistic choices characterize each genre. This includes considerations such as formality, tone, and the level of expertise conveyed through language.
4. **Content:** Genres are distinguished by their focus on particular types of information, employing specialized terms and concepts that are relevant to the specific field or context.
5. **Rhetorical Pattern or Moves:** Each genre adheres to accepted rules and expectations concerning how arguments are organized, evidence is presented, and the overall text is structured, reflecting the rhetorical conventions inherent in that genre.

By mastering genre conventions, high school students develop the ability to communicate effectively and contribute to the discourse for scientific laboratory report writing. Parkinson (2017) introduced the general genre of movements in laboratory report composition. Key features of the scientific laboratory report genre in this study are that a scientific report should possess the following sections: abstract, introduction, methods and materials, results, discussion, and conclusion. Comprehending the features and conventions of the scientific laboratory report genre is crucial for researchers and students, as it enables them to enhance the clarity, coherence, and effectiveness of their writing. This proficiency not only improves communication within the scientific community but also ensures the precise dissemination of research findings, thereby contributing to the advancement of scientific knowledge and scientific literacy in the writing of high school students.

4. Scientific Literacy in Writing

Scientific writing refers to the capacity to convey scientific ideas and concepts proficiently through written means. This skill set encompasses a broad spectrum of abilities and knowledge, including understanding scientific concepts, processing scientific information, applying scientific thinking, and communicating scientifically. Chamberlin (2012) defined scientific literacy in writing as the ability to understand and

critically analyze scientific texts, as well as to effectively communicate scientific ideas. These skills are expected to develop among high school students who registered in a science and mathematics program by utilizing TBLT instruction with a focus on forms in scientific laboratory report lessons. In the present study, the students were required to write the scientific laboratory reports in English through the use of TBLT teaching approach, as it aimed to foster scientific literacy in writing. In addition, the students were tasked to complete scientific reports tasks and familiarize with language use and forms in an English classroom through the lens of TBLT with a focus on forms intervention.

5. English as a Foreign Language Students (EFL)

The term EFL students typically refers to high school students who acquire English language skills in a country where English is not the official language. In this study, the EFL students were a group of 35 Grade 11 high school students enrolled in a science and mathematics program at a public school in Pathum Thani province, Thailand. These students had limited experience with writing scientific texts in English, as most of their prior exposure to English focused on general language skills rather than subject-specific writing. Before the intervention, their scientific writing literacy in English had not been formally developed or assessed. To address this gap, the study incorporated a pre-test and post-test design to measure students' science writing literacy before and after the implementation of the TBLT approach with a focus on forms. This allowed the researcher to evaluate the students' progress and the effectiveness of the instructional intervention.

1.9 Chapter Summary

Chapter one discusses the objectives of this study, which are to investigate the effectiveness of TBLT and explore the students' opinions concerning the treatment in improving the scientific laboratory report in English. This chapter also provides an overview of the research background, including an introduction; a look at students in science and math programs and the problems they face with writing in English; a discussion of Thai high school students' writing and grammar problems; and an exploration of English as a foreign language (EFL) students' problems with writing in

English, including how CILL can be used to teach scientific concepts in an English-language setting.

In addition, this chapter presents a brief elaboration of TBLT incorporated with a focus on forms and previous studies related to utilizing TBLT with a focus on form to improve the students' writing skills. Furthermore, this chapter outlines the research objectives, questions, and hypothesis, as well as the scope, limitations, delimitations, definitions of terms, and significance of the study. Overall, this chapter aims to provide an understanding of the use of TBLT for scientific laboratory report writing and its potential to improve the writing proficiency of high school students in science and mathematics programs.

CHAPTER 2
LITERATURE REVIEW

This chapter reviews literature related to task-based language teaching (TBLT) for scientific laboratory report writing among high school students and presents theoretical background of TBLT, benefits of TBLT, the power of a focus on forms intervention, the CLILL to facilitate science content in the English language context, scientific writing in English, and the understanding of how TBLT improves the student's scientific laboratory report writing.

2.1 Task-Based Language Teaching (TBLT)

The growth of using tasks in second language acquisition (SLA) and language teaching was widely found in the communicative language teaching (CLT) context around the 1970s and 1980s, and TBLT cooperated insights from early SLA research. This development prompted a reevaluation of the structural approach to language teaching, which traditionally involves breaking down a language into discrete parts and teaching them sequentially (Ellis, Skehan, Li, Shintani, & Lambert, 2019).

TBLT was a pedagogical approach that emphasizes the application of authentic language use to accomplish meaningful tasks. It draws on principles of second language acquisition and has been extensively discussed and developed by scholars such as Prabhu (1987), Willis (1996), Nunan (1989; 2004), and Van den Branden (2006). According to Nunan (2004), the concept of tasks has become fundamental in syllabus design, classroom instruction, and learner assessment, shaping educational policy in both ESL and EFL contexts.

The essence of TBLT lied in providing the students with opportunities for authentic communication and meaningful language use. Pedagogical tasks, as defined by Ellis (2003), involved learners in analyzing language pragmatically to produce output that demonstrates comprehension and appropriate language use. This aligned with the

principles of constructivism, which prioritize active engagement and personal involvement in the learning process (Wang, 2011).

Myriad studies revealed that TBLT instruction provides the students' opportunities for language use and communicative activities (Jeon & Hahn, 2006). Furthermore, TBLT assessment is considered integral to TBLT, providing learners with feedback and evaluation to support their language development (Norris, 2009; Van den Branden, 2006). TBLT also prioritizes the understanding of language meanings through communicative tasks. It encourages the students to exercise their strategies to tackle challenges and collaborate with peers to accomplish the task (Ellis, 2003). Crucially, TBLT aims to help learners comprehend language meaning, enabling them to address real-world tasks effectively. In promoting linguistic features or grammar, TBLT combines its emphasis on meaning with the traditional focus on language forms. This approach seeks to prevent learners from developing fluency and complexity at the cost of accuracy (Yi Ji & Thanh Pham, 2020). Considering the advantages of TBLT in encouraging the students' communicative ability and language forms competence in language acquisition, there are still some limitations which the teachers should be aware of.

Some scholars echoed that TBLT might have some problems in cultural settings, like Thailand, even though it works well to improve communicative language skills and linguistic features competency. In Thai culture, which values collectivism and deference to authority, there might be a perceived conflict with the autonomy and independence emphasized in TBLT (Brown, 2007). Additionally, Rahimpour (2008) suggested that while TBLT fosters fluency and complexity, it might be less effective in promoting linguistic features compared to structural-based language teaching. Moreover, concerns were raised about the increased workload for teachers in implementing TBLT, as it requires planning authentic tasks and providing personalized feedback (Mcallister et al., 2012). TBLT supporters, on the other hand, said that culturally sensitive tasks, collaborative learning strategies, and scaffolded support could help students adapt well (Harmer, 2007). Teacher training programs are also crucial for equipping educators with the necessary skills to implement TBLT effectively (Richard, 2008).

Despite these challenges elaborated above, the benefits of TBLT seemed to be prominent, and the reviewed literature suggested that TBLT could be successfully

implemented in the language classroom with careful adaptation and teacher training. The researcher was advised to meticulously explore effective implementation strategies, evaluate their impact on diverse learners, and develop context-specific materials to support the integration of TBLT in Thai high school students.

2.2.1 Theoretical Background of Task-Based Language Teaching (TBLT)

Prabhu (1987), the first scholar of TBLT, introduced the concept of task-based language teaching to educators and researchers in the 1970s. Doughty and Long (2003) describe TBLT as a language teaching theory that incorporates effective teaching components derived from SLA theories and insights from the fields of education and psychology. Two influential SLA theories that inform TBLT were the interactional perspective and the sociocultural perspective, as discussed by Ellis (2009). TBLT was an approach that extended the characteristics of Communicative Language Teaching (CLT) and was embraced by its proponents to incorporate principles of second language acquisition (SLA) into instructional practices. It is considered an innovative approach that has evolved and connected with CLT.

East (2012) categorized CLT into two types: weak CLT and strong CLT. Weak CLT prioritizes grammar instruction in a teacher-led manner, often limiting fluency development. It focuses on accuracy, sometimes restricting spontaneous language use. In contrast, strong CLT emphasizes fluency through natural communication, with minimal grammar instruction, leaving learners to infer rules, which can lead to frequent grammatical errors. East (2021) concluded that strong CLT closely resembles fluency over accuracy, contrasting with weak form, which focuses on language forms over communication aspects.

Interestingly, East (2012) provided notable differences between the two approaches, stating that TBLT is a natural progression from the CLT approach, aiming to resolve some of its notable shortcomings. It strikes a balance between prioritizing fluency and giving appropriate focus to accuracy. In contrast to weak CLT, it does not emphasize grammar in a teacher-centered manner. Likewise, unlike strong CLT, it did not disregard grammar or leave the learners to figure out the rules independently. The TBLT and CLT differ in their approaches to balancing fluency and accuracy.

While promoting spontaneous communication, strong CLT often led to persistent grammatical errors due to the lack of explicit instruction. TBLT bridged these

gaps by integrating both fluency and accuracy through meaningful communication tasks. Grammar is not the primary focus but is addressed when necessary, allowing learners to develop language forms within communicative contexts. Unlike weak CLT, TBLT does not dominate lessons with grammar, and unlike strong CLT, it provides guidance to help learners balance communication and grammatical correctness. This may conclude that TBLT has evolved from CLT with the potential to foster language learning.

2.1.2 TBLT and Its Connection with CLT

The CLT teaching method was widely applied in the late 1970s and early 80s to foster English language students' communication competence (Larsen-Freeman & Anderson, 2000). Theoretically, CLT is the teaching approach where communication is centered. This approach was established to replace traditional teaching methods (Wilkins, 1976). In other words, it was introduced to alleviate a strong focus on grammar lessons in language teaching, and the students were encouraged to use the target language verbally. Similarly, John (1982) defined communicative tasks as situations in which students were required to utilize language that had not yet been taught, encouraging them to develop the ability to search for circumlocutions when the proper language items were unknown. Richards and Rodgers (1986) also pointed out that the CLT emphasized the importance of materials that were deemed beneficial for the students because they were given lots of opportunities to comprehend the language in the real-world contexts. Consistently, Wang (2013) specified that the students involved in TBLT were frequently encouraged to negotiate and interact with the communicative tasks, including language use and forms. In this regard, the students were actively invited to focus on the language use in the assigned tasks at hand; this could accommodate the students to improve their language target knowledge and communicative ability.

Larsen-Freeman and Anderson (2000) argued that TBLT seemed to be a "strong version" of CLT, whereby the target language was utilized primarily by focusing on communicative meanings. Nonetheless, TBLT required the students to familiarize themselves with the language use and linguistic features or grammatical forms in the assigned tasks. Tasks used in TBLT were prioritized and selected based on their level

of difficulty, which can be determined by factors such as task type, theme or topic, and sequencing criteria (Ellis, 2003). In addition, the tasks could be assessed according to students' outcomes, with the assessment aimed at gathering data on their strengths and weaknesses to inform them at the learning reflection stage. These notable functions of TBLT, which were slightly different from the CLT approach, were significant to improve the students' accuracy and fluency at the same time. Brindley (1989) pointed out that the TBLT approach could encourage the students to take responsibility for their language learning through the tasks, which could foster the ability to speak and write the target language.

Accordingly, TBLT was theoretically derived from CLT, which served as a foundational theoretical influence on the TBLT approach, underscoring the significance of cultivating students' communicative competence, which encompasses the effective and appropriate language use and forms in diverse communicative settings (Brown, 2001). In summary, TBLT tasks offered meaningful opportunities to practice and enhance their communicative skills, including noticing linguistic features and forms, as well as their function, aligning closely with the fundamental tenets of CLT.

2.1.3 Theorizing TBLT as a Theoretical Perspectives in SLA

The TBLT teaching approach is intricately linked to SLA theories, as it is psycholinguistically plausible; it acknowledges the learning mechanisms suitable for students of diverse ages while understanding their learning constraints. Traditional methods of language teaching, including grammatical or lexical syllabuses and audio-lingual techniques, frequently prioritize skill-building theories that advocate their usage for younger learners to facilitate accidental language acquisition. In contrast, explicit learning instructions as well as the TBLT teaching model became essential for older children and adult' learners, where knowledge transitions from declarative to procedural through controlled practice, eventually becoming automated for real-time use (DeKeyser, 2007a, 2007b; Segalowitz, 2003; Gatbonton & Segalowitz, 1988; Johnson, 1996). It was suggested that TBLT was appropriate for adult students, emphasizing an awareness to decide and select the target language in the teaching process. Similarly, East (2021) stated that TBLT used a task as an activity that language students could engage in independently to facilitate their progress in SLA. In this regard, it showed that TBLT could apply among students in different educational settings, such

as teachers of various additional languages (L2), English as a second language (ESL), and in foreign language (EFL) settings. This also included teacher educators, curriculum developers, educational administrators, policymakers, language assessment professionals, researchers in SLA, and authors of textbooks (East, 2021). Van den Branden et al. (2009) pointed out that TBLT was being endorsed in numerous contexts around the world as "a potentially very powerful language pedagogy" (p. 1).

In the context of SLA theories, various principles contributed to the theoretical foundation of TBLT. Key theoretical perspectives in SLA that support Nunan's (2004) assertion that "communication fostered communication" could be explained through three cognitivist models as follows:

1. The input hypothesis, or, "It's all about the language students receive"
2. The output hypothesis, or, "It's all about the language students create"
3. The interaction hypothesis, or, "It's all about the language students share"

(East, 2021, p. 25)

Krashen (1985) pointed out that the input hypothesis proposes that the learners acquire language effectively when exposed to comprehensible input slightly above their current level of understanding. His input hypothesis focuses on language comprehension rather than production, as it develops the learners' understanding of the language, leading to the language acquisition, and when students are exposed to comprehensible input, acquisition occurs naturally. Once the language is acquired, students are then able to actively produce it (East, 2021). This theoretical standpoint underlying the SLA suggests that the students should be encouraged to receive extensive reading and listening input before assigning them to speak and write. This relates to TBLT's learning phases, which requires students to construct a strong foundation in the pre-task stage before the during-task phase begins. This review implies that learning contents and background are essential for the students to carry out the assigned tasks or other language assignments.

In the output hypothesis, Nunan (2004) referred to Swain's critique of the input hypothesis as "an eloquent assault" (p. 80). Swain (1985) extended the discussion of successful second language acquisition (SLA) by proposing the comprehensible output (CO) hypothesis, based on extensive research conducted in Canada on immersion and

content-based instruction outcomes. She argued that students need opportunities to produce output through speaking or writing as generating language is a vital component of second language learning. Similarly, Schmidt (1990, 1993, 2001) maintained that students cannot acquire grammatical features or linguistic forms in a second language unless they first notice them and understand how to apply them. Swain's and Schmidt's views suggest that noticing involves students identifying gaps in their knowledge or recognizing specific forms and their functions within the input. Once these forms are noticed, they can be acquired.

Furthermore, the CO hypothesis encourages students to produce output that extends beyond their current language competence. It can be concluded that both comprehensible input and pushed output are essential components of the broader theoretical framework that supports successful SLA. The concept of noticing linguistic forms and applying them to tasks closely aligns with the focus on form implemented in this study. The primary role of the focus on forms intervention within the TBLT framework was to encourage students to explicitly notice language forms embedded in the learning content. In addition, the teacher provided explicit instruction on relevant language structures and usage, enabling students to apply these forms in their science writing tasks. In this way, the students gained a clearer understanding of the linguistic features necessary to complete their assigned tasks effectively.

Long (1996) and Gass (1997) clarified the role of output by arguing that conversational interaction is essential for the students to possibly be successful learners in SLA. The interaction hypothesis posited that interaction with other students is significant for language learning, which could foster the ability to negotiate the forms and meanings to enhance communicative skills. Along the same line, Long (1996) stated that the importance of corrective feedback can provide the teacher with a skill to direct. Guidance or feedback allowed the students to modify their output and facilitated more effective negotiation of meaning. This aligns with Long's Interaction Hypothesis, which suggests that interaction enables learners to receive input, process it, and produce output while simultaneously monitoring and adjusting their language use. Interaction, therefore, is viewed as a powerful tool for language development. In the context of this study, students were encouraged to engage in peer-to-peer interactions, exchanging feedback and sharing opinions to support each other's learning process. Similarly, East (2021) pointed out that various interpretations of the

Interaction Hypothesis from a sociocultural perspective are particularly beneficial in TBLT, as they promote collaboration and mutual support among students in completing tasks.

The sociocultural perspective relies upon the significance of the social and cultural context in the learning process, focusing on collaboration, interaction, and cultural understanding (Lantolf & Thorne, 2006). This could be one of the useful aspects in language teaching as well as in the TBLT learning context, in which the students are given certain tasks, and assigned to complete them in groups and pairs. So, this practice was essential for the students to develop their confidence and collaboration skills in completing the real-world tasks. East (2021) noted also that the sociocultural perspective examined input, output, and interaction through the lens of students collaborating and engaging socially with others. Vygotsky (1978), in the context of sociocultural theory, argued that the students naturally acquire languages through social interaction as they could share and discuss their opinions. This revealed that interpersonal relationships are essential for knowledge and understanding. According to Vygotsky (1978), the zone of proximal development (ZPD) refers to the gap between what a learner can accomplish independently and what they can achieve with the help of a teacher or more knowledgeable peers. In practical terms, Vygotsky's concept of the Zone of Proximal Development (ZPD) highlights the importance of creating a learning environment where students can complete tasks with appropriate support. This support may include scaffolding, simplified language, and constructive feedback provided by the teacher.

The input, output, and interaction hypotheses each offer valuable insights that support the students' understanding of lesson content. These theoretical perspectives help to explain how the students process and use language, which they can then apply to classroom tasks. They also serve as useful guides for the teacher in designing tasks and learning activities in this study, ensuring they are aligned with the students' needs and their developmental levels.

2.1.4 Connecting Theoretical SLA Perspectives to the TBLT Approach

The TBLT approach is theoretically linked to SLA principles through input, output, and interaction, which are integrated to support its dimensions in the teaching process. This framework is believed to contribute to second language acquisition. Pica et al.

(1993) emphasized that language is most effectively learned when students engage in tasks through meaningful interaction (p. 10). East (2021) also pointed out that SLA fosters TBLT and balances attention to both fluency (meaning) and accuracy (forms). In other words, fluency is fostered by providing the students with sufficient opportunities to interact in the target language, while accuracy is addressed through meaningful negotiation and input and feedback from a more proficient collaborator.

Ellis et al. (2019) emphasized the significance of both cognitive and sociocultural perspectives in TBLT, especially in promoting simultaneous attention to meaning and forms. Furthermore, TBLT was endorsed by cognitive interactionist theories by revealing SLA occurs incidentally and implicitly when learners concentrate on meaning while engaging in a task; however, a focus on form (implicit grammar instruction) was also essential to ensure that learners paid attention to the grammatical structures they encountered in the input (East, 2021). From a sociocultural viewpoint, learning happens within the ZPD, but here you're implying it is the ZPD itself that is built.

Language learning involves interaction between an expert (such as a teacher) or more advanced students and learners, allowing students to work within their ZPD through guided support and co-construction of knowledge. The incorporation of these perspectives into task design not only supported meaningful language use but also enhanced both fluency and accuracy. Notably, the alignment of SLA theories with TBLT reinforced the effectiveness of this approach in promoting comprehensive language development.

2.1.5 Facilitating Language Learning Through Tasks

Tasks in TBLT play a crucial role in helping students actively acquire and practice language while promoting a learner-centered approach. Ellis (2003) emphasized that tasks serve as an effective means for acquiring the target language, allowing students to absorb language through real-world application. Willis and Willis (2007) further argued that the best way to teach a language is to involve students in authentic language use through tasks such as discussions, problem-solving, and games (p. 1). Later, Cook (2010) described TBLT as an approach to second language learning in which learners develop language skills by performing meaningful tasks in the classroom (p. 512). Collectively, these scholars underscored the importance of task-based instruction in engaging learners and improving their language proficiency.

However, many scholars have provided different definitions of tasks in language teaching, particularly in TBLT. The “task” was an integral function of TBLT in the classroom contexts in which it had the potential to improve the students’ language development. Long (1980) described the tasks as learning activities that individuals engage in, either for personal reasons or for a specific purpose, whether voluntarily or for some form of compensation. Breen (1989) noted that the task was defined as "a structured plan designed to provide opportunities for refining knowledge and skills related to a new language and its use in communication." Ellis (2003) defined a task as a meaning-centered language activity. His definition suggests that the syllabus should function as a work plan for teachers, helping learners develop language competence rather than simply training them to complete specific tasks. According to Nunan (2004), tasks are communicative and used for designing the curriculum where students can conceptualize, use, produce, and interact with the target language.

In conclusion, tasks in TBLT should reflect real-world situations, such as making travel arrangements, completing household tasks, caring for a child, or filling out forms. These tasks provide meaningful contexts where students can apply their language skills in authentic situations.

2.1.6 Major Characteristics of “Tasks”

Tasks in TBLT serve as a means of language development, with teachers designing and selecting specific language uses and forms to incorporate into tasks. Tasks in different language learning contexts have unique characteristics designed to achieve specific learning goals. Richards et al. (1986) noted that tasks in language teaching were considered to promote language development in a communicative way, as they create a purpose for classroom activities beyond mere language drills. Notably, Willis (2007) and Skehan (1998) synthesized key task characteristics from previous research, as shown in Table 2.1 below.

Table 2.1 Major Characteristics of a "Task" of Willis (2007) and Skehan (1998)

Skehan (1998)	Willis (2007)
Learners are not given other people's meaning to regurgitate. There is some sort of relationship to comparable real-world activities. Task completion has some priority. The assessment of the task is in terms of outcome.	A piece of classroom work which involves learners comprehending, manipulating, producing, or interacting with the target language. (Nunan, 1989). Activity where learners use the target language to achieve the outcome (Willis, 1996). A language use task is an activity that involves an individual using language to achieve a particular goal or outcome in a particular situation (Bachman & Palmer 1996).

Table 2.1 compares the major characteristics of a "task" as defined by two different authors, Skehan (1998) and Willis (2007). Skehan (1998) defined a task in TBLT as a language activity that adopts a meaning-centered approach. This means that tasks should focus on the meaning of language rather than solely on linguistic forms, allowing students to comprehend, manipulate, produce, and interact with the target language. Skehan (1998) also emphasized that task completion is a priority, meaning that tasks should be designed to achieve a specific goal or outcome.

Similarly, Willis (2007) described tasks in TBLT as classroom activities in which students use the target language to accomplish a specific objective. She stressed that tasks should not involve mere repetition or regurgitation of language forms but rather require students to actively engage in language use to achieve a meaningful learning outcome. Additionally, Willis (2007) highlighted the importance of ensuring that tasks reflect real-world activities, making them relevant to students' lives outside the classroom.

Both Willis (2007) and Skehan (1998) recognized tasks as a crucial component of language learning. Table 2.1 illustrates that both scholars agree that tasks are meaning-centered and require students to use the target language to achieve a communicative goal. Furthermore, they both emphasize that tasks should mirror real-world activities and be structured with a clear priority in mind to maximize their effectiveness in language learning.

Beyond Skehan and Willis, Bachman and Palmer (1996) further emphasized that language use in tasks involves individuals applying language for a specific goal in a particular context. In this regard, Palmer (1996) underscored the importance of designing tasks that align with learners' ability to use language for a specific purpose. Collectively, Skehan, Willis, Nunan, Bachman, and Palmer agreed that tasks in TBLT should prioritize meaning-focused and highly interactive language use, facilitating authentic communication that closely resembles real-life situations.

Additionally, tasks in TBLT have been found to significantly enhance students' writing skills. Ellis (2003) noted that tasks can motivate students to participate in meaningful writing activities, thereby improving accuracy and language organization. Similarly, Van den Branden (2006) highlighted that TBLT fosters collaboration and feedback, both of which contribute to the development of writing proficiency. Empirical studies also support the effectiveness of TBLT in improving writing skills in language-teaching contexts. Marashi and Dadari (2012) investigated the impact of tasks on intermediate Iranian EFL students' writing skills, finding that TBLT significantly enhanced their writing ability and creativity. Likewise, Hai-Yan (2014) demonstrated that written tasks improved students' essay-writing skills, further reinforcing the benefits of task-based approaches in developing writing proficiency. These studies collectively highlight the effectiveness of TBLT in fostering structured opportunities for students to refine their composition skills through practical, goal-oriented tasks.

Considering the various scholarly perspectives, it is evident that tasks in TBLT play a vital role in developing both speaking and writing skills. Key characteristics of effective TBLT tasks, as identified in previous research, include their real-world relevance, meaning-centered focus, emphasis on fluency before accuracy, and the expectation that students actively engage with tasks. Furthermore, well-designed tasks should have a clear communicative outcome that extends beyond mere language use. These characteristics serve as a guideline for task design, ensuring that teachers consider the degree of input, output, and student interaction necessary to achieve fluency and accuracy in the language classroom.

2.1.7 Task Classification: Information Gaps and Manipulation Techniques

The classification of tasks in TBLT plays a crucial role in ensuring their suitability for students' needs. Prabhu (1987) identified three types of tasks, all of which require students to bridge an information gap by discovering or providing information that was initially unknown. These task types include:

- Information gap – requires students to find out missing information.
- Reasoning gap – involves problem-solving and working out a solution.
- Opinion gap – requires students to express their viewpoints.

These three elements define tasks in practical terms, emphasizing their role in facilitating communication. East (2021) further noted that tasks are often input-based and teacher-led, with instructors initially guiding the class through language samples for interaction.

To bridge these gaps, it is essential to consider key task features-information gap, reasoning gap, and opinion gap-which should be conceptualized through input, output, and interaction to facilitate learning. Pica et al. (1993) expanded on Prabhu's information gap tasks, explaining that these tasks involve differential access to information between teachers and students. This requires instructors to design tasks carefully to provide students with sufficient comprehension opportunities.

In an "one-way" information gap task, only one student possesses the information that their partner needs to discover. In a "two-way" information gap task, both students collaborate and exchange information to complete the task (East, 2021). Another way of maximizing task effectiveness is through the reasoning gap, which involves problem-solving or decision-making (East, 2021). These tasks typically require students to process input, analyze a situation, and make informed decisions. For instance, a reasoning gap task might involve solving a problem, making a decision based on provided input, or expressing an opinion (East, 2021).

Additionally, an opinion gap or opinion exchange task requires participants to express, justify, and evaluate their viewpoints, emotions, or attitudes in response to a given scenario. Nunan (2004) described opinion gap tasks as those that require students to use information and construct arguments to justify their opinions. Unlike information or reasoning gap tasks, opinion gap tasks do not have a single correct answer, as

outcomes may vary across individuals and situations (Nunan, 2004, p. 57). Table 2.2 provides more detail on the task types.

Table 2.2 Task Selecting Criteria Based on the Guidance of Ellis (2003)

Easy		Difficult
1. Input factors		
1 Non-verbal input	Written input	Aural input
2 High-frequency lexis		Low-frequency lexis
3 Shorter, simple sentences		Longer, complex sentences
4 Static information	Dynamic information	Abstract information
5 Few elements/ relationships		Many elements/ relationships
6 Structured		Unstructured
7 Here and now		There and then Unfamiliar
8 Familiar		
2. Interactive factors		
9 Two-way		One-way
10 Single task		Dual task
11 Dialogue		Monologue
3. Reasoning factors		
12 Information gap	Reasoning gap	Opinion gap
13 Few steps		Many steps
4. Outcome factors		
14 Pictures	Written	Oral
15 Closed	Instructions/narratives	Open Arguments
16 Descriptions		

2.1.8 Output-based Versus Input-based Tasks

Theoretical justifications for TBLT emphasize that tasks have traditionally been designed with a stronger focus on spoken production rather than other language skills, such as reading, writing, and listening (Robinson, 2011). While TBLT was initially developed to enhance communication skills, it has since expanded to include diverse

task types that integrate reading and writing activities. A key distinction in TBLT is between input-based and output-based tasks:

- Output-based tasks involve language production, requiring learners to actively write or speak in response to a task.
- Input-based tasks emphasize language comprehension, where learners focus on listening or reading to process and interpret information.

In this context, scientific writing such as laboratory report writing can be classified as an output-based task, as it aims to enhance students' ability to produce structured, discipline-specific texts in English. For Thai high school students, this categorization highlights the importance of task design in fostering their scientific writing competence.

Although speech and writing are primarily considered "one-way" output tasks, they often incorporate interactive elements. For instance, a speech may include a Q&A session, while writing can involve the use of reference materials (e.g., dictionaries, style guides) to refine and improve output. These aspects introduce elements of interaction, making output-based tasks more dynamic and engaging (East, 2021).

Furthermore, effective task classification is fundamental to structuring TBLT curricula. Ellis et al. (2019) argue that understanding the nature of tasks within language learning environments is essential for designing instructionally sound courses that align with students' linguistic and academic needs.

2.1.9 Task Used in the Current Study

Defining tasks before implementing the TBLT approach is essential for teachers to address students' needs and areas for improvement. In this study, the selection of scientific lab report writing as a task was guided by the study's objectives, the school's and program's requirements, and the widespread challenges students face in science writing in English. This task was designed to enhance students' scientific writing skills while improving their English proficiency in an academic context.

According to Ellis (2003), the writing tasks in this study were selected and sequenced based on four key factors, as outlined in Table 2.2. One of these factors included the integration of scientific laboratory reports as a core writing task. A set of criteria was established for selecting science writing tasks, ensuring their effectiveness in developing students' language and scientific literacy.

The first critical criterion was addressing the common challenges students face in science and math programs, particularly when writing lab reports that require mastering various rhetorical structures and organizational patterns. Another essential requirement was helping students improve grammatical accuracy in their lab reports while fostering collaborative discussions in the language classroom. The final key criterion was selecting scientific lab report writing as a task that provides ample opportunities for language retention in scientific contexts, ultimately enhancing students' science literacy and writing proficiency.

Previous studies have highlighted the benefits of lab report writing in enhancing both scientific understanding and critical thinking skills. Yildirim (2016) found that laboratory-based instruction improves students' learning capabilities, enabling them to apply scientific knowledge to real-world problem-solving. Similarly, George-Williams et al. (2018) argued that lab report writing enhances theoretical understanding, facilitates the acquisition of practical skills, and deepens laboratory experience, all of which are essential outcomes of effective science education.

Based on these criteria, teachers can structure tasks as part of a systematic work plan, ensuring that task sequencing provides students with opportunities to achieve learning outcomes and develop language competence. Additionally, these criteria contribute to a well-rounded scientific education, equipping students with the ability to apply theoretical knowledge to real-world scenarios while mastering practical techniques essential for conducting scientific experiments effectively.

2.1.10 Teacher's Roles in Task-Based Language Teaching

In language teaching, teachers play a crucial role in facilitating and supporting the learning process. In TBLT, they play a key role in supporting students and ensuring the appropriateness and the functions of teaching and learning. Breen (1989) noted that the teachers are responsible for designing work plans for tasks in their classrooms, even when following a task-based syllabus. The recommendation emphasized that teachers should determine the specific tasks students complete each day. In particular, teachers are responsible for supporting students in their language development, as highlighted in the studies by Long (2015), Ellis and Shintani (2014), Mackey (2007), and Ellis (2003). These scholars provided insights into the teacher's role in facilitating interaction in TBLT, outlining the crucial responsibilities teachers are expected to fulfill:

1. Meaning Negotiator

According to Van den Branden (2016), teachers play an active role in negotiating meaning and form as students process input and produce output in task-based activities. This includes checking comprehension, confirming understanding, and seeking clarification to ensure students effectively navigate the language challenges presented by the task. Through these interactions, teachers provide necessary scaffolding to facilitate learning.

2. Feedback Provider

Teachers are responsible for offering constructive feedback on both written and oral tasks, helping students revise and improve their work (Van den Branden, 2016). Providing targeted feedback enables students to identify errors, address weaknesses, and refine their language skills. By guiding students in understanding their strengths and areas for improvement, teachers play a key role in fostering language development and encouraging self-reflection.

3. Writing Accuracy Consciousness-Raiser

Teachers incorporate a focus on form within meaning-oriented activities to help students notice linguistic structures and functions within the given tasks. This involves directing students' attention to frequent errors or patterns, facilitating practice and correction, and integrating explicit instruction when necessary (Van den Branden, 2016). The goal is to enhance students' overall language proficiency by fostering a deeper understanding of grammar, vocabulary, and language accuracy during or after task completion.

4. Task Modifier

Teachers have the flexibility to modify tasks to better align with students' needs, personal learning beliefs, and the specific characteristics of their educational context (Van den Branden, 2016). Adjusting the complexity of a task allows teachers to make language learning more accessible and engaging while ensuring that students gradually build their linguistic competence. Additionally, teachers can incorporate explicit focus-on-form activities as part of task-based instruction, where students work in groups to complete tasks and engage in discussions until they reach the final stage of the lesson.

2.1.11 Students' Roles in Task-Based Language Teaching

Apart from defining the roles of the teacher, determining the students' roles is important in language learning, especially in the TBLT context, where they contribute to the success of given tasks. Lambert et al. (2023) emphasized the importance of students understanding their responsibilities, as this can enhance their opportunities for language acquisition. Fostering responsibility and active participation allows students to maximize the benefits of the TBLT approach, leading to well-structured and effectively designed tasks. Ellis (2009) outlined four essential roles that students play in TBLT: 1) Focusing on meaning, 2) Engaging in an information gap that necessitates communication, 3) Achieving a communicative outcome beyond language use, 4) Utilizing linguistic and non-linguistic resources to complete tasks. Each role provides students with specific responsibilities and guidance in task completion. In this study, these roles were applied as follows:

1. Focus on Meaning

Emphasizing meaning enables students to clearly communicate scientific ideas, ensuring that their reports or essays are coherent and aligned with task objectives. This approach fosters critical thinking and logical reasoning, allowing students to convey scientific findings effectively. In science writing, prioritizing content and purpose over grammatical accuracy in the initial stages helps students focus on the clarity and impact of their laboratory reports.

2. Information Gap

TBLT tasks often involve missing information, differing opinions, or inferences, requiring students to collaborate and share their work. In science writing, students may exchange findings, compare interpretations, or analyze data collectively. This collaborative process enhances problem-solving and analytical skills, both of which are essential for writing well-structured scientific reports. Additionally, it promotes deep engagement with the subject matter, leading to better comprehension and communication.

3. Communicative Outcome

In science writing, communicative outcomes include presenting findings, interpreting data, and proposing solutions. Unlike general language learning, which focuses on spoken discussions and reflections, science writing tasks require students

to express their ideas clearly in written form. By engaging in active learning activities, students apply real-world language skills, preparing them to write reports that are clear, purposeful, and academically or professionally relevant.

4. Utilizing Linguistic and Non-Linguistic Resources

Students rely on prior knowledge, context clues, scientific terminology, and collaborative discussions to complete writing tasks. Through teacher guidance, they familiarize themselves with specific linguistic structures and scientific vocabulary. This role promotes self-reliance and adaptability, helping students gain confidence in expressing complex ideas. Additionally, it enhances their ability to synthesize information and use scientific language effectively within the TBLT framework.

These four student roles play a crucial part in addressing language challenges and developing essential competencies in science writing. By actively engaging in these roles, students improve their ability to communicate scientific findings clearly while preparing for the demands of academic and professional writing in English. Ultimately, the dynamic interaction between teacher and student roles in TBLT fosters a collaborative and interactive learning environment, enhancing both language proficiency and communicative competence.

2.1.12 Benefits and Limitations of Task-Based Language Teaching (TBLT)

TBLT has been shown to enhance target language acquisition, foster a positive learning environment, boost motivation and engagement, and provide students with real-life, meaningful tasks while learning a language. McDonough (2015), East (2012), Shehadeh and Coombe (2012), Müller-Hartmann and Ditfurth (2011), Van den Branden (2009), and Edwards and Willis (2005) have highlighted several pedagogical advantages of TBLT in language learning.

One of the primary benefits of TBLT is that it offers students ample opportunities to practice and enhance their communicative skills, which is particularly beneficial for developing speaking proficiency. Engaging in task-based learning allows students to improve fluency, complexity, and accuracy in their spoken output. Additionally, TBLT fosters self-confidence in students by encouraging them to use the target language in both classroom settings and real-world contexts. Another significant advantage of TBLT is its ability to increase student motivation. Task-based activities are interactive and engaging, making language learning more enjoyable. The sense of

achievement associated with completing tasks toward specific objectives further enhances students' intrinsic motivation. Finally, task-based learning extends beyond language acquisition, as it helps students develop essential life skills such as self-regulation, problem-solving, intercultural competence, and social interaction.

Despite its advantages, the implementation of TBLT in EFL contexts presents certain challenges and constraints. Van den Branden (2016) observed that teachers often have mixed feelings about providing tasks, which can lead to uncertainty regarding task selection and learning outcomes. Similarly, Nayoung (2019) identified four key limitations in TBLT implementation:

- Irrelevant coursebook topics that may not align with students' interests.
- Limited writing skills among students, which can hinder task completion.
- Excessive use of the first language (L1) instead of the target language.
- Misalignment between TBLT and traditional examination systems, which often emphasize rote memorization rather than communicative competence.

Additionally, Littlewood (2007) argued that TBLT poses challenges in large classroom settings due to difficulties in facilitating student communication in groups. Chao and Wu (2008) further noted that teachers in Taiwanese schools encountered obstacles related to task selection, task complexity, and the diverse needs of students.

To address these challenges, it is essential to:

1. Design course materials appropriately, ensuring alignment with students' linguistic and cognitive levels.
2. Enhance students' understanding of target language use and structures during the pre-task phase.
3. Encourage group learning and peer interactions to foster communicative competence.
4. Implement effective classroom management strategies to facilitate task completion.
5. Set achievable learning goals to help both teachers and students track progress effectively.

By implementing these strategies, TBLT can be optimized to enhance language learning outcomes, making it more effective and adaptable for diverse educational settings.

2.2 Principles and Frameworks of TBLT

Several scholars have proposed principles for TBLT that effectively facilitate language learning, including English acquisition. Willis (1996), Ellis (2003), and Nunan (2004) introduced TBLT frameworks that consist of structured learning phases aimed at enhancing students' target language competence and connecting classroom learning with real-world tasks (Jacobs & Farrell, 2003). These frameworks outline learning procedures at each stage to foster language acquisition and provide meaningful learning experiences through task engagement. The key components of these frameworks are summarized in Table 2.3.

Table 2.3 TBLT Frameworks Introduced by Nunan (2004), Ellis (2003) and Willis (1996)

Frameworks of Task-Based Language Teaching (TBLT)		
Willis (1996)	**Ellis (2003)**	**Nunan (2004)**
Pre-task - Defining topics - Recalling necessary - words, and phrases - Providing task	**Pre-task** - Framing the activity - Planning time - Doing a similar task	- Developing scheme - Controlled practice - Authentic listening practice - Focus on linguistics elements - Providing freer practice - Introducing the pedagogical task
Task-cycle - Task - Planning - Report	**During-task** - Time Pressure - Number of participants	
Language focus - Task analysis - Task practice	**Post-task** - Learner's report - Consciousness- raising - Repeat task	

1. Willis's TBLT Framework (1996)

Willis (1996) developed a structured approach to task-based learning, breaking it into three stages: Pre-task: This phase involves defining topics, recalling necessary vocabulary and phrases, and providing task instructions to ensure clarity. Task Cycle: Students engage in completing the task, planning their approach, and reporting their outcomes to encourage interaction and communicative competence. Language Focus:

After task completion, students analyze and practice the language structures encountered in the task to reinforce learning. Willis (1996) emphasized the importance of information flow in TBLT, ensuring that language acquisition occurs naturally through structured exposure and interaction.

2. Ellis's TBLT Framework (2003)

Ellis (2003) proposed a three-phase model similar to Willis's but with additional cognitive and interactive elements: Pre-task: Students engage in a comparable activity related to the target task. Plans and instructions guide students on task completion strategies (e.g., if the task is writing a paragraph, students first read a similar paragraph). During-task: Time pressure and group dynamics influence task performance, improving fluency and decision-making. Smaller groups encourage focused collaboration, while larger groups promote diverse perspectives. Post-task: Students present task outcomes, reflect on findings, and reinforce learning. Task repetition enhances comprehension, and consciousness-raising activities encourage self-assessment of strengths and weaknesses. Ellis's (2003) model is particularly advantageous for writing lessons, as it integrates structured task design with an emphasis on both fluency and accuracy.

3. Nunan's TBLT Framework (2004)

A notable TBLT framework, introduced by Nunan (2004), consists of several essential learning stages designed to foster students' language acquisition. These phases aim to enhance communicative competence by incorporating structured learning activities. The key phases of Nunan's model are as follows:

- Developing a Learning Scheme: Establishing a plan or framework for language learning, including learning goals, objectives, and strategies.
- Controlled Practice: Engaging students in structured activities that focus on specific language skills or grammar points, with guidance and feedback from the teacher.
- Authentic Listening Practice: Exposing students to real-life spoken language, such as in movies, TV shows, or podcasts, to develop comprehension.
- Focus on Linguistic Elements: Directing attention to key language features, including grammar, vocabulary, pronunciation, and discourse patterns, through explicit instruction and practice.

- Providing Freer Practice: Encouraging greater autonomy by allowing students to use language in creative, open-ended ways, such as through role-plays, debates, and discussions.
- Introducing the Pedagogical Task: Assigning a meaningful and purposeful task, such as writing a letter, giving a presentation, or solving a problem, to reinforce language use in authentic contexts.

Nunan's holistic framework integrates structured guidance with authentic tasks, ensuring that students develop fluency, accuracy, and confidence in using the target language across both academic and real-world settings.

2.2.1 Comparing TBLT Frameworks: Nunan (2004), Willis (1996), and Ellis (2003)

While Nunan's (2004) model provides a step-by-step process for language learning engagement, Willis (1996) and Ellis (2003) share more similarities in structuring three core learning phases:

1. Pre-task: Establishing the foundation for learning.
2. Task-cycle (During-task): Engaging in interactive, communicative activities.
3. Post-task: Reflecting on learning and reinforcing language acquisition.

All three frameworks emphasize accuracy and fluency, scaffolding, and linguistic forms. These elements are particularly beneficial for writing instruction, as they provide students with structured opportunities to practice language use in meaningful contexts. A study by Rachayon & Soontornwipast (2019) found that implementing TBLT frameworks based on Willis (1996) and Ellis (2003) had positive effects on Thai EFL learners' language development, as these models provided ample opportunities for skill improvement.

It is evident that TBLT frameworks by Ellis (2003) and Willis (1996) are highly effective in improving EFL students' writing skills, particularly in the science writing context. Both models emphasize: A balance between fluency and accuracy, Scaffolding and structured support and A focus on linguistic forms within meaningful tasks. By combining structured guidance with communicative tasks, these frameworks ensure that students develop language competence while improving academic writing skills.

2.2.2 Key Strengths of the Integrated Ellis (2003) and Willis (1996) Models

Integrating Ellis (2003) and Willis (1996) offers multiple pedagogical benefits, particularly in three critical areas:

1. Addressing Both Fluency and Accuracy

Willis (1996) emphasizes fluency through student interaction and task repetition while Ellis (2003) focuses on accuracy through post-task analysis and feedback. Ellis et al. (2002) observed that task reporting provides opportunities for teachers to correct linguistic errors, strengthening both accuracy and communication skills. Several studies highlight the effectiveness of TBLT in fostering fluency and accuracy. Pham et al. (2021) found that TBLT significantly improves writing speed and grammatical accuracy compared to traditional methods. Munirah (2015) also reported that TBLT enhances both fluency and accuracy in speaking skills. Additionally, Rouhi (2008) highlighted the importance of pre-task preparation in improving students' communication abilities.

2. Task Scaffolding

Willis (1996) reported that pre-task activities focus on knowledge preparation, including defining topics, recalling vocabulary, and offering clear task instructions. Samuda (2015) emphasized the pre-task phase as a pedagogical foundation, enabling students to explore learning content more effectively. Furthermore, East (2021) suggested that scaffolding decisions in the pre-task phase are crucial for ensuring effective task execution. In the during-task phase, students engage in collaborative work under teacher supervision. Ellis (2003) pointed out that providing real-time feedback supports students in developing writing proficiency and achieving learning goals. Studies confirm that teacher scaffolding significantly contributes to student achievement. Van den Branden (2016) found that teacher support enhances students' ability to handle task complexity. East (2021) also suggested that task repetition and rehearsal improve student confidence and task completion. Overall, task scaffolding plays a crucial role in enhancing comprehension, supporting learning, and addressing difficulties encountered during the pre-task and post-task phases.

3. Focus on Forms in Context

Both Ellis (2003) and Willis (1996) incorporate a form-focused learning session, emphasizing task analysis and consciousness-raising activities. Ellis (2006) found that focusing on grammar structures in the post-task phase enhances students' linguistic

competence. Willis (1996) advocated for integrating form and meaning, ensuring that students develop a deeper understanding of language functions. Providing opportunities for students to practice linguistic forms within communicative tasks improves their ability to construct grammatically accurate sentences in writing.

In conclusion, the TBLT models of Willis (1996) and Ellis (2003) are highly effective for EFL learning, particularly in science writing. Their integration balances fluency and accuracy by implementing structured learning activities. It incorporates task scaffolding to guide students through the learning process and emphasizes linguistic forms within communicative contexts to ensure language mastery. By combining structured support with interactive language use, these models offer a systematic and research-supported approach to language development.

2.2.3 Rationale for TBLT of Willis (1996) and Ellis (2003) in this Study

There are many reasons to apply the TBLT models of Willis (1996) and Ellis (2003) in this study. Initially, the framework of Willis (1996) indicated myriad advantages. For instance, Willis's (1996) framework can help teachers introduce and prepare fundamental knowledge before implementing the tasks. This is vital for students to be able to carry on the writing tasks in the current study. Moreover, Willis's task cycle provided spaces for reporting and discussing the tasks. It encourages the students to familiarize themselves with the target language, including fostering the ability to present the tasks verbally.

Furthermore, to focus more on report writing skills, Ellis's (2003) framework of a task-based approach was also used because it revealed crucial aspects of writing lessons. The students, in a consciousness-raising stage, were encouraged to reflect and attend explicitly to the grammatical forms that they used incorrectly or failed in post-task. The implementation of scientific laboratory reports as tasks required a rigorous and specific use of forms and language. Additionally, having a repeat performance component in Ellis's (2003) post-task can be useful and beneficial for science writing. Performing a repeat performance helped the students improved the language complexity and expressed it more accurately (Lynch & Maclean, 2000). Conclusively, these positive aspects led to the adoption of the TBLT by Willis (1996) and Ellis (2003) for this study.

In summary, the TBLT frameworks proposed by Willis (1996) and Ellis (2003) offer structured and pedagogically sound approaches that support both fluency and accuracy in language learning. Their emphasis on scaffolding, interaction, and form-focused instruction aligns well with the objectives of improving EFL students' academic writing, particularly in science-related contexts. Although Nunan's (2004) framework presents a valuable step-by-step model that incorporates authentic tasks and controlled practice, it was not adopted in this study due to its strong focus on receptive aural input, which is more suitable for listening and speaking development. Since writing instruction benefits more from reading-based input and structured output practice, the integrated models of Willis and Ellis were considered more appropriate. By combining communicative tasks with structured support and linguistic focus, these models provide a robust foundation for effective language development in EFL classrooms.

2.2.4 Adapted TBLT Framework for Scientific Laboratory Report Writing based on Willis (1996) and Ellis (2003)

Recently, the TBLT has been utilized by researchers, methodologists, and teachers. A task-based approach is one of the useful approaches in language teaching. It encourages training abilities and acquiring language knowledge while carrying out tasks. Teachers serve as both learners and mentors. In this study, the TBLT framework proposed by Willis (1996) and Ellis (2003) was adopted to be applied for each lesson of the scientific laboratory report writing class in order to maximize the flexibility and appropriateness of the objectives of each lesson based on the course plan. The framework of the Task-Based Approach used for the Scientific Laboratory Report Writing Lessons it is shown in Table 2.4 and 2.5 below.

Table 2.4 Frameworks of Task-Based Approach

Willis (1996: 52)	**Ellis (2003: 244)**	**The Framework of TBLT adopted from Willis (1996) and Ellis (2003) for the Scientific Laboratory Report Writing Lessons**
Pre-Task -Introduction to topic and task	**Pre-Task** **-**Framing the activity -Planning time -Doing a similar task	**Pre-Task** **-**Introducing topics and tasks -Regulating and planning time -Task preparation and framing the activity
Task Cycle **-**Task -Planning -Report	**During Task** **-**Time pressure -Number of participants	**During Task** **-**Confronting and discussing the tasks -Preparing the target language and linguistic features -Task performance -Task rehearsing and practicing
Language Focus -Analysis -Practice	**Post-Task** -Learner report -Consciousness- raising -Repeat task	**Post-Task** **-**Analyzing and reflecting the task performance -Grammar consciousness raising practice -Task presenting and learner reporting

Table 2.5 TBLT Framework Adapted from Willis (1996) and Ellis (2003)

Task-Based Language Teaching (TBLT)		
Pre-task	**During-task**	**Post-task**
1. Introducing topics and tasks 2. Regulating and planning times 3. Task preparation and framing the activity	1.Confronting and discussing the tasks 2. Preparing the target language and linguistic features 3. Task performance 4. Task rehearsing and practicing	1. Analyzing and reflecting the task performance 2. Grammar consciousness - raising practice 3. Task presenting and learner reporting

The TBLT framework, adopted from Willis (1996) and Ellis (2003), consisted of three primary stages: pre-task, during-task, and post-task. During the pre-task stage, the learners were introduced to topics and tasks, which involved setting the context, providing background information, and clarifying objectives. Learners also engaged in activities aimed at regulating and planning the time required for task completion.

Additionally, integral components of this stage included task preparation activities such as brainstorming ideas and gathering necessary materials. Boston (2010) suggested that pre-task activities can be used to prime learners to familiarize themselves with the specific target structures.

In the during-task stage, learners actively engaged in the task itself by confronting and discussing the tasks, collaborating with peers, and actively participating in task performance. Learners prepared the target language and linguistic features necessary for effective task completion. This stage may also include task rehearsal and practice to enhance performance and fluency. The characteristics of tasks, such as their nature, purpose, and how often they're repeated, can make speaking tasks more engaging for learners (Aubrey, 2020).

Following task completion, the post-task stage involves learners analyzing and reflecting on their performance, identifying strengths and weaknesses, discussing challenges encountered, and evaluating strategies. Additionally, learners may engage in grammar consciousness-raising practice, focusing on specific language structures or rules encountered during the task. Finally, learners may present their task outcomes or findings to their peers or the teacher, facilitating the consolidation of their learning and receiving feedback.

2.3 Focus on Forms in Language Teaching

In language teaching, focusing on forms has been applied in language teaching to enhance the students' ability to use linguistic features or grammar effectively and apply introduced forms to complete assignments or language tasks. A focus on linguistic forms is integrated with TBLT implementation, as students were scaffolded into mastering the specific language structures required by the assigned tasks. Scholars in SLA also noted that linguistic competency need to be fostered, especially in writing contexts. Canale (1983) and Canale and Swain (1980) also pointed out that grammatical (or formal) competence has long been acknowledged as a fundamental foundation upon which communicative competence must be developed through language learning.

In language teaching, two contrasting approaches synthetic and analytic have sparked considerable debate. Michael Long (1991) introduced the concepts of 'focus

on forms' and 'focus on form' instruction, emphasizing their distinctiveness. 'Focus on form' instruction is a pedagogical method that integrates attention to linguistic elements—such as words, phrases, structures, or pragmatic patterns within meaning-centered activities. This approach naturally and incidentally draws students' attention to language features during lessons that primarily emphasize communication, thereby enhancing learners' 'noticing' of language forms. East (2021) concluded that a focus on form aligns well with TBLT. However, before implementing focus on form within TBLT, it is important to consider other grammar teaching methods that complement it, providing a more comprehensive understanding of grammar instruction.

In contrast, 'focus on forms' refers to activities or exercises that explicitly target linguistic structures, often presented as discrete grammar rules or metalinguistic information. This traditional teaching method involves proactive instruction on grammatical usage, with instructors meticulously explaining the rules of the target language. Long (1998) also explained that focus on forms is now recognized as the traditional teaching method for linguistic features whereby teachers and course designers create lessons, materials, and textbooks focused on structural components of the language. Additionally, Long (2015) revealed that synthetic approaches involve teaching linguistic units such as words, collocations, grammar rules, sentence patterns, notions, and functions, aligning with a focus on forms. Conversely, analytic approaches engage learners in authentic communicative use of the target language.

A focus on forms, with its explicit emphasis on grammatical structures, can be approached through deductive or inductive methods. In deductive instruction, the teacher directly presents the rule, while inductive methods involve learners analyzing input independently to discover the rule. Ellis (2001) stated that exposing students to sufficient examples of grammatical forms and engaging them in tasks to observe and use the grammar is beneficial. While this model effectively helps students internalize the forms of the target language, it may limit opportunities for communicative exposure. This means that students are directly required to familiarize themselves with language forms during the teaching process.

2.3.1 Rationale of Focus on Forms Intervention Alongside TBLT Approach

The focus on forms intervention manifested a positive effect alongside the TBLT approach. East (2012) stated that once the students were supported in developing grammatical competence through scaffolding, they likely gained specific language use and forms, especially when the teacher stood alone as the interactionist. A focus on forms approach was suggested as a way to help students understand how to use scientific language and forms to write lab reports for this study. It could be helpful to combine this approach with TBLT's learning phases. Because the scientific lab report required vigorous structures and specific language use in constructing the lab report with excellent writing qualities. It was quite unique and different from normal English essays. Halliday and Matthiessen (2004) also said that certain linguistic features were needed to communicate clearly in the scientific register because language was unique and had different writing purposes depending on the situation. Therefore, it was fair to claim that composing scientific lab reports employed strict rules in terms of specific language use, writing patterns, and technical vocabulary, including sentence structures. To construct better results of science writing and its qualities, utilizing a focus on forms coupled with TBLT was necessary.

Previous studies revealed that integrating a focus on forms in the teaching instructions could improve the ability to use language grammatically in writing assignments. Norris and Ortega (2001) conducted a meta-analysis of 49 studies on explicit and implicit language instruction. They found a small difference in effect sizes between explicit focus-on-forms and focus-on-form approaches, suggesting that any explicit teaching method may be effective. Similar to this, Jourdenais et al. (1995) said that "shaping input," like highlighting language forms, could help students notice and use the target forms better in language tasks. Moreover, Takimoto (2009) and Norris and Ortega (2001) stated that an explicit method could foster and facilitate language learning, which would be more effective as the students were invited to grasp the learning contents and language forms. Ellis (2001) stated that once the assigned tasks were accomplished, the students could be invited to observe the forms, which could deepen their understanding of specific language use and forms. Ellis (2001) also said that focusing on forms helped a lot with understanding linguistic forms during the task phase. This was in line with the main focus on getting the message across, which was

the point of the task. Overall, a focus on forms approach exhibited myriad benefits to encourage the students to pay attention to the specific linguistic features and their functions in written tasks. However, literature review regarding a focus on forms also implied that it had alternative options when it applied in a language acquisition context, especially in writing lessons.

2.3.2 Options of a Focus on Forms

Both focus on forms and focus on form fall under the broader umbrella of "form-focused instruction" (FFI). East (2021) defined FFI as any pedagogical strategy that aims to direct students' attention towards language forms, whether implicitly or explicitly. Long (2015) and Ellis (2008) introduced the most notable EFI approaches, differing in their application in language teaching. Long's (2015) approach emphasized a reactive and incidental focus on linguistic elements, arising naturally from communication during task completion. Long (2015) asserts that students should only address linguistic forms when they encounter communicative problems, without any planned or explicit grammar instruction. He asserted that the timing of a focus on form should align with the student's developmental readiness, thus ensuring that learners are addressing forms they are prepared to acquire. Integrating a focus on form into task performance, either during or after the task, gets rid of the need to focus on grammar before the task, which Long says is useless.

In contrast, Ellis's (2008) focus on forms seemed to be broader and more flexible, as Ellis noted that it allowed for both implicit and explicit attention to forms. It was suggested that form-focused instruction needed not occur exclusively during a task. On the other hand, it can be introduced at different stages, such as during the task cycle and the pre-task phase, where learners can be made more aware of linguistic structures through direct instruction before they start performing the task (East, 2021). Ellis (2008) also noted that a balance of planned instruction and reactive focus on forms benefited the students. It was said that Ellis's (2008) focus on form operations was flexible because they could get help at any time during the TBLT framework's learning stages.

Previous studies revealed that a focus on forms could improve the students' language abilities. Ellis et al. (2019) showed the effectiveness of a focus on forms in the pre-task phase where the learners were introduced to essential knowledge. As a

result, such intervention could significantly enhance the use of target structures during task implementation. A study by Long, Samuda, and Bygate (2008) also found that focusing on forms had positive effects in TBLT. In this case, the focus on grammar happened while the task was being done, rather than being introduced beforehand. As a result, this approach could enhance the students' foundational knowledge of grammar, enabling them to apply it effectively in their assigned tasks. More importantly, Ellis (2008) provided various roles of a focus on forms in TBLT's operations as follows:

1. Input-based instruction where input was manipulated in a way that directs students' attention to the target form.
2. Explicit instruction involved consciousness-raising or meta-linguistic explanation.
3. Output-based instruction enabled the students to manipulate and create texts by using explicit corrective feedback.

Input-based instruction focuses on adjusting the material students read or listen to, guiding their attention to specific language forms. Explicit instruction involves raising students' awareness or explaining language rules. Output-based instruction encourages the students to practice writing or speaking by creating texts and receiving clear corrective feedback. These methods have potential to improve science writing skills, as they help the students notice, understand, and apply the specific language features required for scientific communication in TBLT.

Regarding the notable benefits of a focus on forms, it is appropriate to apply Ellis's (2003) concept. Ellis explained how the learning process in TBLT can effectively address specific linguistic features or forms. Accordingly, it is important to consider which language forms a teacher should aim to address and to emphasize teaching a single form in depth, as outlined in the activities below.

1. Review the Students' Errors

Reviewing the students' grammatical errors was significant in language learning, especially during the during-task phase. Regardless of whether the students were working individually or in groups, the teacher should actively monitor their performance in terms of grammatical errors and language use. This allows the students to revisit and revise the assigned assignments as needed. In addition, this support allowed the teachers to identify common mistakes and patterns in students' language

use, and it was suggested that additional supports be provided in each learning phase. Ellis (2006) stated that the students should be encouraged to participate in the error correction process, either by self-correcting their mistakes or by collaboratively revising them with peers. In this regard, engaging the students in linguistic awareness activities not only reinforced their understanding of correct grammatical structures but also promoted autonomous learning and self-awareness in language forms and use. Finally, the teachers reviewed and discussed the identified errors with the students (Lynch, 2001).

2. Consciousness-Raising Task

Consciousness-raising was one of the essential techniques for encouraging the students to pay attention and reflect on language forms. Ellis (1997) and Willis and Willis (1996) pointed out that the CR was an accessible intervention as the teacher used to follow up on the assignments or tasks. This way could effectively gather the students' task performance, which could be useful to inform them of the area of improvement. Ellis (2006) also noted that the students should be invited to follow up on the tasks and explicitly observe the grammatical forms they produced ungrammatically during the task stage. Similarly, East (2021) remarked that the key element of the input was the rule being applied and explicitly revised by the teacher's supports, and it was believed that practicing with explicit knowledge of the rule eventually results in the language development. For instance, the students were provided with an explicit rule and examples demonstrating its application in writing tasks; they may be guided to analyze the input and deduce the rule independently. It was believed that this method encouraged the students to identify their grammatical mistakes, which led to appropriate language used in tasks, and finally they could construct their own sentences that demonstrated the rules successfully.

3. Production Practice Activities

Production practice activities were seen as an alternative to CR. In these activities, students were encouraged to do traditional grammar exercises that focused on repeating certain language forms and functions (Ellis, 2006). These repetitive practices included fill-in-the-blank exercises, flashcards, and jumbled sentences, aimed at fostering the automation of grammatical structures and knowledge that students had initiated but not yet fully mastered. By incorporating these activities into language learning, the students could reinforce their understanding and correct grammar usage

for assigned tasks. With these kinds of activities, students might be able to better remember the structures of language, which would help them speak and write more fluently and correctly. This would also help them remember newly learned forms, which would boost their confidence and writing skills.

4. Noticing Activities

Noticing activities exhibited myriad helpfulness to increase the students' linguistic features knowledge in their language learning. Ellis (2006) suggested that noticing activities with a focus on forms constructs language improvement, leading to better language use in assignments. Lynch (2001) noted that having the students create transcripts of a segment (90-120 seconds) from their task performance was a means of encouraging noticing as the students were instructed to make any edits, they deemed necessary. Subsequently, the teacher collected the word-processed transcripts and revised them. The next day, the teacher assigns students the task of comparing their edited transcripts to the teacher's revised version. Lync (2001) revealed that this method encouraged the students to complete the tasks collaboratively during transcription by applying received feedback to perform self- and peer correction. Finally, Lynch (2001) pointed out that there were myriad opportunities left for the teacher to implement further necessities after the students had made their changes.

2.3.3 Focus on Forms Activities in TBLT for Science Writing

The benefits of focusing on forms include a range of effective instructional techniques, such as error review, consciousness-raising tasks, production activities, and noticing activities. These techniques can be adapted for whole-class instruction or tailored to individual learning needs. In this study, where students were required to complete science writing tasks in English, such activities proved particularly useful in helping learners synthesize the functions and structures of the target language. By engaging in form-focused activities, students were encouraged to pay close attention to language use, enhancing their ability to construct grammatically accurate and coherent scientific texts.

Additionally, these activities supported students in recalling precise wording and lexical patterns, improving their ability to complete science-related writing tasks successfully. Writing lab reports in science classes demands strong language skills, precise grammatical structures, and appropriate word choices. A focus on forms during

task-based activities helped EFL Thai high school students gain deeper insights into linguistic features, ultimately improving the quality and accuracy of their lab reports.

More importantly, while TBLT combined with a focus on forms has been shown to be effective in language learning, previous studies have identified certain constraints and limitations, which will be explored in the next section.

2.3.4 Drawbacks of a Focus on Forms in Task-Based Language Teaching (TBLT)

While a focus on forms can help students familiarize themselves with linguistic features and grammatical structures, particularly in science writing such as laboratory reports certain constraints and limitations have been identified during task completion. These challenges include negative feelings, difficulties, and even boredom in language learning. Guchte (2015) and Hawkes (2012) pointed out that one of the key difficulties students faces is balancing content learning and language form acquisition. Although repeating tasks can help reinforce language structures and forms, they also noted several challenges that arise in learning and teaching processes:

1. Lack of Task Analysis and Needs Assessment: There is often an insufficient analysis of students' communicative needs at an individual or group level. The absence of needs assessment means that students' learning styles and preferences may not be adequately addressed.

2. Overuse of Linguistic Grading: Language-focused materials, particularly in vocabulary and grammar, often lead to overly simplified and repetitive content. Widdowson (1972) noted that an excessive focus on linguistic forms in classrooms can result in unrealistic and inauthentic language input, resembling basal readers rather than meaningful communication.

3. Reduced Engagement and Motivation: Even with highly skilled teachers and well-designed textbooks, an overemphasis on linguistic forms can make lessons dull and monotonous, especially in writing contexts. This can lead to lower student motivation, reduced attention, and even a decline in course enrollments.

2.3.5 Strategies to Address These Challenges

To overcome these limitations, teachers should consider several key adjustments to enhance the effectiveness of focus on forms in TBLT:

1. Conduct Thorough Task and Needs Analyses: Identify students' specific communicative requirements, learning styles, and preferences to create targeted lesson plans. Ensure that lessons are tailored to individual and group needs, rather than applying a one-size-fits-all approach.

2. Incorporate Authentic Materials and Tasks: Use real-world language input to create engaging and contextually relevant classroom activities. Move away from oversimplified, repetitive content that lacks authenticity and communicative value.

3. Balance Linguistic Focus with Meaningful Interaction: Implement interactive, context-rich activities to stimulate engagement while reinforcing grammatical forms. Foster an integrated learning environment where language structures are embedded within meaningful tasks rather than being taught in isolation.

4. Integrate Active Teaching Strategies: Use collaborative projects, creative writing exercises, and problem-solving tasks to enhance interest in writing. Encourage students to engage in discussions, group work, and peer feedback to develop both accuracy and fluency.

2.3.6 TBLT Framework as a Solution

Ellis (2003) and Willis (1996) proposed strategic phases in TBLT that can help mitigate the negative effects of a focus on forms:

1. Pre-task Phase:

- Builds foundational knowledge and introduces key learning concepts.
- Provides students with necessary vocabulary, grammar, and contextual background before engaging in the main task.

2. During-task Phase:

- Encourages active learning, where students implement tasks individually or collaboratively.
- Instructors offer guidance and real-time feedback, ensuring that grammatical accuracy does not hinder communication.

3. Post-task Phase:

- Students analyze, reflect, and discuss their performance through group discussions, peer reviews, or oral presentations.
- Reinforces linguistic awareness while maintaining an engaging, communicative approach to learning.

By following these structured learning phases, Ellis's (2003) and Willis's (1996) models effectively balance form-focused instruction with communicative tasks, ensuring that students develop both grammatical competence and language fluency. These approaches reduce the drawbacks of a focus on forms, making TBLT more dynamic, engaging, and practical in science writing lessons.

2.3.7 Integration of a Focus on Forms into Scientific Laboratory Report Writing

Writing is basically a fundamental aspect of English language acquisition, serving to express ideas through various forms. In this regard, this study applied a focus on forms with the aim of enhancing science writing performance in English through explicit language teaching of forms. A high-quality science writing requires the precise application of grammar, technical vocabulary, organizational structures, coherence, and language clarity to effectively communicate with an audience (Muhari et al., 2017). Hyland (2013) noted that EFL learners had difficulties in balancing the cognitive demands of articulating ideas while navigating grammatical structures in writing. Flower (1994) also observed that instructors often struggled to guide EFL students in understanding the structure of writing, which is crucial for effective communication. These studies shed light on difficulties found among EFL students that needed to be improved in terms of the student's grammar knowledge in a scientific context.

Although relatively few studies, particularly in Thailand, have explored this area, some evidence suggests that focusing on linguistic forms may enhance students' grammatical knowledge. Moreover, research conducted in EFL contexts has indicated the potential effectiveness of form-focused interventions.

Several studies underscored the importance of integrating grammatical accuracy into writing instruction for high school students. Sadeewong (2020) demonstrated that applying a focus on forms approach significantly enhanced Thai secondary school students' performance in the grammar section of the TOEIC test. It

was claimed that focusing on forms was a highly effective model that had positive effects on academic language improvement, particularly in the linguistic feature section of standardized tests.

Focusing on specific grammar topics proves effective when lessons carefully scope the learning content and linguistic features. This regard also addresses students' needs and provides essential knowledge required to write lab reports in a systematic and appropriate manner. To determine the linguistic features or grammatical forms in laboratory report composition, the researcher followed the suggestion from the study of Parkinson (2017). Parkinson analyzed rhetorical moves and specified the importance of each move. Conclusively, the moves that frequently appear in the laboratory report are abstract, introduction, methods, results, discussion, and conclusion. Each rhetorical move contains specific linguistic features and textual features, including signal words, as illustrated in Table 2.6 below.

Table 2.6 Moves, Linguistic Features, Textual Features in Laboratory Report Writing

Moves	**Linguistics features and textual features**
Abstract	Move: A1 stating aim (past tense) *Keys words "aim" or "objective"* Move: A2 introducing topic (present tense) *Mentioning the context of the experiment.* Move: A3 stating results (past tense) *Keywords "the results showed", "were found"* Moves: A4 drawing a summary (present tense) *Providing experiment implication*
Introduction	Move: I1 establishing topic (present tense) *Claiming importance by using the word like "important"* Move: I2 starting aim (past tense) Keyword "aim", "goal" or "purpose" Move I3 Introducing experiment (past tense, passive voice) *Describing experiment method*
Method	Move: M1 listing materials and equipment Move:M2 experimental procedures (past tense, passive voice, linkages) Detailing procedures
Results	Move: R1 restating methodology (past tense, passive voice) Justifying methodology Move: R1 Announcing results (past tense and passive)

Table 2.6: *(Continued)*

	Providing table, graph, or formulae (present tense)
	Move: R2 interpreting the results (past tense)
	Assisting the reader in understanding the findings
Discussion	Move: D1 contextualizing discussion (present tense)
	Explaining the findings in a light of theory
	Move: D2 Interpreting the results (past tense)
	Restating the method and the results of the experiment
	Move: D3 making suggestion and limitation (past tense)
	Recommending for future study
Conclusion	Move: C1 summarizing the results (present tense)
	Drawing conclusion
	Move: C2: Drawing claim, limitations or suggestions (Present tense)

Table 2.6 reveals six rhetorical moves and linguistic features/grammatical patterns involved in composing a laboratory report. Parkinson (2017) noted that lab reports should use explicit language and technical vocabulary to formalize the language of the reports. For instance, signal words in stating aim "aim," "objective," or "purpose" and stating the results "the findings showed," "were found/determined/identified/proved," etc. As shown in Table 2.5, the researcher used certain language elements from Parkinson's (2017) research to plan the course's structure, learning materials, focus-on-forms activities, and learning assessment, including scoring rubric parts for writing lab reports in this study.

2.3.8 The Role of TBLT and a Focus on Forms in English Writing

The integration of TBLT with a focus on forms has gained significant attention in language education, particularly in relation to students' writing abilities and attitudes toward language acquisition. Scholars such as Willis (1996), Skehan (1998), and Long (1988) have emphasized that TBLT is communicative-oriented, yet it also allows for targeted attention to specific language forms and functions, contributing to the development of linguistic accuracy.

Bhandari (2020) suggested that students perform writing tasks more effectively in TBLT-based peer interactions (working in pairs and groups) compared to traditional

teacher-centered instruction. However, to maximize task effectiveness, students require training on how to design, sequence, and implement tasks that align with curriculum objectives at the secondary level.

Long (2015) proposed a balanced approach, integrating focus on forms with meaning-focused activities to provide learners with opportunities to practice specific linguistic forms within meaningful contexts. This approach enables students to understand the role of form in effective communication rather than treating grammar as an isolated component. Similarly, Yin (2012) observed positive outcomes when students engaged in focus on forms activities, as they were able to internalize sufficient language structures to complete writing tasks with grammatical accuracy.

Additionally, Long (1997) highlighted that incorporating a focus on forms within TBLT ensures that students acquire essential grammatical structures, preventing the erosion of grammatical competence during language learning. As a result, a focus on forms serves as a critical instructional strategy in writing lessons, equipping students with both the knowledge and practical application of linguistic features necessary for effective written communication.

2.3.9 The Role of Interaction in Focus on Forms Instruction

In practice, Ellis, Basturkmen, and Loewen (2001) identified two key types of interactions that facilitate language correction in a focus on forms approach. A Focus on Forms episode can occur in two main ways. First, it may arise when a teacher responds to a student's error during spoken or written production. In this case, the teacher provides correction naturally within the flow of conversation or task, subtly reinforcing accurate language use. Alternatively, a Focus on Forms episode may be initiated by either the teacher or students, where the lesson is momentarily paused to explicitly address a specific grammatical structure or expression. Both approaches serve to enhance learners' awareness and understanding of language forms within meaningful contexts.

This approach allows for direct questioning and clarification, ensuring students develop metalinguistic awareness while engaging in meaningful communication. In focus on forms instruction, the teacher plays a critical role in encouraging students to recognize, acquire, and apply linguistic features within authentic language tasks. Ellis, Basturkmen, and Loewen (2001) further noted that introducing a focus on forms during

the during-task phase enhances students' grammatical competence by promoting reflection and discussion on language use and its functions. This process is outlined in Table 2.7 below, demonstrating how TBLT's structured phases facilitate form-focused learning.

Table 2.7 Techniques of a Focus on Forms in TBLT's During-Task Phase

Technique	Interactional device	Description
Implicit	1. Asking for explanation	A student is encouraged to seek for clarification from peers as the first opportunity for him or her to reformulate.
	2. Recast	A task is partly or entirely revised following peers' suggestions.
Explicit	1. Explicit correction	A task student draws explicit attention to another participant's deviant use of a linguistic form. (e.g. 'Not x but y.')
	2. Metalingual comment/question	A task student uses metalanguage to draw attention to another participant's deviant use of a linguistic form (e.g. 'Past tense not present tense.')
	3. Query	A task student asks a question about a specific linguistic form while performing the task (e.g. Why 'can' use here?).
	4. Advise	A task student (usually the teacher) advises or warns about the use of a specific linguistic form (e.g. 'Remember you need to use past tense').

Table 2.7 reveals the functions of a focus on forms during the during-task phase, which are divided into explicit and implicit methods. Both methods are used to promote the students' knowledge of linguistic features in the context of the during-task stage. Ellis (2006) noted that these processes were useful for the students' needs in terms of managing the grammar parts of the tasks, and it could enhance their

comprehensions in language forms that were received from the teacher as well as their peers as described below.

1. Conversation in nature
2. Promoting the explicit formulation of messages
3. Chances for risk tasking in linguistic features or grammatical forms
4. Opportunities for students to engage explicitly in specific linguistics forms
5. Shared goals for tasks
6. Effective scaffolding of the students' efforts to communicate in the target language

These elements can contribute to science writing skills, as the students are required to engage in natural conversations and explicitly formulate messages as feedback to help them articulate ideas clearly, which is a crucial skill in scientific writing. Encouraging risk-taking in using linguistic features or grammatical forms can build confidence and fluency, while tasks focused on explicitly specific language structures can enhance writing accuracy. Shared task goals potentially create a sense of purpose and collaboration, and effective scaffolding supports the students in developing the ability to communicate complex ideas in the target language, aligning with the precision and clarity required in science writing.

Empirical studies revealed the effectiveness of integrating a focus on forms in TBLT for enhancing writing capacity. Çetin (2022) and Kafipour et al. (2018) pointed out that the TBLT exhibited positive effects on writing proficiency development among the EFL learners. Salimi et al. (2014) and Grim (2008) also found significant improvements in the learners' accuracy in written tasks and grammar after a focus on form treatment. In the Thai context, Chanwaiwit (2018) observed an increase in positive satisfaction levels following the implementation of a form-focused TBLT approach in translation accuracy lessons. These studies showed that the TBLT method works best when it focuses on forms and effectiveness to improve students' writing skills. This method could be used in this study to help students write better English lab reports for science.

To address the study's objective which is to examine the effectiveness of TBLT combined with a focus on forms in enhancing Thai high school students' scientific lab report writing. It is useful to integrate form-focused activities that support language functions and grammar use in scientific contexts. The proposed teaching framework is shown in Table 2.8 below.

Table 2.8 Focus on Forms in TBLT to Enhance Scientific Laboratory Report Writing

Learning Stage	Focus on Forms Instruction	Examples
Pre-task	1. Raising awareness of target forms 2. Providing opportunities for controlled practice 3. Scaffolding and pre-teaching of essential vocabulary and language functions	1. Brainstorming vocabulary related to the task 2. Matching exercises 3. Providing word banks 4. Cloze tests
During-task	1. Monitoring and providing feedback on form-related issues 2. Scaffolding learners' use of target forms through prompts and reformulation 3. Encouraging peer interaction and feedback on forms	1. Identifying errors during writing process 2. Providing prompts to guide forms usage 3. Providing prompts to guide forms usage
Post-task	1. Analyzing and reflecting on form-related errors 2. Providing corrective feedback and opportunities for focused practice 3. Integrating form-focused activities into revision and editing processes	1. Identifying common errors in class discussion 2. Offering targeted grammar exercises 3. Highlighting areas for improvement in grammar and usage

Table 2.8 illustrates the integration of focus-on-forms instruction, based on Ellis's (2006) guidelines, within the TBLT framework for teaching scientific laboratory report writing in English. According to Ellis (2006), focus on forms was mainly implemented at the during-task stage which aimed to attract the student's attention to the specific linguistic features while completing the tasks. Interestingly, Ellis (2008) noted that a focus on forms was flexible and could be operated throughout each learning stage of the TBLT framework because the students should be given accessible supports whenever they needed them. These activities were also used to deepen the students' understanding of the scientific report genre and the purpose of each report section by expressing appropriate language use and forms. In this study, a focus on forms was implemented at the during-task stage, and it was also applicable to other stages where necessary.

2.4 Introduction to English Writing in Science Education

Scientific contexts widely recognize English for specific purposes (ESP) as distinct from general English (GE). Teachers for ESP work with a specialized academic language to help students develop an academic science register. Margarita et al. (2019) pointed out that English writing has historically played a significant role in science education, reflecting the trends in scientific culture and human culture in general. Snow, Met, and Genesee (1992) noted that teaching scientific language in English was compatible with learning contents in which the students were given a specific body of knowledge, including key grammatical structures and content patterns, to enable students to communicate scientific knowledge, analyze scientific ideas, and evaluate experimental evidence. Similarly, English writing in science education exhibits positive effects, enabling students to transition from merely demonstrating current information to actively developing new knowledge (Bereiter & Scardamalia, 1987). According to Fang (2006), academic language in science education encompasses specific vocabulary and discourse patterns that are distinct from the language students use in their daily lives. This specialized language includes terms, phrases, and sentence structures unique to the scientific content field, highlighting the importance of integrating language skills with scientific literacy.

It can be concluded that the compatibility of teaching English scientific language with content learning encourages the students to convey, analyze, and evaluate scientific knowledge effectively. Moreover, writing serves as both a medium for demonstrating knowledge and a tool for constructing new understanding. The integration of specific vocabulary, grammatical structures, and discourse patterns unique to science further emphasizes the need for language skills to be embedded within scientific literacy, enhancing students' ability to engage deeply with scientific content.

In this study, linguistic features refer to the language forms and grammatical structures specific to scientific writing particularly experimental laboratory reports in English that students encounter during the TBLT process. The aim is to help students become familiar with scientific language use and develop science literacy through English instruction. To reach these learning goals, it is important to integrate scientific

learning contents where the students can learn, and the teacher can teach, resulting in. Content and Language Integrated Learning, or CLIL. CLL is a strategy that necessitates the involvement of specialists in scientific disciplines to enhance the quality of the learning materials.

2.4.1 Incorporating English Writing into Science Education under the Content and Language Integrated Learning (CLIL) Approach

There are specific goals for writing in science: to improve the writer's critical thinking, understanding of scientific concepts, and communication skills for scientific ideas; to help people become more scientifically literate; and to build the reasoning skills needed to be successful in science teaching and related fields. Wellington and Osborne (2001) noted that having scientific literacy in writing reflected the ability to comprehend the language of science and scientific methodological concepts. Furthermore, Norris and Phillips (2003) pointed out that the significance of the English language in a scientific context is the fundamental aspect of scientific literacy in reading and writing and involve understanding science content. It is suggested that English writing in a science classroom is important to encourage the students to develop critical thinking skills, well-organized writing in the learning process, and it also helps them to express ideas by making critical connections, summarizing data, and effectively communicating the results. Importantly, Next Generation Science Standards (NGSS) proposed a strong emphasis on developing the students' abilities to inquire, problem-solve, experiment, analyze data, draw conclusions, and effectively communicate their findings. It is suggested that emerging scientific concepts knowledge in English language learning could provide the opportunities for the students to improve science writing through exercising scientific reports writing activities in English.

To support Thai high school students in learning English through science and enhancing their scientific writing skills, this study integrated CLIL with TBLT and a focus on forms, combining language instruction with science content and writing tasks. CLIL is also used as a method to collaborate with foreign science teachers and to ensure the quality and appropriateness of the teaching contents in the science writing context. Theoretically, CLIL is an educational method in which two subject matters, such as science or history, and language (often a foreign language like English) are taught simultaneously, and its main goal is to help the students gain expertise in a specific

field while improving their proficiency in a foreign language. Previous studies had proved that CLIL was an effective method to implement science lessons in language classrooms. Marsh et al. (2012) noted that CLIL has proven to be highly effective in creating an interactive atmosphere that encourages deeper learning and promotes the authentic use of language in scientific writing in an English context. Van de Craen et al., (2007) pointed out that CLIL emphasizes language scaffolding, and it was recommended in language learning to provide the students with sufficient language support, reduce their linguistic load, and enhance their overall learning experience. In Thailand, applying CLIL in science writing, especially lab report writing in English, is limited. However, there was an insightful study that investigated the impact of English science textbooks word lists (ESTWL) and the CLIL approach on Thai EFL students' understanding of science vocabulary and science content knowledge. As a result, there was a positive improvement among the three groups of secondary school students, and most of them exhibited positive opinions concerning CLIL and ESTWL (Kruawong & Phoocharoensil, 2024).

In the light of CLIL, it has been proved that teaching science contents in English language classrooms is highly appropriate for EFL students, especially Thai high school students, who can develop English and science knowledge at the same time. Therefore, it can be asserted that this study was implemented through content-based teaching, specifically in a science context, in which scientific laboratory reports written in English were taught to EFL Thai high school students through the TBLT teaching framework. However, the teachers must carefully select relevant content, implement strategies to support language development, and meticulously plan lessons to ensure both the subject matter and language are appropriately taught (Marsh et al., 2012). It was suggested the teacher master learning contents in various fields, particularly in science. Consequently, cooperating with foreign science teachers to ensure the appropriateness of the scientific contents in science writing was deemed essential for both the teacher and the students in the current study.

Previous studies revealed various benefits when applying the CILL to science teaching in an English language context. The findings of Maldonado Chauca, Pérez Ortiz, and Campoverde Lopez (2023) highlighted the benefits of integrating language and content, showing that this approach not only enhances language skills but also helps students better understand complex scientific concepts. Similarly, Beaudin

(2021) examined the effects of a CLIL program on Taiwanese primary school students, finding significant improvements in both science and language learning outcomes. These studies revealed that CLIL was highly effective in teaching science in English and fostering holistic learning by combining content mastery with language development. The next section delves into how science writing practices can support the students to build their scientific understanding, further advancing their literacy in the context of lab report writing.

2.4.2 Science Literacy in Writing

Writing is a productive skill that is crucial for learning practice to develop the students' written communication and critical thinking. In science, writing is one of the essential practices for improving science literacy, leading to the ability to think critically and express information systematically. Roberts (2007) noted that science literacy was crucial for communication, including reading, writing, and language, and it was fundamental in both science and scientific literacy. Yore et al. (2003) also pointed out that educators widely acknowledged the importance of using writing as a tool to improve learning in science, which could develop the conventional scientific writing genres. Similarly, Tomas (2012) and Prain (2006) revealed that once the students achieved mastery of scientific contents and comprehension, positive attitudes and interest in science were found among them as they could comprehend and apply scientific concepts in real life. Consistently, Millar et al. (2007) described that preparing the students to become global citizens in the future and encouraging them to familiarize themselves with scientific knowledge was important. Overall, it was suggested that science writing can enhance the students' wider range of science knowledge and writing capacity, which led to scientific literacy in writing.

The main objective of this study was to investigate the effectiveness of TBLT alongside a focus on forms for scientific report writing performance in English and foster science literacy among a single group of Thai high school students. Within this study, science writing referred to the writing tasks of scientific reports that were given to the students who registered in science and mathematics programs. Science laboratory reports were the written forms or the systematic reports in writing of any scientific experiment that were applied in language teaching as main tasks.

2.4.3 Genre of Scientific Laboratory Reports

Writing in science has been recognized in academic writing, which is significant for EFL high school students to master. According to Gardner and Nesi (2013), scientific laboratory reports are based on experimental works, which are the most common type of writing used to teach science students, as shown by the BAWE corpus. Kalaskas (2013) highlighted that lab reports are a pedagogical genre designed to evaluate, grade, and rank students (p. 132). Among the insights provided by the reports, it has been revealed that a scientific laboratory report writing is a piece of academic writing, evidenced by the laboratory experiments. In schools, lab experiments are required to be implemented in science courses as an opportunity for students to actively build authentic learning experiences in the field.

A number of previous studies provided useful suggestions for the science genre in lab report writing. Hesselbach et al. (2012) provided guidance for writing scientific papers from high school through graduate-level research. They further revealed that specific report sections were essential to produce a specific, clear, and coherent scientific report, namely the abstract, the introduction, the results, and the discussion. According to Wolfe (2011), the lab report consisted of a sequence of predetermined arguments that presented their assertions implicitly. Similarly, Martin and Rose (2008) stated that procedural texts that give directions on how to carry out a task, such as laboratory manuals, are supplemented with procedural recounts, which largely tell what happened. Wignell (1994) also suggested the lab report writing process involved specific moves to reflect specific purposes as well as interpretation of each section. It was suggested that science lab reports are the specific type of writing commonly used in science education to present the findings of laboratory experiments and known as the genre of science lab reports. Lab reports are a big part of science classes like physics, biology, and chemistry. They usually use certain scientific rhetorical moves or patterns, as well as certain linguistic and textual features.

Moreover, Parkinson (2017) showed significant findings in the rhetorical patterns or moves of the laboratory report's genre writing. The dataset used was made up of 60 high-quality lab reports from the BAWE corpus. The reports were from four different science fields: biology, food science, chemistry, and engineering. The results showed that the six required macro-sections an abstract, an introduction, a method, results,

discussion, and conclusion were often used in writing lab reports in all kinds of fields. It was suggested that the particular moves of a laboratory report were essential and obligatory in expressing the experimental data in the form of systematic reports. Based on Parkinson's (2017) insightful findings, this study followed the rules for writing an English lab report and used helpful learning materials, suggestions, and rhetorical moves to carry out the teaching process of this study.

2.4.4 Moves in Scientific Laboratory Reports

Science laboratory reports are systematically written to offer straightforward understanding in patterns for readers. They present a distinctive style of argumentation in the text and serve as a medium to convey existing truths, including observable facts, to the public. In the past, people commonly viewed science laboratory reports as settings for demonstrating, validating, and illustrating established principles and laws (Hofstein & Lunetta 1982; NRC, 2005). Nowadays, science reports are commonly used in many studies in science education and also viewed as an effective way to achieve two goals simultaneously: learning scientific concepts and principles and acquiring scientific skills and practices (Dillon, 2008). Hodson (2014) also pointed out that laboratory reports were commonly referred to as 'doing science' and could be considered a crucial aspect of science education to address the fundamental learning objectives of science curricula. Therefore, the scientific lab report is a technique or learning tool to assist students in building their understanding of concepts in science topics through systematic writing reports, and it helps them organize the findings in meaningful patterns.

The science report moves or patterns are important sessions to express specific data effectively in written communication. Parkinson (2017) recommended utilizing rhetorical moves based on the similarities and differences between different sections of research articles and laboratory reports. From her research findings, laboratory reports comprise six main sections: the abstract, introduction, method, results, discussion, and conclusion. This study accordingly used these sections to guide the students in writing scientific laboratory reports in English, as illustrated in Table 2.9.

Table 2.9 Moves of Scientific Laboratory Reports Employed in This Study

Rhetorical Moves of Scientific Laboratory Report	
I.	Abstract (Stating the overview of the report)
II.	Introduction (Constructing the topic and experiment goal)
III.	Methods (Listing materials and describing experimental procedures)
IV.	Results (Announcing results)
V.	Discussion (Interpreting results and making suggestion)
VI.	Conclusion (Summarizing the study and suggesting for further improvement)

Table 2.9 reveals rhetorical moves for laboratory scientific reports, each section serving a specific goal in science communication. These moves typically include an abstract, an introduction, materials and methods, results, a discussion, and a conclusion. The abstract of the lab report states the aim and introduces the topic, the methods, and results, including providing a brief discussion.

The introduction section aims to provide background information, definitions, and overviews of the experimental topic. This section sets the stage for the lab experiment to help the reader understand the context and significance of the study. Next, the materials and methods section describe the experimental design and methodology used in the study, as well as providing enough detail for another researcher to replicate the lab experiment. Additionally, the results section showcases collected data and observations from the lab experiment. This section needs to be presented in a clear and organized manner, incorporating tables and figures as needed. Accordingly, the discussion and conclusion section provide a summary of the results and then interprets and draws conclusions from the findings. This section should also discuss the implications of the research and any limitations or directions for future studies. Overall, Table 2.9's suggested steps help organize a scientific report and ensure the inclusion of all necessary components.

Day and Gastel (2012) noted that science report writing exhibits clear and concise findings in specific sections such as a topic and introduction, a testable hypothesis, an explanation of the technique, key results, and a discussion that connects the results. When writing the title, the intention is to inform the reader about the purpose of the lab. The introduction phase in a scientific report manifests the

background and a brief overview of the experiment that contain the lab experiment's purpose. Experimental design and data analysis methods describe materials and methods in a laboratory experiment. Furthermore, a scientific report presents the quantitative or qualitative results in a table or figure format. In the analysis and discussion section, the authors provide an interpretation and summary of the experimental findings, explaining the significance of the results and offering suggestions for readers. These scientific methods used in lab reports are crucial for effective communication with readers, and these sections could serve as valuable tools for students to practice science writing in English. Students are encouraged to apply precise language use, specialized terminology, linguistic structures, and specific rhetorical patterns in writing lab reports. This approach simultaneously enhances their science writing skills, subject knowledge, English proficiency, and critical thinking abilities.

Following previous studies and the study of Parkinson (2016), the researcher analyzed and synthesized the findings to determine the features of the science writing tasks used in this study, as illustrated in Figure 2.1.

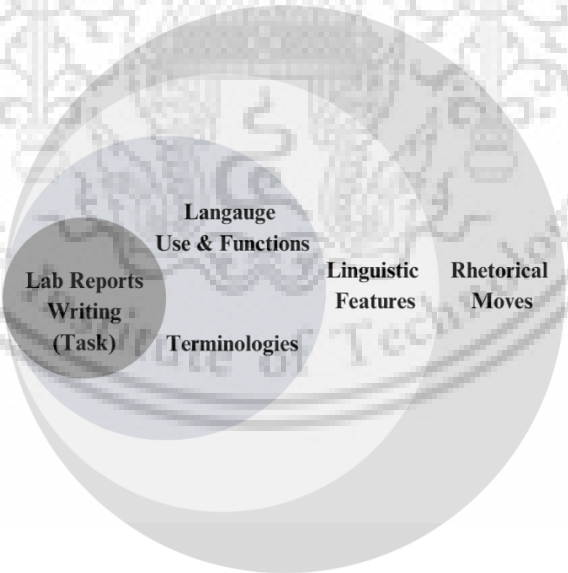


Figure 2.1 Features of Science Writing Tasks used in this study

Figure 2.1 shows how the features of the science writing tasks used in this study are connected, including writing moves, linguistic features, language use, and terminologies. These elements were combined in science writing and applied in the

TBLT learning process for Thai high school students to exercise lab reports written in English. The scientific writing tasks were applied under the framework of TBLT with the aim of enhancing scientific literacy in writing among the students in a science and mathematics program. Previous studies pointed out that writing lab reports had a variety of benefits to improve the students' science literacy in writing and their attitudes. Subramaniam (2010) pointed out that writing science in the classroom could serve as an interpretive task, encouraging the students to gain better comprehension of science knowledge, writing skills, knowledge transformation, critical thinking, and meaning reflection. Wellington and Osborne (2001) stated that exposure to various forms of scientific writing supports the development of scientific literacy and helps the students become familiar with the language and genres commonly used in the scientific community. Hyland (2000) also noted that understanding the genre of scientific writing, the rhetorical structure, linguistic features, and disciplinary norms of scientific discourse was important to communicating the findings to the scientific community effectively. Similarly, Swales (1990) pointed out that analyzing and comprehending the experimental finding in the sciences led to successful scientific communication. Overall, mastering linguistic forms, terminologies, language use, and science writing moves allows the students to effectively convey complex scientific information, leading to the construction of English academic writing.

2.4.5 Empirical Research Findings Related to Science Report Writing in High School Context

Strengthening science writing in this study referred to the act of enhancing the students' science writing ability by using scientific lab reports as tasks in TBLT teaching framework. Previous studies pointed out that EFL students may find science writing challenging to achieve in language classrooms. Rifai and Noerjanah (2021) noted that grade 8 students exhibited low motivation after they experienced English teaching and learning writing in a scientific context, and they faced difficulty in applying technical vocabulary in a science context. In the Thai learning context, Nuntasane et al. (2020) aimed to improve the scientific writing of Thai high school students through inquiry and science writing heuristic learning, and the findings suggested that these students' writing abilities in science needed to be improved urgently. Similar to the study of

Ua-umakul and Vittayapirak (2016), they utilized the corpus-based approach with two groups of Thai upper secondary school students who registered in a physics laboratory program. The findings revealed several common errors made by the students in writing scientific laboratory abstracts, including morphological, syntactic, lexical, semantic, and mechanical errors. Moreover, this study also provided insightful suggestions for teachers to encourage EFL students, especially Thai students, to use proper language use and functions in science writing, such as correct articles, commas, and correct spelling, as well as an appropriate use of active and passive voice. Consistently, the participants in this study exhibited weaknesses in composing lab reports in English, of which their major challenges comprised the proper organization of the writing moves, the appropriate use of linguistic features, and language use, including the use of specific terminologies and language style.

These findings, particularly in the Thai learning contexts, highlighted the research gap identified in this study. These difficulties needed to be improved urgently to enhance their overall writing skills, making them align with the expectations of scientific communication in lab reports. Therefore, alleviating these challenges with the TBLT approach, coupled with a focus on forms, was effective in enhancing the science writing in English by providing the students with authentic science writing tasks, active learning sessions, constructive feedback from the teacher, structured training plans, and active learning activities to foster their mastery of linguistic features, writing patterns, appropriate scientific terminology, and language style. These supports from TBLT could further help the students to overcome their difficulties by focusing on these strategies, and the teacher could equip them with the skills needed to produce coherent and well-structured lab reports, ultimately preparing them for academic and professional success in their respective fields.

2.5 Conceptual Framework of the Study

The TBLT instructional approach was applied and developed into a teaching process to foster science writing ability in English through the task of laboratory reports. The study's conceptual framework is illustrated in Figure 2.2.

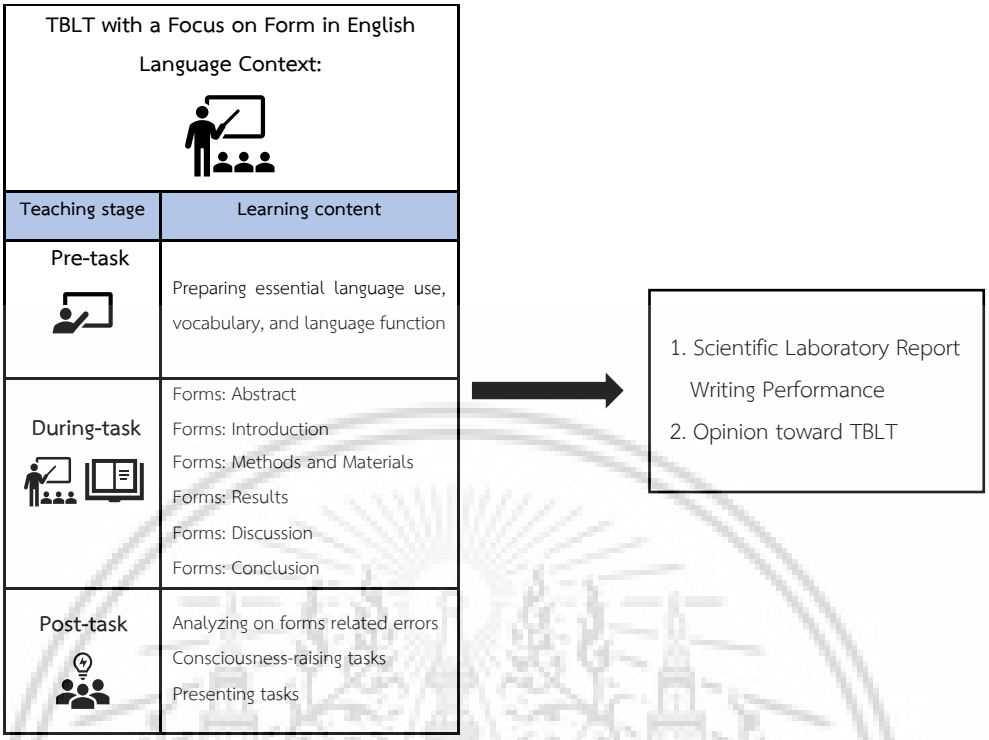


Figure 2.2 Conceptual Framework of the Study

As depicted in Figure 2.2 above, this research aimed to enhance the scientific laboratory report writing skills of Thai high school students through the implementation of TBLT instruction. The TBLT instruction consisted of three phases: pre-task, during-task, and post-task. Each phase of the learning process included distinct lessons designed to offer constructive learning experiences in composing laboratory reports within an English language teaching framework. Therefore, the study sought to investigate the effectiveness of the TBLT approach, particularly when combined with a focus on linguistic forms, in teaching English for writing scientific laboratory reports. Furthermore, this study also aimed to explore the opinions of students towards the TBLT in scientific laboratory report writing lessons.

2.6 Summary

Chapter 2 provided an extensive review of the literature on TBLT. This included its theoretical background, major characteristics of a task, teachers' and students' roles,

benefits and limitations, the principles of TBLT, the focus on forms in language teaching, English writing in the scientific context, scientific laboratory report writing, empirical research findings related to science report writing, and the latest studies of scientific laboratory reports for high school.

The literature review showed that TBLT could help high school students improve their writing skills, especially when writing lab reports for science classes, by giving them a meaningful and interactive way to learn a language. The review emphasized TBLT's potential to enhance these students' writing skills, particularly in scientific laboratory report writing, by providing a meaningful and communicative approach to language learning. It did, however, show that more research needs to be done to find the best ways to implement TBLT in Thai schools, find out how it affects students from different backgrounds, and create materials and resources that are specific to the Thai context to help with the successful integration of TBLT. Lastly, it illustrates the conceptual framework of the current study.

CHAPTER 3
RESEARCH METHODOLOGY

This chapter describes how the research was conducted to fulfill the research's objectives and to address research questions presented in Chapter 1. This includes research design, population and sample, research instruments, data collection procedures, data analysis framework, ethical considerations and confidentiality safeguards, and a concise summary of the chapter.

3.1 Research Design

This study employed a mixed-methods approach that was framed within the pre-experimental one-group pretest and posttest research design. To examine the effectiveness of TBLT on scientific report writing, focusing on its linguistic and textual features, this design was driven by its suitability for assessing the efficacy of an intervention within a single group, enabling direct comparisons of participants' performance before and after the treatment. While Glass (1965) highlighted the advantages of this design in distinguishing between maturation, testing, and treatment effects, it is acknowledged that is limited by the absence of a control group, making it susceptible to validity threats such as history and maturation effects.

In this study, a single group of students in this study was given the science writing tests before and after the treatment as a way to examine the effectiveness of the treatment. It should however be noted that this study had some limitations. There was no control group or comparison group, and it may cause a threat to validity, causing difficulty in the observed change without the control group. So, the results of the present study cannot be generalized to other high school students in Thailand and worldwide. The research design of this study is displayed in Table 3.1 below.

Table 3.1 Pre-experimental (One group pretest and posttest design)

Pretest	Treatment	Posttest
O_1	X_1	O_2

Where O_1 = Pretest (A scientific laboratory report writing)

O_2 = Posttest (A scientific laboratory report writing)

X_1 = Task-Based Language Teaching (TBLT) with a focus on forms

The research design for this study is shown in Table 3.1. The English writing of a scientific laboratory report was used as a pretest at the start of the research phase to see how well the TBLT worked with a focus on forms in science writing lessons in English. O2 demonstrates the posttest of the English writing in a scientific laboratory report that was provided after the participants experienced the treatment. Moreover, X1 represents the treatment used in this study, which was the TBLT with a focus on forms, and it was split into three main learning phases: pre-task stage, during-task stage, and post-task stage. The three learning stages totally lasted ten weeks. The pre-task stage involved introducing the essential learning topics, task preparations, and planning times. The during-task stage involved task practicing, task discussions, and preparing the target language for a scientific laboratory report. The final learning phase was the post-task stage, which comprised task analyzing and reflection, grammar-raising consciousness practice, reports revision and feedback, and task presentation.

3.2 Research Participants

In this study, purposive sampling was used to deliberately select participants who met criteria relevant to the research objectives. The sample consisted of 35 Thai EFL students in grade 11, enrolled in a science and mathematics program. Among these participants, 21 were female, and 14 were male. The program focused on several key objectives: developing scientific skills, improving language proficiency within a scientific framework, and fostering science literacy through writing. By targeting participants from this specialized program, the study sought to evaluate the effectiveness of TBLT in enhancing scientific report writing skills among EFL students. The researcher carefully identified and selected participants based on the following characteristics:

Table 3.2 Participants Selection's Criteria for a Purposive Sampling Method

Criteria	Description	Rationale
Program Eligibility	Qualified to enrolled in a science and mathematics program	Ensures participants possess basic scientific knowledge and skills relevant to the experiment.
Grade Level	Currently in grade 11 of the science and mathematics program	Ensures participants have similar academic experiences and are at a developmentally appropriate stage for the study.
Age Range	16-17 years old	Selects participants within a relevant age group for the experiment and minimizes potential age-related differences in cognitive abilities.
Language Proficiency	Utilize and speak English as a medium language in the classroom	Ensures clear communication and understanding of instructions and research procedures.
Laboratory Experience	Have conducted a scientific laboratory experiment in a science course	Ensures participants have basic laboratory skills and are familiar with scientific procedures.
English Summary Requirement	Must summarize the findings of the experiment in English	Allows for consistent evaluation of written communication skills and analysis of results.
Class Selection	Intact class of 35 students	Provides a manageable sample size and facilitates efficient data collection within a familiar classroom setting.
Program Eligibility	Qualified to enroll in a science and mathematics program	Ensures participants possess basic scientific knowledge and skills relevant to the experiment.

Furthermore, the participants exhibited varying levels of English proficiency, which were determined based on their English grades for the previous semester, allowing the researcher to understand how students with different proficiency levels engaged with TBLT activities, especially those focused on forms. They had never experienced studying English subjects within the TBLT teaching framework, nor had they engaged in learning scientific writing in the context of the English course. Based on the exhibited Table 3.2 above, participants were expected to engage effectively

with TBLT, focus on forms, and complete writing tasks in a scientific context. Prior to commencing the study, the researcher delivered the participants a consent form written in the Thai language of the students, which contained the purpose of the study, the tasks used for science writing, the benefits of this study, and the data collection procedures. The researcher encouraged the participants to read the consent form thoroughly and asked any questions regarding the study to make an informed decision about their participation. To ensure confidentiality and to protect the participants' personal information, their real names were replaced with pseudonyms, and they were allowed to use their own pseudonyms throughout the study.

3.3 Research Instruments

The study employed three primary research instruments to address two research questions. First, instructional instruments included a scientific laboratory report writing pretest and posttest, which were designed to investigate the impact of implementing TBLT on laboratory report writing. Second, a semi-structured interview protocol was utilized to explore students' perspectives on TBLT in scientific laboratory writing in English. Third, lesson plans were developed to guide the TBLT approach, ensuring structured and focused language learning activities for students. These instruments were discussed in detail across two sections: (1) descriptions of the research instruments and (2) validation of the research instruments as follows:

3.3.1 Descriptions of Research Instruments

The study utilized two research instruments, as outlined in Table 3.3, to gather data and answer the following research questions: (1) To what extent does Task-Based Language Teaching (TBLT) impact scientific laboratory writing in English? and (2) What are high school students' opinions on Task-Based Language Teaching (TBLT) in scientific laboratory writing in English?

These research questions focused on the application of the TBLT framework, which encompassed the pre-task, during-task, and post-task stages. To assess the impact of TBLT on scientific laboratory writing in English quantitatively, a pretest and posttest on scientific laboratory writing were conducted. For qualitative insights, a semi-

structured interview was employed to explore students' perspectives on the implementation of TBLT.

Table 3.3 Research Instruments and Statistical Tools

Aspects	Quantitative Data	Qualitative Data
Research Questions	1. To what extent does task-based language teaching (TBLT) improve high school students' performance in scientific laboratory report writing in English?	1. What are the high students' opinions toward task-based language teaching (TBLT) for scientific laboratory report writing in English?
Instruments	1. Pretest & Posttest (Lab Reports Writing)	1. Semi—structured interview (Interview protocol)
Statistical Tools	1. Mean scores (M) 2. Standard Deviation (S.D.) 3. Paired Samples *T*-Test 4. Cohen's Effect Size (1988) 5. Relative Gain scores	1. Content analysis (CA)

3.3.2 The Construction of Pre-and Post-test for Assessing Scientific Writing Performance

The researcher worked collaboratively with a foreign chemistry teacher on laboratory experiments and collecting the findings of the laboratory experiments in the chemistry course before administering the pretest and posttest. This study evaluated high school students' scientific laboratory report writing abilities through a pre-test and post-test process prior to and after their engagement with the TBLT approach. Previous conduction of lab experimental results in the science subject was applied to create the pre-and post-writing test, namely *"Relationship between volume and number of moles of a gas (Avogadro's law)"* and *"Chemical Reactions"* in the chemistry subject. The students were required to complete the pretest and posttest in English before and after the research implementation.

3.3.3 Pre-writing Test and Post-writing Test Reliability and Validation

This study employed both pre-test and post-test as research instruments to evaluate the scientific lab report writing performance of Thai high school students. These science writing tests were carefully designed and developed to ensure that while the content differed, the level of difficulty, format, and overall pattern remained parallel. The contents for both tests were derived from laboratory findings within a chemistry course, establishing a consistent benchmark for evaluating advancements in scientific writing abilities among the participants. This approach facilitated a reliable comparison of writing skills before and after the TBLT intervention, allowing for an accurate assessment of progress over time.

Before the pretest and posttest were given, they were both reviewed and changed by three experts in teaching English and science. The tests were later checked for content validity using item objective congruence (IOC). The researcher sent official letters to three experts for validating tests. The first expert was a school science teacher, holding a Ph.D. in science. Another expert was a foreign teacher in the English program who specialized in chemistry, and the third expert was a senior professional English teacher (K3). The outcome of IOC validation is displayed in Table 3.4 below.

Table 3.4 The Outcome of IOC's Pretest and Posttest Validation

Aspects	Experts			IOC
	No.1	No.2	No.3	
1. Clarity of instructions	1	1	1	1.00
2. Relevance of test items to scientific report writing	1	0	1	0.67
3. Appropriateness of test format	1	1	1	1.00
4. Alignment with TBLT principles	1	1	0	0.67
5. Readability of test items	1	1	1	1.00
6. Coverage of targeted scientific writing skills	1	1	1	1.00
7. Consistency and parallel between pretest and posttest	1	1	1	1.00

As illustrated in Table 3.4, the result of IOC validation was in the acceptable range (0.67-1.00). One of the experts suggested that "each section of the scientific laboratory reports required a specific tense, so the researcher should include a correct

tense for each move for science writing tasks." Another expert suggested that clearly separating each section would be beneficial for students writing lab reports in English.

After the tests were piloted with 30 high school students in a different science and math class, the item of difficulty index and the item of discrimination index were examined. The reliability was also determined using Cronbach's alpha reliability as a measure by using statistical program "Research Tools Analysis Program (RTAP)" which was developed by the faculty of education, Mahasarakham University. Table 3.5 and Table 3.6 showed the criteria for item selection and interpretation of the difficulty index and discrimination index.

Table 3.5 Criterion for Item Selection and Interpretation of Difficulty Index

Index of Difficulty (p)	Items Evaluation
0.80 - 1.00	Too easy
0.60 - 0.79	Rather Easy
0.40 - 0.59	Moderately difficult
0.20 - 0.39	Difficulty
0.00 - 0.19	Too difficult

Table 3.6 Criterion for Item Selection and Interpretation of Discrimination Index

Index of Discrimination (r)	Items Evaluation
>0.35	Very Good items, Excellent Discrimination
0.25 to 0.35	Reasonably Good, Good Discrimination
0.20 to 0.24	Marginal item, Acceptable Discrimination
<0.20	Poor item, Poor Discrimination

The outcomes of the difficulty index and the discrimination index for the pretest and posttest items were summarized in Table 3.7

Table 3.7 Results of Difficulty and the Discrimination Index for the Pretest and Posttest Items

Item	Index of Difficulty (p)	Index of Discrimination (r)	Interpretation	Remarks
1	0.633	0.2	Rather Easy Good Discrimination	Acceptable
2	0.58	0.253	Moderately difficult Good Discrimination	Acceptable
3	0.533	0.24	Moderately difficult Acceptable Discrimination	Acceptable
4	0.56	0.267	Moderately difficult Good Discrimination	Acceptable
5	0.60	0.213	Rather Easy Acceptable Discrimination	Acceptable
6	0.58	0.253	Moderately difficult Good Discrimination	Acceptable
7	0.573	0.24	Moderately difficult Acceptable Discrimination	Acceptable
8	0.533	0.213	Moderately difficult Acceptable Discrimination	Acceptable
9	0.613	0.213	Rather Easy Acceptable Discrimination	Acceptable

The outcomes of the analysis of the difficulty index and the discrimination induced for the pretest and posttest items were the difficulty index ranges from 0.53 to 0.63 and the discrimination index ranges from 0.2 to 0.26. Both were categorized in the acceptable range. Later, the coefficient of Cronbach's alpha was administered to determine the level of reliability of the pretest and posttest. The range of the reliability and its coefficient of Cronbach's alpha is revealed in Table 3.8 below.

Table 3.8 The Criteria of Reliability and Its Coefficient of Cronbach's Alpha

No.	Coefficient of Cronbach's alpha	Reliability Level
1	More than 0.90	Excellent
2	0.80-0.89	Good
3	0.70-0.79	Acceptable
4	0.6-.69	Questionable
5	0.5-0.59	Poor
6	Less than 0.59	Unacceptable

Table 3.9 Pretest and Posttest Reliability Results

Number of tests aspect	Number of the participants in pilot study	Cronbach's alpha
9	30	0.91

The overall value of the Cronbach's alpha score in Table 3.9 was 0.91, Interpreting it as an acceptable reliability level is possible. It is consistent with the study of Bathgate, Crowell, Schunn, Cannady, and Dorph (2015), who mentioned an unspecified alpha statistic twice. They detailed the creation of a tool to assess students' proficiency in constructing effective scientific arguments. The overall instrument demonstrated acceptable reliability, indicated by an alpha coefficient of 0.77. Thus, findings from the pilot study suggest that the pretest and posttest, or scientific laboratory report writing test, are acceptable to implement in this study as shown in Appendix A.

3.3.4 Construction of Scoring Rubric

The construction of the rubrics for assessing scientific report writing involved a systematic and thorough process. Initially, an assessment framework was meticulously developed, delineating the essential criteria for scoring scientific reports. Subsequently, the scoring rubrics were crafted to comprehensively evaluate key components such as the scientific genre or moves comprising abstract, introduction, materials and methods, results, discussion, and conclusion. Language style & technical words, including grammatical usage or linguistics features were assessed. The formulation of

descriptors and the assignment of numerical scale points were undertaken to establish a nuanced and effective scoring system.

The researcher also collaborated with two experts who specialized in a science context and English language teaching in developing the rubric. The advisors also played a pivotal role in aligning the rubrics with established standards and refining them for optimal effectiveness. In the present study, the researcher adapted the rubric from Black et al. (2002) for assessing the participants' performance in scientific laboratory report writing. The rubric was developed by employing the suggested obligatory moves in lab reports, derived from Parkinson (2017), as a guide for assessing students' scientific laboratory report writing performance. Parkinson (2017) stated that the rhetorical moves and linguistics features, specifically the use of sentences and linkages, were mainly identified in the sub-moves (move) within each main rhetorical move (Move) in laboratory reports as illustrated table 3.10 below.

Table 3.10 Moves, Linguistic Features, Textual Features in Laboratory Report Writing

Moves	**Linguistics features and textual features**
Abstract	Move: A1 stating aim (past tense) *Keys words "aim" or "objective"* Move: A2 introducing topic (present tense) *Mentioning the context of the experiment.* Move: A3 stating results (past tense) *Keywords "the results showed", "were found"* Moves: A4 drawing a summary (present tense) *Providing experiment implication*
Introduction	Move: I1 establishing topic (present tense) *Claiming importance by using the word like "important"* Move: I2 starting aim (past tense) Keyword "aim", "goal" or "purpose" Move I3 Introducing experiment (past tense, passive voice) *Describing experiment method*
Method	Move: M1 listing materials and equipment Move: M2 experimental procedures and Detailing procedures (past tense, passive voice, linkages)

Table 3.10 *(Continued)*

Results	Move: R1 restating methodology (past tense, passive voice) Justifying methodology Move: R1 Announcing results (past tense and passive) Providing table, graph, or formulae (present tense) Move: R2 interpreting the results (past tense) Assisting the reader in understanding the findings
Discussion	Move: D1 contextualizing discussion (present tense) Explaining the findings in a light of theory Move: D2 Interpreting the results (past tense) Restating the method and the results of the experiment Move: D3 making suggestion and limitation (past tense) Recommending for future study
Conclusion	Move: C1 summarizing the results (present tense) Drawing conclusion Move: C2: Drawing claim, limitations or suggestions (Present tense)

Table 3.10 revealed that the six rhetorical moves were related to each other, and the linguistic features or grammatical patterns played a vital role in composing a laboratory report. the findings of Parkinson (2017) implied that explicit language and technical vocabulary were essential in formalizing the lab reports, for instance, signal words in stating *aim "aim", "objective", or "purpose"* and stating the results "*the findings showed*", *"were found/determined/identified/proved" etc.* Based on the genre analysis of the student's laboratory report above, the areas of assessment in this study conclusively were abstract, introduction, method, results, discussion, conclusion, format organization, linguistics features, language style and vocabulary. These major moves and their forms were applied in science writing tasks in this study to foster the students' lab report ability in English, and samples were shown in Appendix B.

3.3.5 Assessing Components in Scoring Rubric

In determining the components of the scoring rubric, this study conclusively adapted the rubric's criteria description from Black et al. (2002), and rhetorical moves, linguistic features, technical words, and language style were infused in the scoring

rubrics as the assessing components adopted from Parkinson (2017). Thus, the component in assessing the laboratory reports comprised six rhetorical moves, linguistic features, and vocabulary and language style. The areas of rubric assessment are indicated in Table 3.11 below.

Table 3.11 The Area of Assessing Components in Scoring Rubric

Assessing Components in Rubric Scoring	
1. Rhetorical Moves of a Lab Report	**2. Linguistic Features**
Abstract Introduction Materials and Methods Results Discussion Conclusion	Vocabulary and Language Style (Objectivity, Precision, Formality, Clarity, Technical terms) Grammatical usage (Sentence structure, Subject-verb agreement, Tenses, Linkages)

Table 3.11 outlines the focus of laboratory report assessment for high school students in a science and mathematics program. The table has two mains assessment components: organization of the rhetorical moves and linguistic features. Under the organization of the moves, it lists the six main moves of a laboratory report: abstract, introduction, materials and method, results, discussion, and conclusion. The assessment of the organization focused on how well the student structured their report to include these six moves logically and coherently.

Under linguistic forms, Table 3.10 lists the specific forms to be assessed in each of the moves. These elements include sentence structure, tenses, subject-verb agreement, and linkages. The assessment of linguistic forms focused on how well the student used these grammar elements to convey the content of scientific laboratory reports. Overall, Table 3.10 provides a framework for assessing laboratory reports in English, with a focus on both the organization of the moves and linguistic forms.

To define elements within the two areas of rubric assessment, the researcher provided the descriptive criteria for each element in Table 3.12 shown below.

Table 3.12 Descriptive Criteria of Each Area in Rubric Assessment

Areas of assessment	**Description**
Abstract	Clearly restates the experiment goal, a brief discussion and main findings
Introduction	Provides strong background and context for the experiment question, including relevant literature review
Materials & Methods	Clear, complete, and replicable description of materials, procedures, controls, and statistical methods
Results	Accurate, objective, and organized presentation of results using appropriate visuals and statistics
Discussion	Clear and logical interpretation of results, connection to hypothesis and literature, identification of limitations and future directions
Conclusion	Brief and effective summary of main findings, limitations, and future implications, emphasizes key takeaways without overstatement
Format Organization	Arrange the sections following the correct moves of scientific laboratory report
Vocabulary and Language Style	Uses appropriate scientific terminology and avoids jargon
Grammatical usage	Clear, concise, and grammatically correct writing

Table 3.12 outlined a rubric for assessing high school students' scientific laboratory report writing, specifically focusing on their progress between a pretest and posttest. It evaluates key areas such as abstract, introduction, materials & methods, results, discussion, conclusion, language style, and grammar, each with a score of 5 points for a total of 45 points. The table highlighted the importance of clear and concise communication of research findings, including a strong background, accurate results, logical interpretation, and effective summary. It also emphasized the use of appropriate scientific terminology and proper grammar. Additional notes suggested further refining the criteria within each score level, adding relevant assessment areas,

and potentially creating a separate rubric for evaluating the experiment itself. Overall, this table provided a valuable tool for evaluating and tracking the development of high school students' scientific writing skills in the context of laboratory experiments.

Table 3.13 Scoring Items in the Rubric for Scientific Laboratory Report

The focus and criteria of a scientific laboratory report assessment			
Rhetorical moves	**Points**	**Linguistic features**	**Points**
Abstract	5	Vocabulary and Language Style	5
Introduction	5		
Materials and Methods	5	Grammatical usage	5
Results	5		
Discussion	5		
Conclusion	5		
Format Organization	5		
Total	**35**	**Total**	**10**

Table 3.13 titled "The Focus of Scoring Rubric in Scientific Laboratory Report" provided a structured assessment framework for evaluating scientific lab reports. The rubric was divided into two main parts: Rhetorical moves and Linguistic features, with each category contributing to a total score. The Rhetorical moves category focused on the structural components of the report, such as the Abstract, Introduction, Materials and Methods, Results, Discussion, Conclusion, and Format Organization. Each of these elements was assigned a maximum of 5 points, summing up to a total of 35 points. This approach ensures that all fundamental aspects of the report are systematically evaluate for their contribution to the overall content and structure.

The second category, linguistic features, assessed the quality of language used in the report, specifically emphasizing vocabulary and language style as well as grammatical usage. Both aspects were also allotted a maximum of 5 points each, contributing to a total of 10 points. This part of the rubric aimed to ensure that the language used in the report was appropriate, precise, and free of grammatical errors. Overall, this scoring rubric provided a comprehensive evaluation method, combining

the assessment of content structure with the quality of language, thus fostering a well-rounded approach to evaluating scientific laboratory reports.

3.3.6 Rubrics' Validity and Reliability

Before using the rubric for assessing the lab reports, the rubric was approved by the research advisor. Later, the language use and grammatical structure, including the appropriateness of content, were revised by two specialists in the field of English and science. With approval from the experts, the content validation was administered using the Item-Objective Congruence Index (IOC). There were two findings in content validity consisting of the result of evaluation and the interpretation of IOC scores. In addition, the judgment on test items was evaluated and interpreted in the results The IOC points were calculated using three rating scales to assess the consistency and congruence of the items. The experts had to choose only one answer as the given mark from these three alternatives of choices. The IOC index used in this study ranges from -1 to 1 as follows.

1	means	The item is appropriate.
0	means	The item is unsure.
-1	means	The item needs improvement.

Table 3.14 The Item-Objective Congruence Index (IOC) 's Criteria

IOC Rating Range	Interpretation	Decision
0.5 to 1.00	Acceptable	Item should be retained.
Less than 0.5	Not acceptable	Item should be reviewed or removed.

Consequently, the result indicated the IOC indices for 11 items rated by the three experts ranged from 0.67 to 1.0, which can be interpreted as the acceptable range. According to Rovinelli and Hambleton (1977), the total points for each item must have a consistency value equal to or above 0.50. One of the experts also suggested that "*The evaluation items section, the inclusion of references in scientific laboratory report composition, should be emphasized. References are essential as*

they provide credibility to discussions and substantiate claims made about scientific experiment results". Additionally, *"the scoring criteria require greater specificity and granularity. It is necessary to clearly define what constitutes a "complete" piece of writing for a full score of 5 points and to specify the percentage or level of completeness that corresponds to scores of 4 points, 3 points, and so on. This detailed breakdown will ensure clarity and consistency in the evaluation process."* Regarding these suggestions, the scoring rubric was revised again before using in this study. The IOC for rubric assessment was attached in Appendix B.

3.3.7 Rubric Assessment by Inter-Raters

For the evaluation of high school students' scientific laboratory report writing performance, three experienced teachers were designated as assessors. The panel comprised a native English teacher, A non-native science teacher and a non-native chemistry teacher. All three possessed substantial expertise in evaluating scientific reports written by high school students. Newell (2002) discussed the development of rubrics to evaluate student performance and the need for consistency between different faculty raters.

3.3.8 Lesson Plans

The lesson plans of TBLT for scientific laboratory report writing were designed and developed to enhance the writing ability in a science context. The lesson plans were entitled "English for Scientific Laboratory Report Writing", and their details can be found in Appendix C section. The lesson plans cover all three learning phases of the TBLT teaching framework, consisting of Pre-task, During-task, and Post-task following Willis, (1996) and Ellis (2003). These lesson plans aimed to provide a structured approach for the English 3 course, E321022, for high students in the science and mathematics program throughout the second semester of the academic year 2023. The lesson plans were designed to meet the course learning outcomes (CLOs) that focus on developing students' ability to communicate and write effectively in English and enhance their scientific literacy in writing. The CLOs for this course are as follows:

1. Develop students' language proficiency in composing a scientific laboratory report in English.

2. Enable students to understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.
4. Develop students' analytical and critical thinking skills in analyzing laboratory data and presenting findings.
5. Provide students with an opportunity to collaborate with their peers to achieve a common goal.

Moreover, the lesson plans were developed based on the basic education core curriculum of the year 2008, in accordance with standards on a science and mathematics program curriculum. The lesson plans were presented in terms of their learning phases: pre-, during-, and post-task stage with a total of 8 learning units, and the total of 18 class hours.

3.3.9 Course Plans

The course plans were developed into eight lessons, utilizing the principles of the TBLT teaching models of Willis (1996) and Ellis (2003). Each lesson was for a 2-hour session. The three stages were employed to teach a group of students who registered in a science and mathematics program, and the instructional procedures are detailed in Table 3.15.

Table 3.15 Sample of Instructional Procedures for TBLT-based Lesson

	TBLT
1. Opening:	1. The teacher greets the students and recalls the lessons previously taught.
2. Pre-task:	*Task preparation* 2. The teacher explicitly introduces essential content/concepts such as terminology or language style in science writing context.
	Confronting and discussing the tasks 3. The students are given the writing tasks and required to perform them individually and collaboratively.

Table 3.15 *(Continued)*

	1. Tasks focus on real-world language use and fluency (e.g., problem-solving, negotiation, writing real letters). **2. Focus on controlled practice and accuracy** (e.g., drills, gap-fill, grammar practice). **3. Activities** are a broad category that includes both tasks and exercises, plus games, warm-ups, brainstorming, and discussions. **Relationship Among the Three:** - All tasks and exercises are activities, but not all activities are tasks or exercises.
3. During-task:	- A task is an activity that requires authentic communication. - An exercise is an activity that provides focused language practice. An activity is any learning engagement, which can be communicative (like a task) or controlled (like an exercise). ***Analyzing the linguistics features*** 4. The writing are reflected and discussed verbally, and the encountered common grammatical errors are introduced. ***Task rehearsal and practicing*** 5. The students reperform the writing tasks and they are encouraged to target forms though prompts tests.
	Analyzing and reflecting the task performance 6. The teacher addresses the common linguistic feature errors with the whole class. At the same time, the students who do the writing task need to revise their own performance.

Table 3.15 *(Continued)*

4. Post-Task:	***Consciousness-raising task*** 7. The students are required to follow up on the writing tasks and asked to identify the errors and correct them individually. ***Task presenting*** 8. Once the writing tasks are corrected, the students are required to present the finished task verbally in groups.
5. Closing:	9. The teacher asks the students some reflective questions and provides homework.

The course plans' materials for each lesson included various resources such as videos, PowerPoint presentations, handouts, and worksheets. These materials were specifically created by the researcher in alignment with the content and objectives of each lesson. In each lesson, online applications such as Wordwall, YouTube, and Google Classroom were employed to facilitate the learning and teaching process. These digital tools were utilized to create interactive activities, access educational videos, and facilitate online collaboration and communication among the participants.

3.3.10 Lesson Plans' Validation

The validity of lesson plans was crucial for effective teaching and learning (Pasani et al., 2021). The validity of the lesson plans was assessed through a validation process involving three experts. These experts had extensive experience in English language teaching, with each of them having more than ten years of teaching experience. The names and credentials of the experts involved in the validation process can be found in the Appendix C, which provides a list of experts in learner autonomy.

To assess the content validity of the lesson plans: English for scientific laboratory report writing and determine the appropriateness in alignment with TBLT with a focus on forms, the researcher utilized an IOC form. By utilizing the IOC form, the researcher aimed to ensure that the lesson plans effectively incorporated the key elements and pedagogical approaches associated with TBLT with a focus on form

including learning objectives, learning outcomes, and learning activities. The IOC index used in this study ranges from -1 to 1 as follows.

1	means	The item is appropriate.
0	means	The item is unsure.
-1	means	The item needs improvement.

After the experts validated the lesson plans, the scores obtained were calculated. The IOC values were computed based on a predetermined formula. In this study, the outcome of the IOC value exceeded 0.67 to 0.10; it indicated that the research instrument (long-range lesson plans) is deemed acceptable. One of the experts also provided suggestions that *"In the plan, you may add fun activities such as games or other media before getting to the content about scientific laboratory reports in English. Using online tests to review understanding of scientific laboratory reports in English to attract attention"*. In this regard, online applications such as Wordwall, YouTube, Google Classroom, and Kahoot were applied in the teaching process to maintain the students' attention.

3.3.11 Semi-Structured Interview

The semi-structured interview was conducted at the end of the research phase to explore the opinions of the high school students regarding their experiences with the TBLT in scientific laboratory report writing. The interview protocol was validated and revised by the three experts in English language teaching. The researcher conducted individual interviews lasting approximately ten minutes with each group of students. These interviews aimed to gather the students' opinions regarding the utilization of the TBLT in high school students. The interview protocol utilized in this study was adapted from Acar and Tarhan (2007) and presented in Table 3.16 below, as well as in Appendix D.

Table 3.16 Semi-Structured Interview Protocol

Semi-Structured Interview Questions
1. What are your perceptions of the course which is taught by the application of TBLT? (นักเรียนมีมุมมองอย่างไรต่อการกระบวนสอนแบบเน้นภาระงานในเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์)
2. How do you feel about how the lesson played out? (นักเรียนมีความรู้สึกอย่างไรเกี่ยวกับการกระบวนสอนแบบเน้นภาระงานต่อบทเรียนเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์)
3. How do you find TBLT help you to improve the laboratory report writing ability? (นักเรียนคิดว่ากระบวนการสอนแบบเน้นภาระงานส่งผลต่อความสามารถการเขียนสรุปรายงานเชิงวิทยาศาสตร์หรือไม่อย่างไร)
4. What aspects of the TBLT within this course that assist you increase your understanding in writing a scientific laboratory report? (นักเรียนคิดว่าส่วนไหนหรือองค์ประกอบใดของการเรียนการสอนแบบเน้นภาระงานส่งผลดีต่อความเข้าใจเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์)
5. Would you like to study English subject regarding the TBLT for a scientific laboratory report writing again? (นักเรียนมีความประสงค์อยากเรียนเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์โดยการสอนแบบเน้นภาระงานอีกหรือไม่ เพราะอะไร)
6. What suggestion do you have about the TBLT in laboratory report writing? (นักเรียนมีข้อเสนอแนะหรือคำแนะนำต่อกระบวนสอนแบบเน้นภาระงานต่อบทเรียนเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์หรือไม่ อย่างไร)

3.3.12 Semi-Structured Interview Validation

Essentially, the interview protocol was validated by using an Index of Item Objective Congruence (IOC) to examine content validity. The IOC index ranges from -1 to 1 as follows:

1	means	The item is appropriate.
0	means	The item is unsure.
-1	means	The item needs improvement.

After a panel of three experts appraised the interview protocols, the obtained scores were computed. The IOC values were also calculated using a specific formula. The outcomes of IOC validation are presented in Table 3.17.

Table 3.17 The Outcome of IOC's Interview Protocol Validation

Interview Question	Experts			IOC
	No.1	No.2	No.3	
Q1	1	1	1	1.00
Q2	1	1	1	1.00
Q3	1	1	1	1.00
Q4	1	0	1	0.67
Q5	1	1	1	1.00
Q6	1	1	1	1.00

The validation results revealed that all the interview questions showed an acceptable level within the range of 0.67-1.00. After the validation process, the interview protocols were administered as a pilot study, employing six students from different sections. These students were randomly selected from grade 11, which was the same group of the lesson plans. The purpose of this pilot study was to ensure that the students fully comprehended all the interview questions. After completing the pilot, the students were interviewed to gather their feedback and insights regarding their understanding of the interview questions and their experience with the interview process.

3.3.13 Selection of Sampling Technique

Criterion-*i* sampling was predominantly utilized in mixed-methods implementation studies adopting concurrent design, wherein the qualitative component was secondary to the quantitative component, as well as in studies that assigned equal importance to both qualitative and quantitative methodologies (Palinkas et al., 2015). The criterion was aimed at identifying and selecting all cases that contained some essential criterion. Based on Palinkas et al. (2015), this study employed a criterion sampling technique to select participants to attend the interview.

From a qualitative research standpoint, individuals who satisfy or surpass specific criteria are deemed to have profound (or, at the very least, enhanced) understanding of the phenomenon being investigated due to their experiences. This characteristic renders them as cases rich in information (Palinkas et al., 2015). To achieve the criterion sampling, the specific characteristics of students who were recruited to attend the interview were formulated.

With this study, the notable criterion in selecting students to join the interview was their learning achievement resulting from mean scores of scientific laboratory report writing before conducting semi-structured interviews. This criterion significantly enriched qualitative research by ensuring a diverse and representative sample.

To categorize students based on their science writing performance, the mean scores from their pre-writing and post-writing tests were computed and used to classify them into four distinct groups: Low, Medium, High, and Very High. The classification was based on the Relative Gain Score method, a statistical tool widely recognized in educational research. Kanjanawasee (2014) introduced this approach to contextualize student performance relative to their peers, highlighting its effectiveness in creating meaningful performance-based groupings.

Table 3.18 The Scale of Achievement Gain Score by Kanjanawasee (2014)

Participants	Relative Gain Scores	The Level Achievement Gain Score
35 Participants	76 - 100	Very high
	51 - 75	High
	26 - 50	Moderate
	0 - 25	Low

Furthermore, the scores of the pretest and posttest mean scores were analyzed by using the formula proposed by Kanjanawasee (2014), displayed below:

$$DS(\%) = \frac{\text{Posttest} - \text{Pretest}}{\text{Full score} - \text{Pretest}} \times 100$$

3.3.14 Justification for Grouping Students into Four Different Groups

Ability grouping is an initiative carried out by educational institutions to classify students into distinct categories based on their abilities. This approach allowed for tailored instructional strategies that addressed the specific needs of each group, thereby enhancing the overall educational experience (Guskey, 2003). In other words, not all students had the potential to fully express science writing. Some students may have low/high English proficiency or ability to understand science concepts and may receive insufficient support from instructors. These might exhibit different opinions toward the treatment, and this way was possibly to light on the suitability and unfitness of the treatment among the different levels of students.

Thus, selecting the students from each performance group (Low, Medium, High, Very High) who participated in semi-structured interviews tended to be useful to better understand their experiences and opinions related to TBLT and scientific report writing. This qualitative approach also allowed for flexibility in exploring participants' unique opinions of different levels of the students while maintaining a consistent structure across interviews.

3.3.15 Data Collection and Interview Procedures

The main interview task was to comprehend the message and its meanings to the participants (Moser et al., 2010). It was imperative to determine a method to collect data in a semi-structured interview. To explore the students' opinions after they were classified into four groups based on their developmental mean scores in science writing, this study employed face-to-face in-depth Interviews, involving a one-on-one conversation between the participant and the interviewer. These interviews can address topics related to past or current events and personal matters (Moser & Korstjens, 2018). The method was used in most qualitative studies to understand what happened in the past, and it likely fit the present study that aimed to obtain the students' opinions at the end of the research phase.

The interview was conducted within 1-2 days following the completion of the post-writing test. This timeline ensured sufficient time for the researcher to analyze preliminary results from the post-test while maintaining the participants' recall of their experiences during the study. The interview session marked the concluding phase of

data collection. To implement the semi-structured interview through the frame of a face-to-face interview, this study adopted the guidance of Moser and Korstjens (2018) as follows.

Eight students were chosen to participate in semi-structured interviews, divided into four groups of two each. These groups were formed based on the students' performance in scientific laboratory report writing, categorizing them as very high, high, middle, and low achievers. Before conducting the interview, creating a comfortable atmosphere was important to encourage the students to feel at ease. The participants were also asked to sign an interview consent form and questioned following a series of interview questions.

In the interview session, the researcher assumed the role of a complete participant, being designated as an interviewer and assumed an insider role. The interview took place in a classroom where the students felt at ease. The students were asked six questions regarding their opinions toward the utilization of TBLT for scientific laboratory report writing and the overall learning process and engagement in this course. Even though the interview protocol was written in English, the students responded in Thai to facilitate their cognitive processes and communication. The following questions were asked individually during the interview session, and it lasted 10 minutes for each student. Additionally, the conversation was recorded with a digital voice recorder throughout the interview to collect the data.

3.3.16 Data Organization and Analysis

The qualitative data from the interview underwent analysis to yield comprehensive insights and interesting findings through content analysis (Moser & Korstjens, 2018). In categorizing the data from the semi-structured interview, the researcher applied suggestions from Moser and Korstjens (2018). The researcher transcribed, coded, and translated the findings from the digital voice recorder into English. To ensure accuracy, the researcher meticulously reviewed and revisited the audio recordings while thoroughly rereading the transcripts. Then, back-translation was employed to analyze how the process of translation and the methods applied to influence the gathering and understanding of qualitative data in the original language when presenting it in English (Chen & Boore 2010). In this study, back-translation was appropriate to check by converting the target language (English) back into the source

language (Thai), allowing for the comparison and assessment of the equivalence between the original and translated versions. The ways of back-translation were adopted from Chen and Boore (2007; 2008) and summarized in Figure 3.1 below:

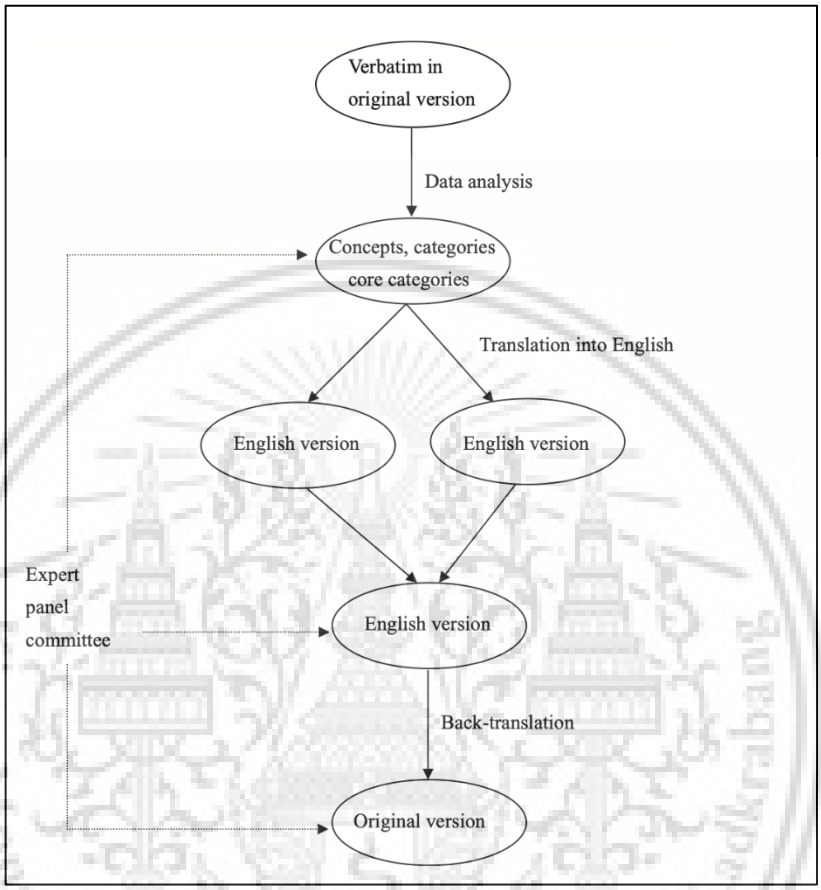


Figure 3.1 Translation and Back-Translation Procedures

In this research, the translation procedures were structured to ensure accuracy and consistency. First, the content was transcribed verbatim in the original language, which was then followed by a thorough analysis of the content. Next, two bilingual experts in English were essential for translating the identified concepts and categories that emerged from the analysis. To further ensure accuracy, back-translation was employed, where the translated content was converted back into the source language for comparison, which was in Thai. Finally, an expert panel convened to review the translations and reach a consensus on the final version, ensuring that the meaning was preserved across both languages. This multi-step approach enhances the reliability of the translation in qualitative research. The results of the back-translation were attached in Appendix F.

3.3.17 Interrater Agreement and Reliability of Data Collected

Once the qualitative data was thoroughly translated and checked through back-translation, then interrater reliability was implemented to assess the credibility of the data. Credibility, akin to internal validity in quantitative studies, ensures the accuracy and truthfulness of the research findings. This method was aimed at enhancing the reliability of the qualitative data. The reliability and consistency of qualitative data analysis were important for the validity of research findings. Interrater reliability refers to the degree of agreement among independent coders or raters assessing the same data (Creswell, 2014).

Several statistics have been used to assess interrater reliability. The study used Cohen's kappa for two raters due to its potential to provide the range of agreement among raters. Moreover, using correlation coefficients like Pearson's *r* may not accurately represent the level of agreement between raters, potentially leading to significant overestimation or underestimation of the actual rater agreement level (Stemler, 2004). Cohen's kappa can range from -1 to +1, with 0 indicating the level of agreement expected by random chance and 1 signifying perfect agreement between the raters. Interpretation of the degree of agreement has been introduced by many scholars. However, the more logical interpretation was suggested by Cohen (1960) and used as a reference for interpretation in the current study. The details are illustrated below.

Table 3.19 Interpretation of Cohen's Kappa

Value of Kappa	Level of Agreement	% of Data that are Reliable
0–.20	None	0–4%
.21–.39	Minimal	4–15%
.40–.59	Weak	15–35%
.60–.79	Moderate	35–63%
.80–.90	Strong	64–81%
Above.90	Almost Perfect	82–100%

Table 3.19 presents the agreement reliability criteria, which were used by two experts in English language teaching to assess the accuracy , correctness, and appropriateness of the data following the back-translation process. This evaluation ensured the reliability of the qualitative data. The summary of the content analysis model followed Moser and Korstjens (2018) is shown in the Table below.

Table 3.20 The Summary of Content Analysis Procedures

Procedures	Content analysis
1. Transcripts from	Face-to-face interviews
2. Reading notes	Revisit transcripts, adding marginal notes, assigning
3. Describing	preliminary codes
4. Ordering	Initial codes
5. Interpreting	Descriptive categories and subcategories
	Initial interpretation
	Back-translation implementation
6. Findings	Interrater-agreement reliability
	Narrative summary of main findings.

The content analysis sought to uncover themes and sub-themes that exist both within individual themes and between them. This process proceeded under an inductive content analysis that involved the process of dividing the data into smaller segments, assigning codes and labels to each segment based on their content, and organizing the coded segments into groups that share common concepts (Elo & Kyngäs, 2008). This method was applied to sort and organize the qualitative data into categories, concepts and patterns.

3.4 Data collection

Before implementing the study, this study required a permission letter from the School of Liberal Arts, King Mongkut's Institute of Technology Ladkrabang. Later, the researcher needed to inform the school where the study took place by sending a permission letter.

In the study, the researcher collected both qualitative and quantitative data through the implementation of TBLT with a focus on forms at a public high school in Pathum Thani, Thailand. The teaching lasted 18 hours, or 8 weeks, in the 2nd semester of the academic year 2023, from 1st January to the end of February. The participants' performance in writing scientific laboratory reports was the focus of a pretest and a posttest. At the end of the research phase, the participants in the treatment group were required to explore their opinions after experiencing the treatment. The overall details of the study's procedures are displayed in Table 3.18 below.

Table 3.21 Data Collection Process

Week	Learning Phase	The TBLT for Scientific Laboratory Report Writing Structure
1	(Pre-Stage)	**1. Writing (PRETEST)** 2. Greeting and introducing learning objectives, introducing learning references, grading criteria and standards, and learning framework and teaching strategy 3. Preparation and planning
2 - 8	(During-Stage)	1. Genre of scientific report and rhetorical moves 2. Presenting A style guide to scientific laboratory reports 3. Examples of scientific experiment reports 4. Introducing the moves of a laboratory report 5. The usage of grammar for each move Peer review 6. Forms: Experiment introduction Peer review 7. Forms: Experiment Method and materials Peer review 8. Forms: Presenting results and discussion Peer review 9. Forms: Presenting conclusion Peer review 10. Reviewing a laboratory report

Table 3.21 *(Continued)*

9	(Post-Stage)	1. Writing practice 2. Presenting tasks in 3. Feedback and Revision from Teacher 4. Presenting tasks in group **5. Writing (POSTTEST)** **6. Semi-Structured Interview Administration**

3.4.1 Lesson Implementation

Week 1

This week's pre-task involved teaching English for the purpose of writing scientific laboratory reports. The instructor informed the details of the research purpose, aimed to develop their skills in composing scientific reports in English. The research implementer briefly explained the experimental study and informed the participants about their roles and responsibilities in the research. The target students were required to do a pre-test individually to measure their scientific laboratory report writing ability, based on the result of the laboratory experiment from the Chemistry course. In collaborating with chemistry subjects, the researcher and a foreign chemistry teacher agreed to plan for the lab experiments. The pretest utilized the results of the first scientific experiment.

Week 2-3

The teacher gave the students detailed information about the learning materials, grading criteria, and standards to be used throughout the semester. Additionally, he explained the structure of the semester, consisting of three distinct learning phases: the pre- task stage, the during-task stage, and the post-task stage. Each phase was designed with specific learning objectives and expected outcomes, which were formally documented in the lesson plans. Furthermore, the teacher introduced the concept of genre in scientific language and laboratory report writing, emphasizing the importance of understanding the various components involved in composing scientific laboratory reports.

Week 4-8

To prepare and plan for the learners to write scientific reports, the instructor introduced the process of collecting and handling information, as well as the language

style used in scientific reporting. Instructional treatment is during-task. Following the framework of TBLT, a during-stage mainly emphasized appropriateness, accuracy, and fluency through practical and authentic scientific writing tasks. The lessons guided students through collecting information, structuring reports, and applying scientific language conventions in the *experiment "Investigating the Effect of Light Intensity on Plant Growth",* and other previous experimental labs where necessary.

In Week 4, students were introduced to key components of a lab report objective, procedure, results, and discussion while practicing grammatical structures like verb tenses and cohesive devices through guided writing and peer review. The teacher emphasized the application of grammar such as sentence structure, tenses, subject-verb agreement, and cohesive devices during the drafting and revision stages of scientific laboratory report writing. This was achieved through guided writing activities, grammar-focused exercises, and peer review tasks aligned with each scientific rhetorical move.

To provide a concrete example, the experiment *"Investigating the Effect of Light Intensity on Plant Growth"* was used. Students examined how different light intensities influence plant height and biomass, learning how to structure a research-based introduction. The hypothesis predicting that plants exposed to higher light intensity would grow more efficiently, while excessive light might hinder growth helped students practice formulating clear and concise scientific statements. Through guided activities, students applied appropriate grammatical structures, such as using the present simple for general scientific facts and past simple for describing specific experiments. This foundational week prepared them for drafting and refining their own lab reports in subsequent sessions.

Weeks 5-6 emphasized hands-on writing tasks, where students drafted report sections, analyzed sample data, and engaged in peer feedback to refine their use of scientific language. Error analysis activities helped them identify and correct common mistakes, reinforcing the importance of clarity and accuracy in scientific writing. Week 7 focused on class presentations, where students collaborated on structured reports, participated in a gallery walk to showcase writing techniques, and received peer feedback to improve clarity and organization.

In Week 8, students reflected on their progress through individual and group discussions, connecting their writing skills to real-world scientific communication. By

the end of the course, students demonstrated improved proficiency in composing structured, accurate, and coherent scientific reports in English.

Week 9

Once the lessons were taught, the teacher concluded the instructional sessions by conducting a comprehensive review of the common issues that arose during the classes. Additionally, individual feedback was provided to each student, offering valuable insights and suggestions for improvement. The participants were assigned to prepare the revised tasks and present them orally to their classmates. To assess their progress or performance in a lab report writing. The posttest was administered to gauge the students' learning outcomes after they conducted the second laboratory experiment. Towards the end of the research implementation, a semi-structured interview was conducted to gather further insightful opinions from the participants.

3.5 Data Analyses

The data obtained from the research instruments are subjected to the following analysis procedures:

1st Research Question

1. To what extent does task-based language teaching (TBLT) improve high school students' scientific laboratory report writing in English?"

Hypotheses

1. H^0: There is no statistically significant difference in pretest and posttest mean scores on scientific laboratory report writing among high school students after the implementation of Task-Based Language Teaching (TBLT).
2. H^1: There is a statistically significant difference in pretest and posttest mean scores on scientific laboratory report writing among high school students after the implementation of Task-Based Language Teaching (TBLT).

To answer research question 1 and to prove the hypothesis of whether a significant difference in mean scores in the pretest and posttest was the *p*-value >0.5 or not. The descriptive statistics method involved analyzing mean scores and standard deviation (SD) from pretest and posttest scores to investigate and compare whether

participants were able to improve their test scores following their participation in the TBLT intervention or not.

Moreover, the inferential statistics, a paired-samples *t*-test, also known as a dependent-samples *t*-test, was employed to assess whether the post-test mean score significantly exceeded the pre-test mean score at a significance level of 0.05. The formula of the paired sample t-test is shown below.

$$t = \frac{\Sigma \mathrm{d}}{\sqrt{\frac{n(\Sigma d^2) - (\Sigma d^2)}{n-1}}}$$

Paired samples *t*-test formula

Additionally, the effect size proposed by Cohen (1988) was calculated to determine the magnitude of the implementation. The analyzed result was interpreted based on the following criteria:

Table 3.22 Effect Size Criteria and Interpretation (Cohen, 1988)

Effect Size (ES)	Interpretation
$0.0 \leq ES < 0.20$	Ignored
$0.20 \leq ES < 0.50$	Small
$0.50 \leq ES < 0.80$	Moderate
$0.80 \quad ES < 1.30$	Large
$1.30 \leq ES$	Very Large

2nd Research Question

2. What are the opinions of high school students toward task-based language (TBLT) for scientific laboratory report writing in English?

To answer research question 2, qualitative data were collected by employing semi-structured interviews, recognized as one of the effective tools in qualitative research, allowing for in-depth information and flexibility (Ruslin et al., 2022). Before implementing the interview, the students were classified into four groups (low, medium, high, very high) based on their developmental gain scores of a pretest and

posttest. After implementing the interview, the findings were transcribed and analyzed utilizing systematic content analysis to ensure valid and reliable inferences. Qualitative content analysis employed a systematic and transparent set of procedures for data processing.

Crucially, the data of the individual interviews was kept confidentially. During the interview sessions, the students were required to record their voices until the end of the interview sessions. The researcher also noted significant points throughout the interview. Lastly, the coded interview data was analyzed using content analysis. Strijbos et al., (2006) highlighted the need for critical reflection in content analysis, particularly in the choice of units of analysis.

To summarize the quantitative data and qualitative data in the study's implementing process, the researcher presented a research matrix designed to explore the effectiveness of TBLT in enhancing high school students' scientific laboratory report writing skills and their perceptions of this teaching approach. It outlined the key areas of investigation, data collection methods, and data analysis techniques for each research question as it is illustrated below.

Table 3.23 Research Matrix of the Current Study

Area	Research Questions	Data Collection	Data Analysis
Performance in laboratory report writing	To what extent does task-based language teaching (TBLT) high school students' performance in scientific laboratory report writing in English?	To assess the effectiveness of TBLT in enhancing high school students' performance in scientific laboratory report writing, this study is employed: - Pre- writing test - Post- writing test	Statistics for comparison of pre- and post-test scores consisting of: - Mean scores (M) - Standard deviation (SD) - Paired Samples *t*-Test - Effect Size (Cohen, 1988) - Relative Gain scores
Students 'Opinions	What are high students' opinions on task-based language teaching (TBLT) for scientific	Selected low, medium, high, and very high group of students expressed about their experiences with TBLT:	Content analysis (CA) Interview data was categorized the following patterns: - Opinions toward TBLT, - Feelings toward TBLT

Table 3.23 *(Continued)*

	laboratory report writing in English?	- Individual interviews for deeper exploration of student opinions using the semi-structured protocol.	- Influential aspects of TBLT with a focus on forms on lab report writing skills - Willingness to experience TBLT in the future - Suggestions to identify key areas for improvement. - Prioritization of suggestions based on feasibility and potential impact.

3.6 Ethical Consideration and Confidentiality

Due to the significance of research ethics and the complexities associated with conducting studies, universities make extensive efforts to ensure the preservation of research participants' dignity and well-being (Silverman, 2009). Williams and Pigeot (2017) suggested that it is necessary to have a more comprehensive comprehension of safeguards and protocols to maintain the integrity of research. Before conducting the research, this study was approved by the ethical research committee of the institution. To obtain official permission, a formal letter was sent to the school outlining the research objectives and seeking approval. Before the study, all participants were provided with detailed information regarding the nature of the research and the data collection process. Informed consent was obtained from each participant, and they had the freedom to withdraw from the study at any point without any consequences. To ensure confidentiality, no personal names or identifying information were recorded, and all collected data was securely stored confidentially. Respecting the privacy and rights of the participants was of utmost importance throughout the research process.

3.7 Summary

This study adopted a mixed methods approach, utilizing a pre-experimental design with a one-group pretest and posttest. The study aimed to address two key research questions: (1) To what extent does TBLT enhance the scientific laboratory

report writing skills of high school students? and (2) What are the perceptions of high school students regarding the effectiveness of TBLT in the context of scientific laboratory report writing?

The study was guided by the TBLT framework proposed by Willis, (1998) and Ellis (2003, structured into three phases: pre-task, during-task, and post-task. Quantitative data was collected through pretest and posttest assessments of scientific laboratory report writing, while qualitative data was obtained through semi-structured interviews.

A purposive sampling method was employed, involving 35 high school students enrolled in a science and mathematics program at a public school in Pathum Thani, Thailand. These students were in grade 11, representing both male and female students, and they were non-native English speakers learning English as a foreign language (EFL).

For quantitative analysis, the research employed instructional tools such as pretests, posttests, lesson plans, and rubrics for assessing scientific laboratory report writing performance. For qualitative analysis, a semi-structured interview protocol was used to explore students' opinions on TBLT, and the qualitative data from the interview was interpreted by employing content analysis. All research instruments underwent validation and evaluation by three experts and were pilot tested with a similar group of students to ensure data collection reliability and effectiveness.

To address research question 1, mean scores (M) and standard deviations (SD) were computed for both the pretest and posttest. A paired-samples *t*-test was conducted to assess the statistical significance of the differences observed. The chosen significance level for the test was set at 0.05. The effect size proposed by Cohen (1988) was implemented, as well as using relative gain score to analyze the developmental level of the participants. For research question 2, qualitative data obtained from the semi-structured interviews was transcribed and analyzed using content analysis (CA). The detailed findings of the study are presented in Chapter 4 of the research report.

CHAPTER 4
RESULTS

4.1 Introduction

This chapter presents both quantitative and qualitative results collected from a pre-writing test and a post-writing test and a semi-structured interview after the participants were given task-based language teaching (TBLT) in science writing lessons.

The study addresses two research questions: the first question investigates the effectiveness of TBLT by comparing pretest and posttest scores, while the second question explores students' opinions through insights gathered from the interviews that is conducted at the end of the study. The findings are presented in three sections as follows:

i) Participants' demographic information
ii) Quantitative research findings
iii) Qualitative research findings

4.2 Participants' Demographic Information

The sample of this study consisted of 35 Thai high school students at one public high school in Pathum Thani province, Thailand. The students' demographic information is categorized by gender, age, grade level, program type, and instructional language and presented in Table 4.1.

Table 4.1 Participants' Demographic Information

Demographics	Category	Number of students	Percentage (%)
Gender	Male	14	40%
	Female	21	60%
Age	16-year-old	10	28.6%
	17-year-old	25	71.4%
Grade Level	Grade 11	35	100%
Program Type	Science and Math	35	100%
First Language	Thai	35	100%
Instruction Language	English	35	100%

Table 4.1 presents the demographic information of the student participants in this study, consisting of 35 Grade 11 Thai EFL students enrolled in a Science and Mathematics program. The sample included 60% female (21 students) and 40% male (14 students). The age distribution showed that 28.6% of the participants (10 students) were 16 years old, while the remaining 71.4% (25 students) were 17 years old. As native Thai speakers, students used English as the medium of instruction in science writing lessons to enhance scientific skills, improve language proficiency, and foster scientific literacy.

4.3 Research Question One

This section aims to answer the first research question of this study as follows:

1st Research Question: *To what extent does task-based language teaching (TBLT) improve high school students' performance in scientific laboratory report writing in English?*

This question aims to investigate the effectiveness of TBLT in improving Thai students' scientific laboratory report writing capacity in English. The descriptive and inferential statistics were used to answer the first question by comparing the scores of

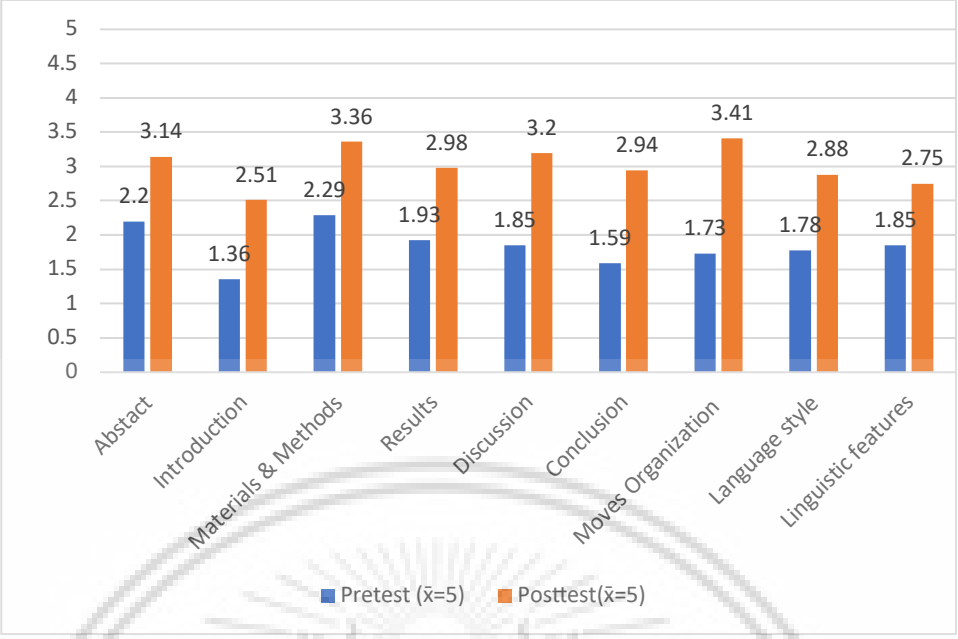
the pre-writing and posttest tests, which each student was given to complete before and after the treatment. The results were elucidated below.

4.3.1 Descriptive Statistics

Initially, the descriptive statistics, particularly the mean and standard deviation, were used to answer the first research question in terms of the overall improvement among the specific lab report sections comparing between pre-test and posttest. The students completed these tests before and after the research phase, which included the abstract, introduction, materials and methods, results, discussion, conclusion, moves organization, language style, and linguistic features. The results are presented in Table 4.2 below.

Table 4.2 Descriptive Statistics Results for Each Lab Report Scoring Section

Lab Report Scoring Sections	Pre-test		Post-test	
	Mean	SD	Mean	SD
Abstract	2.20	0.93	3.14	0.44
Introduction	1.36	0.68	2.51	0.61
Materials & Methods	2.29	0.78	3.36	0.78
Results	1.93	0.77	2.98	0.97
Discussion	1.85	0.81	3.20	0.77
Conclusion	1.59	0.61	2.94	0.86
Moves Organization	1.73	0.57	3.91	0.70
Language style	1.78	0.54	2.88	0.50
Linguistic features	1.85	0.54	2.75	0.59
Overall	**1.84**	**0.67**	**3.02**	**0.70**



Graph 4.1 Comparison of Pretest and Posttest Scores Across Different Lab Report Writing Components

Table 4.2 reveals the descriptive statistics that indicated substantial improvements across all sections of lab report scoring from the pre-test to the post-test, and each move contained 5 in full score. For example, the moves organization showed an increase from a pre-test mean (M =1.73, SD = 0.57) to a post-test mean (M = 3.91, SD = 0.70). Similarly, the abstract section improved from (M = 2.20, SD = 0.93) to (M = 3.14, SD = 0.44), and the introduction section rose from (M = 1.36, SD = 0.68) to (M = 2.51, SD = 0.61). These were consistent in other areas, such as the materials and methods section (M = 2.29, SD = 0.78 to M = 3.36, SD = 0.78) and the discussion section (M = 1.85, SD = 0.81 to M = 3.20, SD = 0.77). The conclusion section improved from (M = 1.59, SD = 0.61) to (M = 2.94, SD = 0.86), while the language style section rose from (M = 1.78, SD = 0.54) to (M = 2.88, SD = 0.50), and linguistic features" improved from (M = 1.85, SD = 0.54) to (M = 2.75, SD = 0.59). Overall, the results of the pretest increased from (M = 1.84, SD = 0.67) to the posttest (M = 3.02, SD = 0.70), reflecting significant improvement in scientific writing performance.

Graph 4.1 shows the mean pre-test and post- test scores of students' writing performance across various components. Blue bars represent pre-test scores, and orange bars represent post-test scores, with each component scored out of 5 points.

The results indicate an overall improvement in all components after the intervention. The highest posttest scores were observed in "Moves Organization" (M=3.41) and "Materials & Methods" (3.36), suggesting notable progress in structuring ideas and describing research procedures. Conversely, the lowest posttest scores were found in Introduction (M=2.51) and Linguistic Features (M=2.75), suggesting that students may still face challenges in effectively introducing their topics and refining language use. These findings highlight the areas of progress and the aspects that may require further instructional support.

Accordingly, the pre-writing test and the post-writing test scores were computed using mean scores (M) and standard deviation (SD.) to reveal the overall results of the students' scientific laboratory report writing performance in English as presented in Chart 4.2 and Table 4.3.

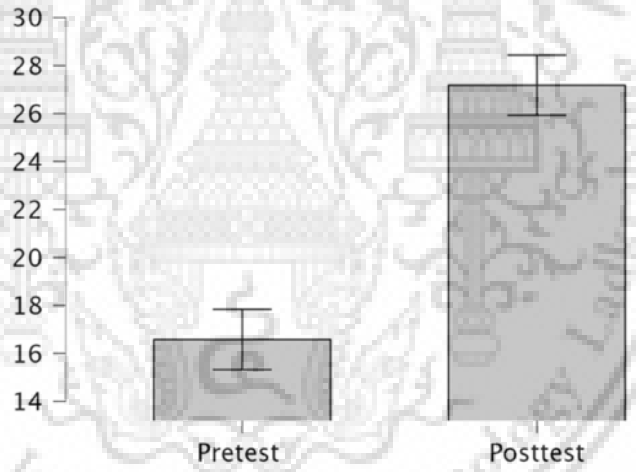


Figure 4.2 Comparison of Participants' Pretest and Posttest Mean Scores

Table 4.3 The Results of Descriptive Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-test	16.58	35	3.73	0.63
	Post-test	27.18	35	3.57	0.60

The results from Table 4.3 and Figure 4.2 show that high school students in the science and mathematics program who experienced TBLT in scientific laboratory report

writing over a 9-week treatment period demonstrated significant improvements. The participants achieved mean scores (M) and standard deviations (SD) for both pretest and posttest scores in lab report writing ability. The pretest scores had mean scores of (M) 16.58 with a standard deviation (SD) of 3.73. Conversely, the posttest scores had mean scores of (M) 27.18 with a standard deviation (SD) of 3.57.

4.3.2 Inferential statistics

The collected data from the pretest and posttest scores underwent analysis using a paired samples *t*-test to investigate the effectiveness of TBLT on the students' scientific laboratory report writing performance. Hypotheses were also proved through the comparison of the pre-test and post-test scores analyzed by inferential statistics. The findings are displayed in Table 4.4 below.

Hypothesis 1*:* There is a statistically significant difference in pretest and posttest mean scores on scientific laboratory report writing among high school students after the implementation of Task-Based Language Teaching (TBLT).

Table 4.4 Results of Paired-Samples *T*-Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	99% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest-Posttest	10.60	5.17	0.67	12.98	8.21	12.12	34	0.00

**At significance level of 0.01*

Table 4.4 reveals the effectiveness of the treatment through the analysis of paired-samples *t*-test. As a result, there was a statistically significant increase from the pretest (*M* =16.58, *SD* = 3.77) to the posttest (*M* =27.18, *SD* = 3.57), *T* (34) = -12.123, *p* > 0.00 (two-tailed). The mean increased from the pretest scores to the posttest scores was 10.6, with a 99 percent confidence interval ranging from 12.98 to 8.21.

As the result of inferential statistics, the null hypothesis was rejected. The findings indicated that there was a significant difference in pretest and posttest mean scores (M) after the employment of TBLT in laboratory report writing lessons in Thai high school students who registered in a science and mathematics program.

4.3.3 Effect Size of TBLT's Effectiveness in Science Writing

While the findings above revealed the difference obtained in the two sets of scores, it did not offer substantial insights into the extent of the intervention impact. Thus, the effect size was calculated to determine the degree of effectiveness of the TBLT approach whether small, medium, large, or very large on students' scientific writing ability, using eta squared as presented below.

Eta squared can be obtained using the following formula:

$$\text{Eta squared} = \frac{t^2}{t^2 + (N-1)}$$

$$\text{Eta squared} = \frac{(12.12)^2}{(12.12)^2 + (35-1)}$$

$$= \frac{146.89}{146.89 + (35-1)}$$

$$= 0.81$$

According to Cohen's (1988, pp. 284–287) guidelines, the eta squared value of 0.81 indicates a large effect size, suggesting a significant improvement in pretest and posttest scores following the TBLT intervention. The posttest's mean scores (M) in scientific laboratory report writing performance (M=27.18, SD= 3.73) was significantly greater than the pretest mean score (M=16.58, SD=7.3), T (34) = -12.123, p > 0.00 (two-tailed). The mean increase from the pretest scores to the posttest scores was 10.6 with a 99 percent confidence interval ranging from 12.98 to 8.21. The effect size of the TBLT method on the mean score was 0.81 large (eta squared=0.81). This confirmed that the treatment had a significantly positive effect on the students' scientific laboratory report writing performance.

4.4 Summary of Quantitative Findings

The first question aims to shed light on the effectiveness of TBLT in scientific laboratory report writing ability in English among 35 high school students who registered in the science and mathematics program. Considering the significant improvement of students' science writing performance, an acceptance of the alternative hypothesis, and a large effect size of TBLT potential, these findings reveal the TBLT's potential as a pedagogical approach to integrate language learning with scientific contents in English and provide evidence for the applicability to shape EFL high school students' lab report writing performance.

Regarding the results of each scientific lab report move, it is suggested that the significant improvement in the organization and the discussion moves reflected students' enhanced ability to structure and communicate their findings logically. However, smaller gains in the language style section and linguistic features indicated that further focus that is needed to improve precise language use and stylistic elements in scientific writing in English are reflected in the findings outlined in Chart 4.1.

4.5 Research Question Two

This section aims to answer the second research question of this study as follows:

2nd Research Question: *What are the high school students' opinions on task-based language teaching (TBLT) for scientific laboratory report writing in English?*

To answer the second research question of this study, the researcher employed a semi-structured interview as an instrument to gain the students' insightful opinions after they were given the treatment at the end of the research phase. Prior to commencing the interview session, the students' pre- writing test and post-writing test mean scores were analyzed by using relative gain scores to determine their levels of developmental gain score. This way can identify and group them into four groups: low,

medium, high, and very high, and the results were indicated in Table 4.5. In addition, grouping students based on their developmental scores before the interview allowed for targeted and differentiated questioning, ensuring that the interview addressed each group's specific needs, challenges, and strengths. This approach helped gather more accurate and relevant data to deepen the understanding of how their developmental levels influence their learning outcomes and experiences.

Table 4.5 Relative Gain Scores and Developmental Levels of 35 High School Students

N	Pretest	Posttest	Relative gain scores	Developmental levels	N	Pretest	Posttest	Relative gain scores	Developmental levels
1	15.67	30.67	51.14	High	**19**	13.67	29.67	51.06	High
2	11.67	27.00	46.00	Moderate	**20**	24.33	25.33	4.84	Low
3	23.67	30.33	31.25	Moderate	**21**	24.67	31.00	31.15	Moderate
4	15.33	16.67	4.49	Low	**22**	20.33	30.67	41.89	Moderate
5	16.33	21.33	17.44	Low	**23**	16.67	22.67	21.18	Low
6	16.00	27.00	37.93	Moderate	**24**	20.00	29.00	36.00	Moderate
7	13.33	29.67	51.58	High	**25**	15.00	26.67	38.89	Moderate
8	12.67	26.00	41.24	Moderate	**26**	20.00	31.00	44.00	Moderate
9	16.00	22.33	21.84	Low	**27**	17.00	27.67	38.10	Moderate
10	20.00	26.33	25.33	Low	**28**	15.67	22.00	21.59	Low
11	19.33	26.00	25.97	Low	**29**	18.33	28.00	36.25	Moderate
12	16.33	29.00	44.19	Moderate	**30**	13.67	30.67	54.26	High
13	15.67	28.00	42.05	Moderate	**31**	11.33	27.67	48.51	Moderate
14	18.67	20.67	7.59	Low	**32**	17.33	30.00	45.78	Moderate
15	11.33	30.67	57.43	High	**33**	17.00	23.33	22.62	Low
16	10.67	30.67	58.25	High	**34**	15.67	25.67	34.09	Moderate
17	9.33	30.67	59.81	High	**35**	20.67	30.67	41.10	Moderate
18	17.00	26.67	34.52	Moderate					
				Average:		**16.58**	**27.18**	**36.27**	**Moderate**

Table 4.5 above reveals the developmental score range of each Thai high school student in this study, showing the students achieved a high development level, which represented 20 percent of the sample. Additionally, 18 of the students were placed in the moderate development category, accounting for 51.43 percent in the

developmental score. Furthermore, 10 students were categorized as having a low level of development, accounting for 28.57 percent. There was not any student who could achieve a very high level of developmental gain score. Therefore, the students' classification regarding their developmental gain scores were low, moderate and high.

In conducting the semi-structured interview in the current study, the selected two students of each level in science writing performance were identified by using numerical identifiers to safeguard the confidentiality of the participants in this study. Importantly, the students were encouraged to express their opinions in the language they were most comfortable with during the interview session. During the interview session, each participant's interview conversation was recorded and transcribed. The findings are displayed below. The descriptions, code names, and the range of developmental gain scores were revealed in Table 4.6 below:

Table 4.6 Pseudonym Used in This Study

Code Description	Name code	Developmental Gain Score Range in Scientific Writing
High Performance in Science Writing No. 1 and No. 2	HP Students 1 and 2	(76% - 100%: very high) (51% – 75%: high)
Moderate Performance in Science Writing No. 1 No. 2	MP Students 1 and 2	(26% - 50%: Moderate)
Low Performance in Science Writing No. 1 No. 2	LP Students 1 and 2	(0% - 25%: Low)

Table 4.6 shows the six students who were selected and required to attend the interview at the end of the study, of which the pseudonym appeared as *HP Students 1, HP Students 2, MP Students 1, MP Students 2, LP Students,* and *LP Students 2*. For example, a student with the code *"MP Student 1"* referred to a high school student enrolled in the science and mathematics program who achieved a developmental gain score ranging between 26% and 50% after their pre-writing and post-writing test mean scores were analyzed using the relative gain scores method (Kanjanawasee, 2014).

4.5.1 Interrater Reliability

After the interview sessions were done, the obtained interview data were analyzed to find the range of agreement. Interrater reliability is crucial in qualitative research to ensure that different raters interpret and code data consistently. The goal of interrater agreement analysis was to assess how often different raters agreed on the same rating for a subject. This analysis was important because it ensured that data was consistent and reliable.

After the semi-structured interview was implemented, the students' interview data were translated from Thai into English, and then the process of back translation was applied to check whether the translated English data matched with the Thai version. Later, the translated interview data were coded by two raters to determine the level of agreement, and the list of interview protocol and their codes were shown in Table 4.7, including the coding's results that were revealed in Table 4.8.

Table 4.7 List of Interview Protocol and Codes for the Interrater Agreement Analysis

Code Number	Code Name
1	Opinions toward TBLT
2	Feelings toward TBLT
3	Influence of the treatment
4	Aspects of the Treatment
5	Willingness to Experience the Treatment Again
6	Suggestions

Table 4.8 Results of Agreement across Qualitative Data

Students	Rater 1 Code	Rater 2 Code	Agreement (Yes/No)
Question 1. Opinions (Code Number: 1)			
HP Students 1	1	1	Yes
HP Students 2	1	1	Yes
MP Students 1	1	1	Yes
MP Students 2	3	1	Yes
LP Students 1	1	1	Yes
LP Students 2	1	1	Yes
Question 2. Feelings (Code Number: 2)			
HP Students 1	2	2	Yes
HP Students 2	2	2	Yes
MP Students 1	1	2	Yes
MP Students 2	2	2	Yes
LP Students 1	2	2	Yes
LP Students 2	2	2	Yes
Question 3. Influence of the Treatment (Code Number: 3)			
HP Students 1	3	3	Yes
HP Students 2	3	3	Yes
MP Students 1	3	3	Yes
MP Students 2	1	3	Yes
LP Students 1	3	3	Yes
LP Students 2	3	3	Yes
Question 4. Aspects of the Treatment (Code Number: 4)			
HP Students 1	4	3	Yes
HP Students 2	4	4	Yes
MP Students 1	1	4	Yes
MP Students 2	4	4	Yes
LP Students 1	4	4	Yes
LP Students 2	4	4	Yes
Question 5. Willingness To Experience the Treatment Again (Code Number: 5)			
HP Students 1	1	5	Yes
HP Students 2	5	5	Yes
MP Students 1	5	5	Yes
MP Students 2	5	5	Yes
LP Students 1	5	5	Yes
LP Students 2	5	5	Yes

Table 4.8 *(Continued)*

Students	Rater 1 Code	Rater 2 Code	Agreement(Yes/No)
Question 6. Suggestions (Code Number: 6)			
HP Students 1	6	6	Yes
HP Students 2	6	6	Yes
MP Students 1	6	6	Yes
MP Students 2	6	6	Yes
LP Students 1	6	6	Yes
LP Students 2	6	6	Yes

Table 4.7 and 4.8 reveal the six interview questions used in this study to gather qualitative data by using semi-structured interview, each being assigned a code number for the two interrater assessments. These questions addressed students' opinions, feelings, the influence of TBLT, aspects aiding improvement, willingness to re-experience the teaching method, and suggestions for TBLT in scientific writing. Consequently, there was complete consistency in agreement across all questions and each group of students (HP, MP, LP), as both raters aligned perfectly, with all responses marked as "Yes." Then, the Symmetric Measures Cohen's kappa (*K*) was used as a statistic intended to account for the agreement reliability of the interview data. The results are summarized in Table 4.9 below.

Table 4.9 Results of Interrater Reliability

Symmetric Measures				
	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Significance
Measure of Agreement (*K*)	.80	.075	10.76	.00
N of Valid Cases	36			

After two interraters analyzed qualitative interview data, the value of Kappa's coefficient was 0.80, which was interpreted as a strong strength of agreement level (Cohen, 1960). Therefore, the qualitative data analysis of this study was claimed to be reliable. Then, the qualitative findings from the interviews were examined through content analysis and organized into a main themes and corresponding subthemes as outlined below:

Question 1: *In your opinion, what do you think about the course which was taught by the employment of Task-Based Language Teaching (TBLT) for scientific lab report writing?*

The initial question delved into the overall opinions of participants and intended to explore the beneficiaries of TBLT. The initial outcome generally indicated that many of the high school students had positive experiences when using TBLT for writing scientific laboratory reports. These findings are exemplified in the subsequent quotations:

".....I think that It is an effective learning and teaching approach because there is minimal reliance on traditional exams for assessment..... Instead, the focus is on report writing and practical training...." (HP Student 1)

"...This approach helps me learn better because I can show what I know through writing and real tasks, not just exams..."...." (HP Student 2)

"In my opinion, ...I have learned a significant number of new vocabulary words, and the complexity of the content I have learned.... it improved my ability to both write and read new vocabulary words in writing a lab report...." (MP Student 1)

....."It's a hands-on learning and teaching experience that enhances practical skills..... It requires a deeper understanding of techniques and..... vocabulary, which can be applied effectively in the future....." (MP Student 2)

....."Once I had the chance to try it for real.... I found it quite challenging..... but it required practice and perseverance....." (LP Student 1)

"I think that..... the workload I have received is manageable,...but there are certain lessons that I find challenging to comprehend....." (LP Student 2)

Most students perceived TBLT as an effective teaching approach which offered an essential role in developing science writing skills despite some challenges, particularly in understanding complex vocabulary, mastering technical techniques, and

adapting to the hands-on learning process. The students' answers were summarized into the main theme and sub-themes as displayed Table 4.10 below

Table 4.10 Summary of Main Themes and Sub-Themes Resulting from the First Question

Themes	Sub-Themes
1. Effectiveness of TBLT	1. Practical writing tasks *(HP Student 1,2)* 2. Science writing skill enhancement *(MP Students 1)* 3. Vocabulary comprehension *(MP Students 2)*
2. Challenges in learning	1. Level of difficulty in science writing *(LP Student 1)* 2. Some technical words are difficult to apply *(LP Student 2)*

All high-performance students agreed that the scientific writing tasks were effective in terms of practicality. They could practice their writing through the assigned tasks. This was also found among moderate students who experienced significant vocabulary and language growth through hands-on activities such as lab reports, fostering writing skills and demonstrating resilience and a growth mindset. Conversely, low-performing students were able to manage the overall workload and some written tasks, but they were faced with some difficulties in understanding specific lessons and executing writing tasks in terms of certain contents and terminologies.

To sum up, the similarities between high and moderate students are that they could manage their science writing tasks via TBLT with integrated and practical learning. On the other hand, low performers seemingly needed additional support and alternative teaching methods to increase a wider length of vocabulary in a scientific laboratory context.

Question 2: *How do you feel about the taught lessons and scientific writing tasks?*

The second question was focused on exploring the participants' feelings after engaging in the TBLT in scientific laboratory report lessons, specifically the tasks used in the TBLT approach. Based on the outcomes of the semi-structured interviews, the majority of the participants perceived science writing lessons in TBLT as challenging, as evidenced in the following excerpts.

".....It can be quite challenging, but..... it is a positive experience that encourages us.... to explore on our own and .....acquire new skills, and it's.... incredibly challenging. Without assistance,..... it would be extremely difficult to accomplish." (HP Student 1)

"....I feel that the writing task is a manageable and workable due to..... the need for extensive research, ...and it becomes particularly challenging without guidance to ensure accuracy." (HP Student 2)

"I hesitate a bit..... because it is difficult. Sometimes, I do not quite understand and feel unsure about how to proceed with the task.... However, I have a positive outlook, as I see it as an opportunity to self-train and improve." (MP Student 1)

"...It's challenging and sometimes confusing, but I see it as a chance to train myself and get better..." (MP Student 2)

"It is very challenging,.... and I have a heavy workload. However, it provides an opportunity to develop and enhance my skills....." (LP Student 1, 2)

Two main themes were captured. While all groups acknowledged the challenges of TBLT in lab report writing tasks in English, their responses varied depending on their performance levels, with high and moderate performers showing resilience and a growth mindset, and low performers feeling more challenged and overwhelmed as presented in Table 4.11.

Table 4.11 Summary of Main Themes and Sub-Themes Resulting from the Second Question

Themes	Sub-Themes
1. Feeling of challenges in scientific writing	1. Overwhelming workloads *(LP Student 1,2)* 2. Difficulty in completing *(MP Student 1,2)*
2. Opportunities for Learning growth	1. Tasks as opportunities for skill enhancement *(MP Student 1,2)* 2. Writing tasks extensive research *(HP Student 1)* 3. Boosted confidence and accuracy in science writing through research and teacher assistance *(HP Student 2)*

The expanded interview data revealed distinct perspectives across high, moderate, and low-performing students regarding their learning experiences in scientific laboratory report writing. High students thought that while challenging, the tasks gave them opportunities to enhance written skills and develop extensive research studies. These supports helped boost their confidence as well as the accuracy of their writing. Although they admitted that the written tasks had some difficulties, teacher assistance, via positive motivation and guidance, were crucial for them to succeed. Similarly, moderate students similarly believed that completing science writing tasks would be challenging but viewed them as valuable opportunities to improve their writing skills. In contrast, low-performing students found science writing tasks in TBLT highly challenging and felt overwhelmed by the number of assigned tasks.

Overall, high and moderate students exhibited resilience and a growth mindset, effectively leveraging challenges for personal development whereas low-performing students sometimes felt that the scientific writing tasks were complicated and nerve-racking.

Question 3: *How did you find TBLT affects the laboratory report writing ability?*

The third question sought to ascertain the participants' perceptions regarding the relationship between TBLT and their writing proficiency in the context of scientific laboratory reports. This study offered insights into the efficacy of TBLT as a pedagogical approach to enhancing the capacity to compose laboratory reports, specifically about its perceived benefits for improving scientific writing skills. Consequently, the different levels among performers agreed that the TBLT in the scientific laboratory reports writing led to effectiveness on their writing ability in science as follows:

> *".....It has had a significant impact. Having this workload has provided us with opportunities to gain a deeper understanding of the subject matter, learn to find answers independently, discover new insights beyond the classroom,... and acquire skills that make future learning easier. The research and knowledge gained from previous tasks have made us more efficient at our work." (HP Student 1)*

It deepened our understanding..... built skills for future learning." (HP Student 2)

".....It has had an impact .....because it focuses on practical work..... It has provided opportunities to write reports, which improved..... my understanding of scientific experiment summary reports significantly....." (MP Student 1)

"...It made an impact by emphasizing practical work and report writing, which greatly improved my understanding of scientific summaries." (MP Student 2)

"It has had..... an impact because..... it has improved my understanding of .....and adherence to correct writing principles....." (LP Student 1)

".....It has had an impact because this teaching method emphasizes frequent practice. When we attempt tasks ourselves, we gain expertise and improve our ability to memorize vocabulary more rapidly." (LP Student 2)

The notable two themes and sub themes were discovered through the second interview question, where students acknowledged the favorable effects of TBLT and the beneficial influence of given science writing tasks, as illustrated in Table 4.12 below.

Table 4.12 Summary of Main Themes and Sub-Themes Resulting from the Third Question

Themes	Sub-Themes
1. Impact of TBLT on Science writing ability	1. Opportunities for deepening comprehension *(MP Student 1, 2) (HP Student 1, 2)* 2. Improved ability to summarize scientific experiments *(MP Student 1, 2)* 3. Enhanced adherence to correct writing principles *(LP Student 1)* 4. Vocabulary retention and structural improvement *(LP Student 2)*
2. Positive effects of science writing tasks	1. structured guidance fosters writing improvement *(HP Student1, 2)* 2. Practice reinforces foundation in writing lab reports (M*P Student 1, 2)* 3. Memorization and frequent practice *(LP Student 2)*

The third question revealed distinct perspectives among high, moderate, and low-performing students regarding their learning experiences and the dissatisfaction of workload assignments. High students agreed that applying TBLT in science writing offered a positive effect and better opportunities to gain deeper comprehension for them to write lab reports in English. They also thought that science writing lessons were advantageous for their future use. Likewise, moderate students seemed to appreciate scientific writing tasks in TBLT, especially the writing reports in science despite some impacts of treatment between the lessons. In addition, they thought that TBLT offered them a myriad of opportunities to exercise scientific lab report writing, from which they could gain the foundation of lab report writing, such as summarizing the laboratory experiment accurately and appropriately. Similarly, low performers found that there were some constructive effects on TBLT in lab report writing lessons as they were instructed to write written tasks frequently. As a result, they could develop writing structures and memorize more technical vocabulary for later use.

To recapitulate, the third question shed light on the positive effects of the treatment that benefited high students, moderate students and low students differently. High students received structured guidance leading to their science writing improvement. Moderate students received enough practice to reinforce their understanding and writing ability. Low-performing students achieved science writing improvement through frequent practice and memorization.

Question 4: *What aspects of the TBLT within the course that assist you in increasing your understanding of writing a scientific laboratory report?*

The purpose of fourth question was aimed at identifying the specific aspects or components of the TBLT that were beneficial in enhancing the participants' ability to write scientific laboratory reports. Based on the findings, different levels of participants exposed different notable aspects as follows:

"I think it is the pre-task phase when the teacher introduces new vocabulary, it enhances our understanding of writing and our ability to apply it. The teacher

also encourages us to ask questions, actively engaging with us in the learning process." (HP Student 1)

"It is the during-task phase that encourages the process of writing experiment reports on my own, submitting them for evaluation by the teacher, and subsequently receiving feedback on my mistakes has been instrumental in enhancing my understanding."
(HP Student 2)

"....I think it is a during phase when the teacher and..... we get to try doing it first, and then the teacher reviews it, helping us understand it better." (MP Student 1)

"The post-task discussions allow me to hear how others approached the same task..... It gives me new ideas..... and helps me understand different ways to structure my reports."
(MP Student 2)

"It is during-task phase that we get to try doing it first, and..... then the teacher reviews and gives us feedback helping us understand and write the reports better." (LP Student 1)

“It's a group project in a during-task phase where we research and present using English. We delve deep into each section of our group's scientific report, and we gather information through discussions and presentations with our peers in the room." (LP Student 2)

One notable theme was revealed out of the fourth interview question, indicating pre-task, during task and post-task played significant roles in improving their science writing ability in English as presented in Table 4.13 below.

Table 4.13 Summary of Main Themes and Sub-Themes Resulting from the Fourth Question

Themes	Sub-Themes
1. Notable aspects of TBLT	**1. Pre-task phase:** 1.1 Vocabulary building session *(HP Student 1)* 1.2 Knowledge foundation preparation *(MP Student 2)* **2. During-task phase:** 2.1 Practical writing tasks *(HP Student 2)* 2.2 Feedback for revisions *(HP Student 2) (LP Student 1)* 2.3 Group projects *(LP Student 2)* **3. Post-task phase:** 3.1 Peer discussions *(MP Student 2)* 3.2 Errors reflections *(MP Student 2)*

The responses to the fourth question revealed students' different perspectives of TBLT to support their scientific laboratory reports writing tailored to different performance levels. High-performing students gained significant benefits from the pre-task phase that helped enhance a wider length of new specific vocabulary applying in science writing tasks. They also thought that the pre-task phase of TBLT was an active learning engagement session since certain topics were discussed to enhance their understanding and supporting science writing tasks. Furthermore, high performers thought that the during-task phase was helpful as evaluation and constructive feedback were given for them to revise scientific writing tasks themselves. Therefore, pre-tasks and during tasks were essential components of TBLT to foster high students' scientific laboratory report writing capacities.

Moderate students preferred pre-task and post-task, viewing them as vital components in TBLT. They thought that the pre-task was significant to help them complete the writing tasks first, before the teacher reviewed their finished tasks where constructive feedback was given to improve and develop the students' lab report writing ability. Similarly, they found that the during-task in TBLT was useful for them to gain others' opinions which were viewed as supportive ideas for them to complete writing tasks. This task encouraged them to analyze various answers from the same

writing tasks, and it enhanced their ability to write scientific laboratory reports to reach the teachers' expectation.

In parallel, low-performing students found that it was valuable to study the during-task phase since feedback was given after completing the science writing tasks. They thought that it enhanced their understanding of composition lab reports. Interestingly, they pointed out that collaborative groups working in science writing activities could enable them to engage in peer discussions and presentations. These supports could foster a deeper comprehension of completing the assigned writing tasks.

Conclusively, TBLT's structured phases: pre-task, during-task, and post-task contained plenty of beneficial learning sessions such as continuous feedback, learning contents and terminologies preparation, collaborative activities, and writing tasks discussion sessions. These stages could construct an active learning environment that accommodated varying skill levels and science writing abilities that led students to write effective scientific laboratory reports.

Question 5: *Would you like to study English subject regarding the TBLT for a scientific laboratory report writing again?*

The purpose of this question was aimed at determining the participants' interest and willingness to engage in the TBLT for scientific laboratory report writing in the future. This also provided insights into the participants' motivation for continuing their education in this field and whether they believed the TBLT method was worthy as they were permitted to exercise science writing in English. Consequently, the findings illustrated that the majority of the participants were willing to study this approach again in the future as shown in the excerpts below:

"It's good to learn... and prepare for future studies at the university." (HP Student 1)

".....I want to learn because it will help me gain knowledge, improve my understanding, and..... learn new vocabulary and the rhetorical moves of writing in a science context." (HP Student 2)

"....I want to learn because it will allow me to develop myself in various aspects, ...such as improving my confidence and.... writing in science significantly." (MP Student 1)

...I want to learn because it helps me grow, especially in building confidence and improving my science writing." (MP Student 2)

"......I want to learn more because it's an effective teaching method that simplifies the subject matter, breaking it down into manageable steps,....allowing us to practice real report writing. however,.....I need to pay more attention to the writing lesson especially linguistic features for lab reports including extra practices " (LP Student 1)

"I want to learn more as this method simplifies the subject and provides report writing practice. However, I need to focus more on linguistic features for lab reports and do extra practice." (LP Student 2)

One remarkable theme was discovered through a frame of the fifth interview question, which they perceived TBLT as a useful and helpful approach for future studies as revealed Table 4.14.

Table 4.14 Summary of Main Themes and Sub-Themes Resulting from the Fifth Question

Themes	Sub-Themes
1. Willingness to Continue TBLT	1. Future studies preparation *(HP Student 1)* 2. Knowledge and skill development *(HP Student 2) (LP Student 1, 2)* 3. Confidence building *(MP Student 1, 2)*

The excerpts highlighted the students' eagerness to continue studying English through TBLT for scientific laboratory report writing. High-performing students agreed that they preferred to learn the science writing in English via TBLT because it enhanced their knowledge, understanding, vocabulary, and the rhetorical patterns of scientific

laboratory reports, including equipping them with lab report writing ability for future university studies. Along the same line, moderate students desired to study science writing through TBLT again because they thought that the TBLT in science writing fostered their confidence in using both forms and functions to complete written tasks.

Similarly, low-performing students recognized that TBLT techniques were practical as it had a clear process to minimize complexity in science writing tasks, such as providing structures which were manageable steps for authentic lab report writing. However, they pointed out that effective management of science writing tasks such as reviewing more linguistic features or grammar in the lab report writing context could alleviate certain difficulties while performing the assigned writing tasks. Therefore, most participants agreed with the usefulness of TBLT for their future studies regarding its roles in enhancing both language forms and functions of scientific writing. This was the results of the TBLT functions that could motivate different levels of students in writing lab report.

Question 6: *What is your suggestion about the TBLT in the laboratory report writing?*

The purpose of this question was to elicit the participants' suggestions and feedback regarding the TBLT in the context of laboratory report writing. The findings of the sixth question are demonstrated below:

"I think that..... sometimes the assigned writing task has too many details, making it overwhelming and challenging to handle and.... I need to take more time to remember." (HP Student 1)

"I prefer individual tasks over group work because..... this helps me concentrate more." (HP Student 2)

"I think a teacher should provide more examples..... in writing parts and I think some lessons should have a simpler explanation." (MP Student 1)

"I think the teacher should give us easy writing examples and explain some lessons more simply." (MP Student 2)

"I would like more detailed guidance and repeat the lessons more that helps me understand the task better." (LP Student 1)

"I need clearer guidance for writing practice." (LP Student 2)

One insight theme emerged from the sixth interview question, when participants provided some suggestions concerning the TBLT in science writing lessons as revealed Table 4.15 below.

Table 4.15 Summary of Main themes and Sub-Themes Resulting from the Sixth Question

Themes	Sub-Themes
1. Suggestions for Improving TBLT	1. Task complexity *(HP Student 1)* 2. Individual writing tasks *(HP Student 2)* 3. Use of more examples *(MP Student 1, 2)* 4. Repeating explanations *(LP Student 1, 2)*

The sixth question revealed insightful recommendations among different levels of students. High-performing students advised that task complexity be minimized since excessive details may overwhelm and hinder their ability to retain information. Additionally, individual tasks over group work were preferred to gain focus and concentration. In contrast, moderate students suggested that it would be helpful for them if the teacher provided more examples during writing sections to facilitate better understanding. Similarly, low-performing students requested more additional guidance to help them grasp the tasks more effectively.

Similarly, the students' suggestions were the need for balancing task complexity, offering clear and simplified instructions, and providing ample examples and support. Additionally, tailoring TBLT to accommodate different learners' needs by focusing on different proficiency levels would yield optimal results of the study. In addition, a variety of activities should be offered such as both individual and collaborative tasks, breaking down assignments into manageable steps, and enhancing instructional clarity to alleviate and improve the effectiveness of laboratory report writing.

These recommendations shed light on fostering a more supportive and accessible learning environment, enabling all different levels of students to develop their scientific writing skills more confidently and effectively. Significantly, it was highly expected that these differentiated instructional strategies would provide appropriate support and guidance to help all students thrive, ensuring that each group could overcome their specific obstacles and achieve their academic goals successfully.

4.6 Summary of Qualitative Findings

The semi-structured interviews conducted with students of varying performance levels in developmental gain scores, and the findings revealed insights into their perceptions of TBLT for scientific laboratory report writing in English. The students provided an in-depth understanding of their challenges, growth, and suggestions across six key interview questions. The interview findings revealed the strengths and challenges of TBLT in supporting scientific laboratory report writing. While students of all levels recognized its benefits, their suggestions point to opportunities for refining the approach to make it more inclusive and effective. By incorporating clearer instructions, tailored tasks, and enhanced guidance, TBLT can continue to foster students' confidence, skills, and motivation in scientific writing.

4.7 Summary

There were significant improvement of Thai high school students' lab report writing mean scores after scientific laboratory report writing lessons were given via TBLT in the context of language classrooms. Moreover, most students considered TBLT in scientific writing lessons as a useful method. Quantitatively, the results of inferential statistics, paired-samples *t*-test, revealed a statistically significant increase when making a comparison between the mean post-test score and the pre-test score of TBLT. The impact size results in this study aligned with Cohen (1988), indicating that the treatment had a substantial influence on science writing among Thai school students. This indicates that the TBLT approach positively influenced the general writing abilities of Thai high school students in tackling English science writing problems.

Before conducting semi-structured interview, the pretest and posttest's mean scores were computed and stratified into different performing levels: low, moderate, high and very high. As a result, the majority of high school students achieved a moderate level of development according to the analysis of developmental gain score and none of them was able to achieve a very high level. With six interview protocol, most participants expressed positive viewpoints after the nine weeks engagement of the treatment in science writing tasks during a second semester of academic year 2024. Overall, both high and moderate students' science writing had become effective after applying several learning sessions of TBLT. The effectiveness of their science writing had become much clearer after receiving structured learning stages, constructive feedback and completing the assigned science writing tasks, terminologies and linguistic forms and functions preparation session. TBLT positively contributed something new to high and moderate students in completing science writing tasks in English. Although low-performing students thought that they could manage science writing in English through the teacher's guidance, collaborative writing activities and memorization, they underwent some difficulties during completing the assigned tasks, such as inadequateness of technical vocabularies, complexity of the science writing tasks, and a number of assigned workload or tasks. Nonetheless, high, moderate, and low students agreed that the science writing tasks in TBLT context were beneficial and practical for their future studies. Notably, the transcribed interview data, which were analyzed by using the value of Kappa's coefficient, significantly revealed strong strength of agreement, denoting a high reliability.

CHAPTER 5
DISCUSSION AND CONCLUSION

Chapter five presents six sections, including an overview of the study, discussion of the study, implications for education, limitations of the study, recommendations for future studies, and conclusion. The chapter also discusses insightful implications of TBLT in science writing for stakeholders, such as educators, policymakers, and researchers in the field of writing in English classrooms, providing a foundation for future exploration and improvements in teaching practices and curriculum development.

5.1 Overview of the Study

This study mainly investigated the effectiveness of TBLT in improving scientific laboratory report writing in high school students. Furthermore, it explored the participants' opinions toward applying of TBLT in scientific laboratory report writing. The study used mixed-methods experimental research with a one-group, pretest, and posttest design. This design was implemented to compare the improvement of scientific laboratory report writing performance of participants by utilizing a pre-writing test and post-writing test, and it was utilized to explore the participants' opinions at the end of the study phase.

The 35 participants were purposively selected from grade 11 enrolling in a science and mathematics program at one public school in Pathum Thani province, Thailand. The duration of the study was 9 weeks, 18 hours in the 2nd semester of academic year 2023. The participants, registering in the science and mathematics program, were ethically informed to experience laboratory report writing lessons through the lens of TBLT method in the English language classroom. The teacher designed the course syllabus, lesson plans, learning materials, science writing tasks, learning activities, assessment tools as structured plans and instructional strategies

within the TBLT teaching framework, entitled “English for scientific laboratory report writing”.

Vitally, content and language integrated learning (CLIL) was the approach applied throughout the study in collaboration with science teachers as the researcher taught students with science learning content in the English classroom. This way was appropriate and helpful for the teacher to consult and check the learning contents and assessment ways from science teachers. The experimental laboratory results from science classes were composed and utilized as pre-writing test and post-writing test as well as the task contents, which were applied in the teaching and learning process.

The TBLT teaching approach was separated into three learning stages: pre-task, during-task and post-task and the framework of the task-based approach followed Willis (1996) and Ellis (2003). Active learning sessions and practical learning sessions were integrated in each learning stage so that the learners received opportunities to familiarize with learning contents, such as linguistics forms and functions, terminologies, rhetorical patterns and language use in scientific laboratory report in English language context.

Before TBLT was commenced in science writing lessons, each student was required to do pre-writing test based on the results of the previous experimental laboratory data. Implementing TBLT in science writing involved three key stages. The "pre-task" stage was developed to enhance students’ foundation knowledge and prepared them to face the science writing tasks. This step was facilitated by the teacher who introduced important learning matters, such as linguistic forms and functions, terminologies, language use, lab report moves including instructional criteria encompassing the introduction of learning objectives, reference materials, grading criteria, the learning framework, and teaching strategies. This phase made the students become ready to face the science writing tasks and fostered the ability to carry out the science writing tasks in the next learning stage.

After completing the pre-task phrase, the students were required to engage and carry out the assigned science writing tasks in the during-task stage. This stage offered the students to practice science writing through authentic tasks, and discussion sessions were also encouraged for the students to brainstorm the answers among their groups. In addition, constructive feedback was given individually and collectively to the students, so they could revise the assigned tasks appropriately.

The "post-task" stage aimed to raise awareness, requiring students to revisit the taught lessons, including language forms and functions, lab report structures, and technical vocabulary. This process encouraged them to evaluate their task performance and reflect on their learning experiences. They were also motivated to give the oral presentation of scientific tasks in pairs and groups. Following the presentations, the teacher concluded the lessons by addressing and correcting common errors made by students. Finally, each student was required to complete a post-writing test.

The quantitative data, gathered through a pretest and posttest, ware analyzed using statistical methods Additionally, students of varying performance levels participated in a semi-structured interview to share their opinions on their experience with TBLT in science writing. The interview data were transcribed and translated into English for qualitative content analysis. The findings revealed that not only did the comparison between pretest and posttest mean scores show significant improvement, but most students also expressed positive opinions toward the TBLT approach in scientific writing lessons

5.2 Discussion

The results revealed that using TBLT significantly improved students' scientific laboratory report writing performance, and that most students had positive opinions on the TBLT of science writing in English. The findings are discussed as follows:

5.2.1 Enhancement in Writing Scientific Laboratory Reports through TBLT Framework

Teaching science in English has been widely applied in non-English-speaking countries, but it remains a controversial approach in EFL high school settings. Using English as the medium of instruction benefits students by enhancing both their scientific knowledge and their English proficiency. Scientific literacy in writing, shaped through studying science in English, is considered essential for education (Gallagher, 2000).

In this study, Thai high school students in science and mathematics programs faced difficulties in writing lab reports in English. They often applied incorrect grammar, vocabulary, rhetorical patterns, and sentence structures. These difficulties resembled those found in general English courses, highlighting the need for effective teaching methods to improve students' writing proficiency.

The TBLT has been recognized as an effective approach in second language acquisition, providing learners with opportunities to engage in authentic tasks (Willis, 1996; Ellis, 2003). A focus on forms, where specific linguistic features are explicitly taught, has also been found effective in writing lessons (East, 2021).

This study applied TBLT with a focus on forms to enhance students' ability to compose scientific laboratory reports. they were required to carry out assigned tasks in three learning phases. Each learning was filled with a myriad of active learning activities where the students could familiarize themselves with specific science learning contents and necessary language forms and functions in composing an English lab report. Findings from this study confirmed that TBLT significantly enhanced students' science writing performance, leading to the acceptance of the alternative hypothesis and demonstrating a large effect size. These results underscore TBLT's potential as a pedagogical approach for integrating language learning with scientific content in English. The findings further provide empirical evidence supporting the application of TBLT in shaping EFL high school students' lab report writing skills. Regarding specific aspects of lab report writing, the study found significant improvements in students' ability to organize and present their findings logically, particularly in structuring and discussing their results. However, the relatively smaller gains in language style and linguistic features suggest a need for additional instructional emphasis on precise language use and stylistic refinement in scientific writing in English.

Previous studies on TBLT in EFL contexts, particularly concerning lab report writing by Thai school students, have been limited. However, research on TBLT in English and in EFL writing performance more broadly may support this study's findings**.** Nhem (2020) explored TBLT's impact on writing and found that it improved both writing ability and motivation. Kafipour et al. (2018) asserted that tasks enhance EFL learners' writing competence, while Elshoff (2014) emphasized the need for alignment with students' proficiency levels. Sari and Pangaribuan (2018) found that TBLT increased students' writing skills, interest, motivation, and engagement. Derakhshan

(2018) demonstrated that TBLT improved writing accuracy, particularly in summary and image-based writing tasks. These studies highlight the benefits of active learning and authentic tasks in fostering writing skills.

Despite the strong evidence supporting TBLT's benefits, previous studies often focused on general academic writing rather than the specific context of scientific laboratory report writing. The current study fills this gap by substantiating TBLT's effectiveness within a scientific lab report writing framework, particularly regarding the organization, logical reasoning, and clarity of lab reports. Nonetheless, the smaller gains observed in the average mean score of linguistic accuracy section indicate the need for further instructional refinements. These findings accentuate the importance of tailoring TBLT to discipline-specific tasks, enabling students to develop both general writing proficiency and a mastery of scientific discourse conventions.

In summary, the findings of this study affirm TBLT's effectiveness in EFL scientific writing and its role in enhancing linguistic forms and overall writing performance. The positive outcomes of TBLT, especially when combined with a focus on forms, represent a practical approach to developing scientific writing skills in language classrooms.

5.2.2 Students' Perceptions of TBLT in Scientific Laboratory Report Writing in English

TBLT has been increasingly recognized for its ability to enhance writing performance and create a positive learning atmosphere, leading to student satisfaction. Interview data from this study revealed that most participants had positive opinions about their scientific writing improvement. Beyond the effectiveness of TBLT in enhancing writing ability, students enjoyed writing lab reports under TBLT instruction. This aligns with Lambert (2019), who highlighted TBLT's dynamic nature in supporting learners' internal syllabuses, resources, and experiences.

Students reported increased motivation and better task management, supported by teacher guidance, active learning, and structured writing tasks. These findings are consistent with previous studies in EFL contexts. Douglas and Kim (2014) found that learners preferred TBLT for its interactive nature and its integration of reading, listening, speaking, and writing. Nhem (2020) also found that students enjoyed TBLT writing lessons and classroom discussions, and that teacher feedback contributed

to their positive experiences. Similarly, Willis (1996) supported TBLT's role in reducing The interview findings also revealed the strengths and challenges of TBLT in supporting scientific laboratory report writing.

While students at all levels recognized its benefits, their suggestions highlight opportunities for refining the approach to make it more inclusive and effective. Specifically, students suggested the need of more examples during task completion, more tailored tasks, and enhanced guidance to better support their lab report writing development. By incorporating these refinements, TBLT can continue to foster students' confidence, skills, and motivation in scientific writing.

Specifically, an analysis of student feedback across performance levels provides further insights into the diverse needs within the classroom. High-performing students expressed concerns about task complexity, suggesting that excessive details could be overwhelming and hinder information retention. Some of them also preferred individual tasks over group work to maintain focus and concentration. Moderate-performing students emphasized the need for more examples during writing instruction to enhance their comprehension, while lower-performing students requested additional guidance and support to help them effectively grasp the tasks.

These findings highlight the importance of balancing task complexity, offering clear and simplified instructions, and providing ample examples and scaffolding. Tailoring TBLT to accommodate different proficiency levels would optimize its effectiveness. A combination of individual and collaborative tasks, breaking down assignments into manageable steps, and enhancing instructional clarity could further support some students in developing their scientific writing skills. Ultimately, these differentiated instructional strategies would ensure that all students receive the necessary support to overcome their challenges and achieve their academic goals successfully. The interview data are discussed further as follows:

1. Students' Overall Opinions toward TBLT in Science Writing

It is useful for the high, moderate and low students to use scientific tasks to improve their lab report writing performance in language classrooms. The writing skills applying for experiment reports are developed through the discovery learning method. This encourages the students to explore and form ideas independently and they could express their systematic observations in their reports without relying on the teacher's

assistance. As noted by Saab et al., (2007, p. 386), the students who experience discovery learning could construct their own understanding actively by conducting experiments within a specific domain where conclusions are derived from the results of their investigations. The improvement in their writing is clearly shown in linguistics features and language forms and functions in science writing. In addition, the written tasks are authentic, so it helped them to gain better science writing quality. Nevertheless, the scientific writing tasks in TBLT seem challenging for low students due to the use technical vocabularies. It seems that high and moderate performers show the effectiveness once they were assigned writing tasks more than low performers. However, the low performers were alleviated their difficulties by the teacher's additional supports to review scientific vocabularies such as flash cards and filling in the blanks learning strategies before carrying out the science writing tasks. Baddeley (1986) pointed out that these strategies were helpful to enhance working memory and comprehension among low students. Turley-Ames and Whitfield (2003) stated that the pre-task of introducing vocabularies is the effective strategy of cognitive approach in semantic association. Accordingly, these sorts of pre-task phase activities were essential to multiply a wider range of vocabularies knowledge, and it also foster memory-working ability to store significant terminologies for the following writing tasks.

2. Students' Opinions on TBLT in Science Writing Assignments

TBLT in science writing is a challenging task for students; however, they considered the writing tasks as having some difficulties to improve their science writing ability. It is difficult for high students because of extensive studies. Moderate-performing students found the difficulties in science tasks in terms of language forms and structures to write lab reports in English. On the other hand, low students feel that a substantial number of assigned workloads and working tasks are their major problems.

High and moderate performance in science writing students have good-mindset belief that they could develop their practical writing tasks once they are suggested. Gardner and Lambert (1972) also noted that learners' positive attitudes towards learning a language maintain positive motivation to achieve their language learning goals. Although a number of assignments is not major problems, the students have some difficulties and obstacles about researching academic information. Likewise, a

recent International Computer and Information Literacy study found that Thai teachers and students lacked sufficient levels concerning computer literacy, information processing, and communication skills needed for the 21st century (Fraillon et al., 2014). However, low students have become less enthusiastic if the given tasks are too many pieces, which impact on their accomplishment in a given time. In addition, Fukuda (2018a) highlighted that the motivational and cognitive differences in self-regulated learning skills between low- and high-proficiency groups have an influence on self-regulated learning, which significantly result in language learning achievement. Therefore, it seems fair to claim that the ability of the low students in learning English in science writing is likely to drop because of a high workload.

To alleviate given problems, the teacher may consider reduce a number of assigned writing tasks for low students if possible. Alternatively, the tasks can be given to the lower students only a few pieces of writing tasks may be given at a time but increase the frequency of assignments. These ways could relieve the tension of science writing tasks including workloads as well as producing productiveness and positive satisfaction among the students.

3. TBLT and the Students' Performance on Scientific Laboratory Report Writing in English

The TBLT treatment has a substantial influence on the students' writing performance, especially in the scientific laboratory reports in various levels. Overall, it is effective for both high performing students and moderate students to follow TBLT in their science writing tasks. High-performing students presented their positive perceptions of TBLT in writing lab reports in English because this approach provides deeper comprehension and more benefits for their future use. It is pleasant for moderate-performing students to complete scientific writing tasks within TBLT, particularly lab report writing, despite having some challenges during the lessons. Moreover, it is thought that TBLT tasks are helpful as constructive feedback and plenty of writing practice sessions were given during learning sessions. This gives enough practice and useful feedback leading productive outcomes. Nevertheless, TBLT also provides written structures and technical vocabularies to upgrade the knowledge of low-performing students.

In addition to get enough practice, it is useful for high and moderate to receive structured guidance and vocabularies preparation which they can apply forms and meanings at the same time. Low performers also agreed that authentic science writing examples give them ready-to-use collocational patterns and vocabularies that enhance their capacity of science writing. This sheds light on the practicality of TBLT in science writing tasks linking between theoretical knowledge and real-world tasks. Thereby, the students gain deeper understanding, and they are able to apply scientific report writing effectively. Likewise, Samuda (2015) pointed out that the tasks as used by the teacher should be applied to the real-world activities, so this contained the value pedagogical implications to motivate the learners to have the real-world experience. Rahimpour (2008) further pointed out that teachers' role in TBLT is the delivery of constructive supports and guidance, which encourage the students' expertise, confidence and target language development. Similarly, TBLT approach helps develop the students' target language acquisition by the use of authentic tasks (Jacobs & Farrell, 2003). Accordingly, the usefulness of TBLT towards Thai high school students theoretically contributes to authentic tasks, teachers' supports and feedback, sufficient writing practices and collaborative learning systems. Ellis et al. (2019) noted that the TBLT has a significance in language learning in terms of cognitive learning process and sociocultural perspectives, encouraging the students to pay closer attention to forms and meanings simultaneously. As pointed by Norris (2009) and Van den Branden (2006), TBLT approach also helps the students acquire the target language from constructive feedback and tasks evaluation, which support their language development. Willis (2007) claimed that TBLT is considered as the best way to teach the students the authentic language via tasks, discussion sessions, problem-solving, and learning activities.

4. Effective Aspects of TBLT for Improving Scientific Laboratory Report Writing Skills

Three essential learning phases, pre-task and during-task and post-task phase were mentioned by all levels of students but varied. The pre-task and during-task phases are focused by High-performing students. They were introduced a strong foundation knowledge such as technical vocabularies, rhetorical moves, specific language forms and functions. They claimed that these introductions of learning topics

in the pre-task enabled them to complete science writing tasks effectively. Pre-task activities are important to prime learners so that they become familiarize with the specific target structures and necessary vocabulary lists, which could lead to more extensive and varied language utilization during the task stage (Boston 2010; Foster & Skehan, 1996). Lee (2000) also agreed with the significance of 'framing' which encourages the students to familiarize themselves with the nature of the language they were expected to achieve at the end of the study phase. Conclusively, this learning stage as a process of preparation could facilitate the students to carry out the science writing tasks before the during-task phase comes.

Furthermore, high and moderate students perceived during-task phase as the step of providing feedback sessions, task evaluation sessions, and frequent practical task practice. These active learning sessions were crucial for the students to revise the assigned science writing tasks leading to the higher ability to write. This is consistent to Aubrey's (2020) during-task stage which encourages the leaners to familiarize with the task' nature and its purpose including how the tasks were repeated and produced via a degree of learners' task engagement. Interestingly, low-performing students paid more attention to the during-task phase when constructive feedback was given, and this could lead to their achievement in science writing tasks and the effectiveness of their lab report composition. They also highlighted that collaborative group work encouraged peer discussions and presentations, fostering a deeper grasp of ideas to write. This implies that low students rather rely upon their peers and teachers in order to making a progress on their science writing tasks. Finally, post-tasks phase was favored by moderate students, which they were assisted to recall and revisit overall science writing performance as well as received different answers from peers. They also pointed out that this learning stage encouraged them to monitor their writing mistakes found in their science writing tasks. These activities were called "consciousness-raising activities" (Willis, 2003; Willis & Willis, 2006). This process could construct supportive learning environments, encouraging continuous improvement of language use and writing skills in science.

In summary, TBLT's structured phases: pre-task, during-task, and post-task, offer a variety of learning opportunities. The students received feedback, learning contents and terminology preparation, collaborative activities, and writing discussions, which are valuable for them to learn. These stages created an active learning environment to

support different skills including science writing abilities, so the students could finally produce effective scientific laboratory reports in English themselves.

5. Willingness to Experience the Treatment under Science Writing Lessons in the Future

It is desired by the students to produce the TBLT approach for scientific laboratory report writing again in the future. High-performing students expect that science writing in English through TBLT could improve their knowledge, understanding, specific vocabulary, and familiarity with the rhetorical patterns of scientific lab reports. They also believed that the writing of lab reports is applicable in their future, especially in the level of university studies. Moderate students feel interested to study science writing through TBLT again because it enhances their confidence to complete science writing tasks, which forms, genre and functions are used at the same time. Low-performing students enjoy practicing their written tasks via TBLT because the writing process is clearly provided into steps. However, they prefer to study the linguistic features of the lab reports which could help them accomplish science writing tasks more effectively.

Those previous studies reported that experienced TBLT students strongly appreciated real-world tasks, collaborative learning, and opportunities for self-directed language use (Dornyei & Skehan, 2009; Richards & Rodgers, 2014). Inayanti (2019) supported that using writing-focused approach, TBLT improve the students' writing skills. Wright (2021) emphasized the importance of students' motivation to write, their perceived value of writing, and their self-belief as writers in influencing their writing outcomes. These qualities and the three active learning stages may contribute the students to perceive the productiveness and the usefulness of TBLT that could motivate them to proceed in science writing tasks in future studies.

5.3 Pedagogical Implications

The findings from this study revealed two essential pedagogical implications: the use of TBLT in scientific laboratory report writing lessons and the integration of TBLT in EFL Thai high school students through the frame of scientific writing tasks as

the way to foster their lab report performance among their different levels in science writing capacity.

5.3.1 The Use of TBLT for Scientific Laboratory Report Writing Lessons

The quantitative findings indicated that TBLT, specifically when combined with a focus on forms, could significantly improve experimental report writing performance among EFL high students. Both quantitative and qualitative findings of this research shed light on the effectiveness, usefulness, and productiveness of strengthening students' experimental laboratory report writing in English. The TBLT framework offered clear advantages to both teachers and students, particularly for EFL learners in English. Its emphasis on authentic language use through tasks further enhanced students' language learning experiences (Sholeh et al., 2020). Scholars had proposed TBLT for language learning (Estaire and Zanon, 1994; Lee, 2000; Prabhu, 1987; Skehan, 1996; Willis, 1996), which typically included three learning stages: pre-task, during-task, and post-task, holding potential to levitate not only communication skills but also writing across disciplines like science. Because structured learning plans and strategies were mixed and matched with hands-on activities like writing assignments, helpful feedback, language support, learning content reflections, activities that raised linguistic awareness, and writing tasks with discussion and presentation. These supports were merged into each notable stage that was specified in syllabus activities and applied to science writing lessons.

Apart from remarkable learning sessions in TBLT, defining the learning contents was an integral part of this study. The analysis of Parkinson's (2017) study findings in rhetorical moves in scientific laboratory reports and language use and forms such as tenses, keywords, and each move's objectives and purposes, including language style. These contents played a significant role in fostering the students' lab report writing comprehension as they could manage scientific tasks in English. Another learning-contributing intervention that has a significant role in expanding their linguistic features in lab reports was a focus on forms. Practically, the students received an intense learning session focusing on specific grammar throughout TBLT as they could apply the grammatical forms correctly in completing science writing tasks. It was recommended that teachers integrated a focus on forms so that it had the potential to encourage the students to intensely look at necessary language forms and functions.

Yin (2012) also recommended that a focus on forms can significantly contribute to developing students' ability to use the target language effectively, correctly, and appropriately. Therefore, it could be claimed that a focus on forms in TBLT was possible to increase the quality of scientific lab reports' linguistic features, as it was seen as one of the major EFL problems.

In summary, the potential of TBLT to enhance scientific laboratory report writing performance in English was remarkable, particularly when combined with a focus on forms intervention**.** This approach not only facilitated students' mastery of essential scientific writing skills but also addressed common linguistic challenges faced by EFL students. Consequently, the findings of this study shed light on the importance of adopting innovative teaching frameworks like TBLT to bridge the gap between language learning and discipline-specific writing, thereby equipping students with the tools to succeed in scientific laboratory report writing ability, including academic and professional contexts.

5.3.2 The Integration of TBLT in EFL Thai High School Students Through Scientific Writing Tasks Among Different Levels in Science Writing Capacity

Integrating English writing lessons focused on scientific laboratory reports presented significant challenges for Thai students. The scientific writing genre, with its distinct language style, rhetorical structure, and specialized terminology, often caused unfamiliarity and confusion among high school students. These challenges were compounded by students limited prior exposure to such tasks in their EFL contexts. To address these issues to overall students, teachers should provide additional guidance, scaffolding, and feedback, particularly during the initial stages of learning. This support would help students build a foundational understanding of the material, enabling them to approach writing tasks with greater confidence and competence during the 'during-task' phase and successfully complete assignments in the final stages.

The analysis of the findings suggests that TBLT possesses numerous characteristics capable of enhancing students' scientific writing performance and fostering positive learning engagement. Specifically, TBLT encourages students to focus on both linguistic elements and textual features crucial for composing laboratory

reports. Through its structured phases - pre-task, during-task, and post-task students were actively involved in reviewing lessons, reflecting on their learning process, and engaging in peer and self-assessment. This cyclical approach not only reinforced their understanding of the content but also empowered them to critically evaluate their work, which is essential for developing scientific writing proficiency.

Furthermore, the study highlights the importance of integrating explicit instruction of a focus on forms in delivering rhetorical moves, grammatical forms, and stylistic conventions relevant to scientific writing. Such targeted interventions ensure that students not only grasp the conceptual framework of lab reports but also develop the linguistic accuracy necessary for effectively communicating their scientific observations and findings. By addressing these components, TBLT bridges the gap between language acquisition and disciplinary writing requirements.

It is suggested that groups of low, moderate, and high-performance lab report students should be encouraged and trained in extensive research skills to make sure that they can classify and use reliable sources during learning sessions. Students with low science writing performance should receive training in self-regulated skills to help them manage the assigned tasks. In addition, providing extensive time in frosting relevant language use and forms in science writing is helpful for high, moderate, and particularly low students to build a strong foundation to complete scientific lab report writing tasks in English.

In conclusion, this study contributes to the broader understanding of TBLT as an effective language teaching methodology, particularly in the specialized context of scientific writing instruction. Findings from both quantitative and qualitative research showed how important TBLT is when it combines real language use with the needs of the discipline. The implications of the study extend beyond the classroom, offering practical insights for curriculum design, instructional practices, and teacher training in EFL contexts. By adopting TBLT as a treatment to help the students to write lab reports in English, educators can better equip pupils to meet the certain demands of English and academia in science and beyond.

5.4 Limitations of the Study

While the current study yielded a wealth of insightful findings, it was not without limitations. The sample was selected using a purposive sampling technique, focusing solely on students enrolled in the science and mathematics program at a public high school in Pathum Thani, Thailand. This study was limited by both its small sample size and its one-group pretest-posttest design, which restricts the generalizability of the findings. Future research should incorporate a larger and more diverse sample, along with a comparative experimental design, to provide a more robust evaluation of TBLT's effectiveness in scientific writing instruction. The findings of this study cannot be generalized to all Thai high school students and international contexts, where English is used as a second language and native-speaking countries.

Furthermore, this study was conducted in a single educational setting which does not represent the diversity of learning environments and student experiences across different schools or regions. So, these setting characteristics of this study may not be generalized to other students with different resources, teaching methods, and student demographics.

The study did not classify students by a standardized English proficiency test before implementation due to practical constraints, such as time limitations and the availability of standardized assessments. Instead, students' proficiency levels were inferred from their pretest and posttest scores, which were analyzed using development gain scores. This approach allowed for a post-hoc categorization of students into very high, high, moderate, and low development for interview analysis. However, pre-classifying students based on proficiency could have provided a more structured foundation for tailoring TBLT instruction, potentially leading to more targeted support and improved learning outcomes. Future research should consider incorporating standardized proficiency assessments to enhance instructional effectiveness and result accuracy.

Finally, the sample selected for this study comprised students enrolled in the mathematics and science program, where English was used as the medium of instruction. Therefore, the findings may not be generalizable to high school students outside of this program, particularly those who do not regularly engage with English in

their academic environment. This limitation suggests the need for further research involving diverse student populations to validate the applicability of the study's conclusions across different educational contexts.

5.5 Recommendations for Future Studies

Some areas in this research can be investigated for future studies as follows. Firstly, the quantitative and qualitative findings of the current study suggest that other researchers intend to improve the students' science writing, namely scientific laboratory report writing skills by utilizing the TBLT instruction among Thai high school students. This study employed a single-group pretest-posttest design. To further validate the effectiveness of TBLT in science writing instruction, future research should incorporate a comparative approach by involving two distinct groups one receiving TBLT with a focus-on-forms intervention and the other using a different instructional method. This would allow for a clearer assessment of TBLT's impact relative to alternative approaches, providing deeper insights into its strengths and limitations in fostering scientific writing skills. Additionally, this study employed a semi-structured interview as a tool to explore the participants' opinions after they experienced the TBLT approach. To profoundly investigate their perspective and thinking, another instrument, such as observation logs or an in-depth interview, should be implemented in future studies. Lastly, it could be worth classifying the students' English proficiency before conducting the study to compare the performance among different groups of students. Because it facilitates and integrates language objectives into class, using visual aids and providing extra time among students for practice (Goldenberg & Coleman, 2010).

5.6 Conclusion

After the students experienced the TBLT for 9 weeks, the statistical data from the pretest and posttest revealed a significant growth in students' scientific laboratory report writing, indicating that the treatment positively influenced the development of Thai EFL students' science writing performance. The semi-structured interview

examined students' perceptions of TBLT in science writing lessons. Most students across all proficiency levels expressed positive viewpoints, highlighting improvements in technical vocabulary, grammar, engagement, and lab report structure.

Remarkably, students with high and moderate performance in science writing actively engaged with the science writing tasks without extra assistance from the instructor. On the other hand, some low performance students found the lesson challenging. They were required to have basic knowledge in both science and English and extra practices, which could have alleviated their struggles while confronting scientific laboratory report-writing activities. This implies that the TBLT for science writing would be challenging for low English ability students, and the TBLT for science may be suitable for those who have not only basic background in science, but English proficiency. Therefore, the teacher is recommended to assess their student's English proficiency and activate background knowledge of low students before implementing the task.

The findings of this study underscore the value of TBLT in enhancing EFL high school students' ability to write scientific lab reports in English. By integrating language learning with scientific content and incorporating a focus-on-forms intervention, educators can equip students with both linguistic proficiency and scientific literacy in writing. As the digital age continues to evolve, fostering these interdisciplinary skills is no longer optional but essential. Therefore, educators and policymakers should actively implement and refine TBLT-based instruction to prepare students for the complexities of academic and professional communication in a technology-driven world.

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APPENDICES

APPENDIX A

Samples of Pretest and Posttest

This study adapted the suggestive obligatory moves in lab reports resulting from the study of Parkinson, (2017) as a guidance in assessing the scientific laboratory report writing performance of students. Parkinson (2017) stated that the rhetorical moves and linguistics features, specifically the use of sentences, and linkages were mainly identified within each move of Moves in laboratory reports as illustrated table below.

Table Moves, linguistics features, textual features in laboratory report writing

Moves	Linguistics features and textual features
Abstract	Move: A1 stating aim (past tense) *Keys words "aim" or "objective"* Move: A2 introducing topic (present tense) *Mentioning the context of the experiment.* Move: A3 stating results (past tense) *Keywords "the results showed", "were found"* Moves: A4 drawing a summary (present tense) *Providing experiment implication*
Introduction	Move: I1 establishing topic (present tense) *Claiming importance by using the word like "important"* Move: I2 starting aim (past tense) Keyword "aim", "goal" or "purpose" Move I3 Introducing experiment (past tense, passive voice) *Describing experiment method*
Methods	Move: M1 listing materials and equipment Move:M2 experimental procedures (past tense, passive voice, linkages) Detailing procedures
Results	Move: R1 restating methodology (past tense, passive voice) Justifying methodology

	Move: R1 Announcing results (past tense and passive) Providing table, graph, or formulae (present tense) Move: R2 interpreting the results (past tense) Assisting the reader in understanding the findings
Discussion	Move: D1 contextualizing discussion (present tense) Explaining the findings in a light of theory Move: D2 Interpreting the results (past tense) Restating the method and the results of the experiment Move: D3 making suggestion and limitation (past tense) Recommending for future study
Conclusion	Move: C1 summarizing the results (present tense) Drawing conclusion Move: C2: Drawing claim, limitations or suggestions (Present tense)

As shown Table revealed that the six rhetorical moves were concerned and related to each other, and the linguistic features or grammatical patterns played a vital role in composing a laboratory report. the findings of Parkinson (2017) implied that explicit language and technical vocabulary were essential in formalizing the lab reports. For instance, signal words in stating *aim "aim", "objective", or "purpose"* and stating the results "the findings showed", *"were found/determined/identified/proved" and etc.* Based on the genre analysis in the student's laboratory report above, the areas of assessment in this study conclusively were *Abstract, Introduction, Method, Results, Discussion, Conclusion, Format Organization, Linguistics Features, Language Style and Vocabulary*.

Pre-writing test: Chemistry Lab

Instruction: Write the scientific laboratory report in English based on the results of the laboratory experiment of the chemistry subject.

1. Title: The Relationship Between Volume and Number of Moles of a Gas: Avogadro's Law

2. Abstract:

The Avogadro's is under the condition of temperature and pressure, equal volumes of gases contain an equal number of molecules. The lab experiment aims to investigate the relationship between the volume and the number of moles of a gas, by Avogadro's Rule. This study was a laboratory experiment. By reacting sodium bicarbonate ($NaHCO_3$) with hydrochloric acid (HCl), the production of carbon dioxide gas (CO_2) was observed. The experiment involved varying amounts of reactants to observe corresponding changes in gas volume. The results demonstrated that as the number of reactants increased, the volume of gas produced also increased, validating Avogadro's Rule.

Establishing the importance of the topic by using simple present tense (S+V1)

Stating aim

Stating method (Simple past & passive voice)

Stating the overall results of the lab experiment (Simple past)

Establishing topic

3. Introduction:

Avogadro's Rule is important. It is stated that equal volumes of gases, under the same conditions of temperature and pressure, contain an equal number of molecules. This experiment aimed to examine this principle by examining the relationship between the volume and the number of moles of a gas. The purpose of this experiment was to develop an understanding of the reaction between sodium bicarbonate and hydrochloric acid was used to produce carbon dioxide gas, allowing for the observation of changes in gas volume.

Subject-verb agreement

Introducing experiment (Simple past)

Stating the experiment's objective

Subject-verb agreement

4. Methods:

4.1 Materials

Materials	Unit
Chemicals	
1. Sodium bicarbonate ($NaHCO_3$)	5 Grams
2. Hydrochloric acid solution (HCl)	150 mL
Equipment	
1. Balloons (10-inch size)	3 Flasks
2. Conical flasks (150 mL)	3 Flasks
3. Funnel	1 Piece
4. Scoopula	1 Piece
5. Beaker (50 mL)	3 Beakers
6. Marker pen	1 Piece

Listing materials

Describing experimental procedures (Simple past & Passive voice)

4.2 Experimental Procedure

Firstly, the experiment conductor poured 50 mL of 1 mol/L hydrochloric acid solution into each of the three balloon flasks labelled 1, 2, and 3 and weighed 1, 2, and 3 grams of sodium bicarbonate separately and transfer them into three balloons labelled 1, 2, and 3, respectively. Next, the experiment removed any air from the balloons securely, attached them to the mouth of each conical flask and added the sodium bicarbonate from each balloon into the corresponding conical flask containing hydrochloric acid solution. After that, the experiment conductor shook the conical flasks to ensure a complete reaction. Finally, the changes in the sizes of the balloons were observed and compared.

Linkages

Subject-verb agreement.

Restating the method (Simple past & Passive voice)

5. Results:

This laboratory experiment was conducted to explore the relationship between the volume and the number of moles of a gas, by Avogadro's Rule. The finding of the laboratory experiment revealed that by mixing sodium bicarbonate with hydrochloric acid, gas bubbles were observed and there was

Announcing results (Simple-past)

an increasing the volume of the balloons. As a result, the balloon labelled 3 exhibited the largest final volume, followed by balloons 2 and 1, respectively.

Linkages

Contextualize discussion. (Simple-present)

6. Discussion:

From the experiment studying the relationship between volume and the number of moles of gas in proving Avogadro's Law through the reaction between hydrochloric acid (HCl) and sodium bicarbonate ($NaHCO_3$), carbon dioxide gas (CO_2) is experimented according to the chemical equation:

$$NaHCO_3(s) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l) + CO_2(g)$$

Interpretating the results (Simple past)

As the mass of $NaHCO_3$, which is the limiting reactant of this reaction, varied, balloons numbered 3, using more mass than balloons 2 and 1 respectively. Therefore, the number of moles of CO_2 produced in balloon number 3 was greater than in balloon 2 and 1 respectively. This indicated that the volume of CO_2 gas produced in balloon number 3 was greater than in balloons 2 and 1 respectively. Hence, the gas volume increased according to the number of moles of the gas. This experiment can support the notion that the volume of a gas is directly proportional to the number of moles of the gas, as stated by Avogadro's Rule.

Making suggestion (simple present)

Linkages

Linkages

Interpretating (Simple present and Passive voice)

7. Conclusion:

In conclusion, this experiment successfully is demonstrated the relationship between the volume and the number of moles of a gas, consistent with Avogadro's Rule. The results obtained reaffirm the validity of this fundamental principle and its applicability in understanding gas behaviour. By verifying Avogadro's Rule, this experiment contributes to the foundational knowledge of chemistry.

Additional: Drawing claim, noting limitations and further suggestions should be stated.

Post-writing test: Chemistry Lab

Instruction: Write the scientific laboratory report in English based on the results of the laboratory experiment of the chemistry subject.

1. Title: Chemical Reaction Experiment

2. Abstract:

This experiment aims to investigate various chemical reactions and their observable changes, to establish general criteria for identifying chemical reactions. This laboratory experiment was achieved through a series of experiments involving different reactants and solutions, changes such as colour, formation of precipitates, gas evolution, and temperature alterations were observed. The results showed that as the following changes. In the test tube, the KMnO4 colour was diluted and disappeared. In the second test tube, there was a slight increase in temperature and the solution remained clear and the third test tube revealed a dark yellow precipitate formed. By analyzing these changes, the experiment seeks to provide insights into the characteristics of chemical reactions and their indicators.

3. Introduction:

Chemical reactions are fundamental processes in chemistry where substances transform to form new products. Recognizing the occurrence of a chemical reaction is essential in understanding chemical phenomena and their applications. This laboratory is conducted to investigate the different chemical reactions and their associated changes, aiming to establish criteria that indicate when a chemical reaction has taken place. By observing and analyzing the effects of various reactants and solutions, this experiment aims to deepen our understanding of chemical reactions and their observable characteristics.

Establishing the importance of the topic by using simple present tense (S+V1)

Stating aim

Stating method (Simple past & passive voice)

Providing discussion (Simple Present)

Establishing topic

Introducing experiment (Simple present)

Stating the experiment's objective (Simple present)

4. Methods

4.1 Materials

Materials	Unit
Chemicals	
1. Hydrochloric acid solution, 2.0 mol/dm³	5 cm^2
2. Potassium permanganate solution (KMnO4), diluted	5 cm^2 1 gram
3. Sodium hydroxide solution (NaOH), 2.0 mol/dm³	5 cm^2
4. Lead(II) nitrate solution (Pb(NO3)2), 0.1 mol/dm³	15 cm^2
5. Potassium iodide solution (KI), 0.1 mol/dm³	
Equipment	
1. Test tubes (medium size)	3 tubes
2. Graduated pipette, 10 cm³	6 units

Listing materials

4.2 Experiment Procedure

Test Tube Experiment 1

Linkages

Firstly, the experiment conductor dropped the potassium permanganate solution (KMnO4) in the amount of 5 cm in the test tube followed by a 5 cm Hydrochloric acid solution. Finally, the experiment conductor shook the test tube gently and observed the changes such as colour, formation of precipitates, gas evolution, and temperature alterations.

Linkages

Test Tube Experiment 2

Linkages

Describing experimental procedures (Simple past & Passive voice)

Firstly, the experiment conductor dropped the Sodium hydroxide solution (NaOH) in the amount of 5 cm in the test tube followed by a 5 cm Hydrochloric acid solution. Lastly, the experiment conductor shook the test tube gently and observed the changes such as colour, formation of precipitates, gas evolution, and temperature alterations.

Linkages

Test Tube Experiment 3

Linkages

Describing experimental procedures (Simple past & Passive voice)

Initially, the experiment conductor dropped the Lead(II) nitrate solution (Pb(NO3)2) in the amount of 5 cm in the test tube followed by a 5 cm of 5

Linkages

Potassium iodide solution (KI). Finally, the experiment conductor shook the test tube gently and observed the changes such as colour, formation of precipitates, gas evolution, and temperature alterations.

Describing experimental procedures (Simple past & Passive voice)

5. Results

This laboratory experiment was conducted to investigate various chemical reactions and their observable changes, to establish general criteria for identifying chemical reactions. The results of the chemical reaction experiment are shown in the table below.

Table attention (Simple present)

Restating the method (Simple past & Passive voice)

Test Tube	Chemicals Added	Changes Observed
1	HCl solution + Diluted KMnO4	Dilution or disappearance of KMnO4 color
2	HCl solution + NaOH solution	Clear solution, slight increase in temperature
3	Pb(NO3)2 solution + KI solution	Formation of dark yellow precipitate

Displaying the results

Based on the table above, the experiment results revealed as following changes: in test tube 1, the KMnO4 colour diluted and disappeared. In test tube 2, there was a slight increase in temperature and the solution remained clear Lastly test tube 3 revealed a dark yellow precipitate formed.

Announcing results (Simple-past)

Contextualize discussion. (Simple-present)

Discussion

The results of the experiments reveal distinct changes indicative of chemical reactions by drawing on established principles of chemical reactions. the observed changes, such as colour dilution, precipitate formation, gas evolution, and temperature variations, are interpreted as clear indications of chemical transformations. These included the dilution or disappearance of colour in certain solutions, the formation of precipitates, the evolution of gas bubbles, and temperature variations. These observable changes served as

Subject-verb agreement.

Interpretating (Simple present and Passive voice)

criteria for identifying chemical reactions, providing insights into the nature of chemical transformations.

Interpretating (Simple present and Passive voice)

Conclusion

Through this experiment, the experiment successfully identified observable changes that indicate the occurrence of chemical reactions. By studying various reactions and recording the resulting transformations, we established criteria for recognizing chemical reactions based on observable changes. This understanding enhances our ability to interpret chemical processes and contributes to our knowledge of chemical reactions and their characteristics.

Subject-verb agreement.

Additional: Drawing claim, noting limitations and further suggestions should be stated. (Simple present)

APPENDIX B

Scoring Rubric Guideline

Rubric for Assessing Scientific Laboratory Report Writing

Rubric for Assessing Scientific Laboratory Report Writing A “0” (zero) score will be earned for any section that is missing completely, unintelligible, or grossly incomplete. A score of zero will be given for the complete lab report assignment if condition 7 under “Incorporation of additional resources” is not met.

(45 POINTS TOTAL) A science lab report is a structured way of communicating the outcomes of your practical work. The structure of a typical lab report includes the following sections: the employment of a writing rubric assessment adapted and developed from Black et al. (2002)

- **Aim and Hypothesis** - Why you conducted the practical work.
- **Materials and Method** - How you conducted the practical work and how any data was processed.
- **Results** - What was the data, process or product obtained from the practical work
- **Discussion -** How your results address your aim and hypothesis.
- **Conclusion** - What was the overall outcome of your practical work and how does your finding relate to the larger body of scientific knowledge

Contents	Criteria	Scores
Abstract	Clearly and concisely describes the experiment question and main findings.	5
	Specific, relevant keywords, avoids redundancy.	4
	Adequate clarity but may lack specificity or conciseness.	3
	Lacks clarity or misrepresents the research.	2
	Contained abstract but misinterpreted.	1
Introduction	Provides strong background, context, and research justification.	5
	Thorough literature review, clear hypothesis statement, specific research objectives.	4
	Adequate background and context, but may lack depth in literature review, clarity in hypothesis, or specificity in objectives.	3
	Weak or missing background/context, unclear hypothesis/objectives.	2
	Contained Introduction, but misinterpreted	1
Materials & Methods	Clear, complete, and replicable description of materials, procedures, controls, and statistical methods.	5
	Precise details, appropriate references, justifications for chosen methods.	4
	Adequate details but may lack some clarity or justification.	3
	Incomplete or unclear descriptions, potential ethical concerns.	2
	Contained materials & methods, but misinterpreted	1
Results	Accurate, objective, and organized presentation of results using appropriate visuals and statistics.	5
	Clear error bars, units, unbiased data presentation.	4
	Adequate presentation but may lack clarity or data variability explanation.	3
	Unclear, inaccurate, or incomplete presentation, potential data manipulation.	2
	Contained result, but misinterpreted	1
Discussion	Clear and logical interpretation of results, connection to hypothesis and literature, identification of limitations and future directions.	5
	Avoids overgeneralization or unwarranted conclusions.	4
	Adequate interpretation, but may lack depth or clarity, or may not fully address limitations or future directions.	3
	Unclear, illogical, or unsupported interpretations.	2
	Contained discussion, but misinterpreted	1
Conclusion	Briefly and effectively summarizes the main findings, limitations, and future implications of the research	5
	Summary is adequate but may lack conciseness or clarity.	4
	Summary is unclear, inaccurate.	3
	It does not address the key points of the experiment.	2
	Contained conclusion, but misinterpreted	1

Report Format	Consistent and professional format, clear headings, numbered sections, appropriate use of visuals.	5
	Follows the moves of scientific laboratory report	4
	Adequate format but may have minor inconsistencies or errors.	3
	Unclear, inconsistent, or unprofessional format.	2
	Contained report format, but all moves are inconsistent.	1
Vocabulary & Language style	Clear, concise, and grammatically correct writing, uses appropriate scientific terminology and avoids jargon.	5
	Objective and formal tone.	4
	Adequate writing but may contain some grammatical errors or lack clarity or conciseness.	3
	Unclear, grammatically incorrect, or excessive jargon.	2
	Difficult to understand or poorly constructed.	1
Grammatical Usage	No grammatical errors.	5
	Consistent spelling and punctuation.	4
	Minor grammatical errors but does not hinder comprehension.	3
	Distracting grammatical errors or typos.	2
	Frequent errors that significantly impact the clarity	1
Total scores		/45

APPENDIX C

Lesson Plans

Subject: English for scientific laboratory report writing 1 (E321032)
Grade 11: Science and Mathematics Program
Duration: 9 weeks (18 hours)
Academic Year: 2023

These lesson plans aim to provide a structured approach for the English 3 course with course code E32102 for high school students in the second semester of the academic year 2023. The lesson plans are designed to meet the course learning outcomes (CLOs) that focus on developing students' ability to communicate effectively in English and to enhance their scientific literacy. The CLOs for this course are as follows:

1. Develop students' language proficiency in composing a scientific laboratory report in English.
2. Enable students to understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.
4. Develop students' analytical and critical thinking skills in analyzing laboratory data and presenting findings.
5. Provide students with an opportunity to collaborate with their peers to achieve a common goal.

The English 3 lesson plans for Grade 10, with the course code E32102, consist of 20 points and a total of 18 class hours. These lesson plans are designed in accordance with the basic education core curriculum of the year 2008, incorporating standards from the science and mathematics program curriculum. They are organized into three learning phases: pre-stage, during, and post-stage, comprising a total of 8 learning units. The distribution of class hours for these lessons is as follows:

- Unit 1: Pre-test, class orientation, and introducing the course outline
  CLOs: 1, 2
- Unit 2: Language use and Genre of Scientific laboratory report writing

CLOs: 1, 2, 3

- Unit 3: Presenting an example of a scientific laboratory report in a Chemistry lab experiment.
  CLOs: 1, 2, 3
- Unit 4: Elements of the Scientific Laboratory Report
  Procedures
  Results
  Discussion
  CLOs: 1, 2, 3, 4, 5
- Unit 5: Discussing the common errors found in learning practice
  Focus on forms (Grammatical consciousness raising)
  Reflection on the student's performance
  CLOs: 1, 2, 3, 4, 5
- Unit 6: Providing feedback and revision.
  Common mistakes in composing lab reports
  CLOs: 1, 2, 3, 4, 5
- Unit 7: Showcasing lab report mastery
  Share the taught techniques for classmates
  Present the reports in the class
  CLOs: 1, 2, 3, 4, 5
- Unit 8: Post-test and Semi-structured Interview Administration
  CLOs: 1, 2, 3, 4, 5

These lesson plans enable students to meet the course learning outcomes and develop the necessary skills to communicate effectively in English and enhance their scientific literacy. By the end of the course, students should be able to demonstrate their ability to communicate scientific laboratory report writing in English, develop writing skills in composing scientific laboratory reports in English, and increase their science literacy through task-based language teaching methodology.

Teaching Outlines: English 3 (E32102) for Grade 11

Week	Learning phase	Task-based language teaching (TBLT) for scientific laboratory report writing structure
1 (2 hrs.)	1st (Pre-Stage)	Writing (PRETEST)
		Greeting and introducing learning objectives, introducing learning references, grading criteria and standards, and learning framework and teaching strategy
2 (2 hrs.)		Preparation and planning
		Genre and rhetorical moves in scientific reports writing
3 (2 hrs.)	2nd (During-Stage)	Presenting A style guide to scientific laboratory reports Examples of science reports Introducing the moves of a laboratory report
4 (2 hrs.)		The usages of grammars for each move Peer review
5 (2 hrs.)		Forms: Experiment introduction and abstract Peer review
6 (2 hrs.)		Forms: Experiment Method and materials Peer review
7 (2 hrs.)		Forms: Presenting conclusion Peer review
8 (2 hrs.)		Forms: Presenting discussion, abstract Peer review Presenting a laboratory report Peer review
9 (2 hrs.)	3rd (Post-stage)	Writing practice
		Feedback and Revision
		Posttest
		Semi-Structured Interview Administration

Lesson Plan No. 1

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 1: Pre-test, Class orientation and introducing the course outline. (Pre-stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: By the end of the lesson, students will be able to understand the course outlines and the grading system.

CLOs:

1. Understand the learning objectives of each learning period.
2. Understand the learning framework for the whole eight weeks.
3. Understand the grading system.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching

5. Learning Process:

5.1. Warm-up

1. The students and the teacher greet each other.
2. The teacher and the students introduce themselves, and all will have a short ice-breaking activity.

5.2 Presentation

3. The students are asked to sign the consent in participating in the whole research process. Importantly, they are informed that they can withdraw from the research at any time.
4. The teacher presents the course outlines and the grading system.
5. Later, the students are required to do a pre-test in which they have to write the scientific laboratory report in English. (Gained results from chemistry's previous lab experiment)
6. ---------- (Pretest 30 minutes) ----------
7. The students are informed of the learning objectives of each learning period.
8. The students are informed of the learning framework for the whole eight weeks.

5.3 Learning Activity: -

5.4 Conclusion

9. The teacher asks the students some questions about what they have been informed so far, and a teacher review again about the all five-week learning process and what they need to achieve within this course.

6. Teaching assessment and evaluation: (Rubric Question and answer during the class)

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment.

Comments

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Lesson Plan No. 2

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 2: The genre of scientific report writing and essential Vocabularies for scientific laboratory reports (Pre-Stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: By the end of the lesson, the students will be able to:

- Explain the genre of scientific report writing.
- Apply essential vocabularies for scientific laboratory reports

CLOs:

1. Develop students' language proficiency in composing a scientific laboratory report in English.
2. Understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching (TBLT)

5. Learning Process:

5.1. Warm-up:

1. The teacher and the students greet each other.
2. The teacher reviews what they had learned from the previous class.

5.2 Task Preparation & Activation of Prior Knowledge

3. The teacher prompts students with guiding questions:
   "Have you ever written a conclusion for a lab report in English?"
   "What kind of language do we normally use in a lab report?"
   (Students respond freely; all answers are accepted.)
4. The teacher introduces the concept of scientific lab report writing:
   Differentiating lab report writing from other disciplines (e.g., history, philosophy, literature).
   Discussing the importance of lab reports in scientific fields like biology, chemistry, and physics.
5. The teacher presents a model scientific lab report structure on the projector and explains it using both English and the students' native language (for clarity):
   Purpose of Lab Reports: Communicating and interpreting experimental results (Slade & Hess, 2020, p. 18).
   Common Sections: Abstract, Introduction, Materials & Methods, Results,

Discussion, and Conclusion.

Key Components: Hypothesis, procedures, findings, and their significance.

6. The students engage in a five-minute peer discussion on what they have learned

---------- Five minutes discussion on what have been learned so far----------

3. Task Performance & Analysis

7. The teacher introduces key vocabulary relevant to writing scientific lab reports in chemistry:

- Sections: Abstract, Introduction, Materials and Methods, Results, Discussion, Conclusion.
- Scientific Verbs: Indicate, determine, demonstrate, investigate, compare, illustrate.
- Reporting Phrases: Highlights that, proves, shows, findings suggest.

8. The teacher provides contextual examples and demonstrates the vocabulary in use.

9. Task 1 (Collaborative Activity): Students work in pairs to match given scientific terms with their definitions and provide verbal explanations.

10. Task 2 (Comprehension Check): Students complete a short multiple-choice test on vocabulary usage.

4. Learning Activities

11. Task 3 (Application Activity): Students write a mini lab report conclusion based on a sample experiment provided by the teacher.

12. Task 4 (Peer Review & Feedback): Students exchange their written work and provide constructive feedback using a peer assessment checklist.

13. The teacher facilitates a class discussion on common errors and improvements in writing lab report conclusions.

5. Closing (Reflection & Homework)

14. The teacher revisits key objectives and encourages students to reflect on what they learned.

15. Homework: Students draft a full lab report conclusion based on an experiment they recently conducted.

6. Teaching assessment and evaluation: Question and answer during the class

Objective 1: Rubrics Assessment

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment.

Objective 2: Multiple choice

- The assessment consists of 10 items and the pass criteria is to answer 7 or more questions correctly.
- The pass rate is determined by the performance of the students,
  with 70% of them required to achieve a score of 7 or higher.

Comments

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Lesson Plan No. 3

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 3: A style guide to scientific laboratory reports & Lab report's elements: Introduction and Objectives. (During-Stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: By the end of the lesson, the students will be able to:

- Compose the introduction and the objectives in scientific laboratory reports

CLOs:

1. Develop students' language proficiency in composing a scientific laboratory report in English.
2. Enable students to understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching (TBLT)

5. Learning Process:

5.1 Warm-up

1. The students and the teacher greet each other.
2. The teacher reviews what they had learned from the previous class.

5.2 Presentation

3. The teacher introduces the guidelines for writing a lab report, including the use of English tenses, pronouns ('I' and 'we'), and language use for each lab report element.
4. The teacher provides guidelines for composing an introduction for lab report writing.

Title

The title should be detailed and reflect the most significant result of the study.
It should include the lab title, student's name, date, period, lab partner's names, and course details.

5. The teacher explains how to write the objective or purpose of a lab report and provides examples.

Objective or Purpose

A brief statement (1-3 lines) outlining the purpose of the experiment.

6. The teacher explains how to write the introduction of a lab report and provides examples.

Introduction

The present simple tense is used to state the aim and describe permanent facts.

The past simple tense is used to describe previous experiments.

5.3 Tasks completion: Topic: *Investigating the Effect of Light Intensity on Plant Growth*

7. The students are given a sample lab report in their mother tongue and asked to create a proper English title. (Writing task)

----------Five minutes for writing practice----------

8. The students write the objective and introduction of the given lab report in English. (Writing task)

----------Twenty minutes for writing practice----------

9. The teacher facilitates a discussion on students' responses for the title, objective, and introduction in English.

--------A question-and-answer session to reinforce learning and clarify doubts-------

5.4 Conclusion

10. The teacher engages students by posing questions about the lesson content. The objectives and goals are revisited to prepare students for the next class.

6. Teaching assessment and evaluation: Writing practice

Objective 1: Rubrics Assessment

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment.

Comments

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Lesson Plan No. 4

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 4: Presenting procedures, results, and discussions of a lab report (During-Stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: At the end of the lesson, the students will be able to:

- Write the procedure, results, discussion, and abstract in scientific laboratory reports

CLOs:

1. Develop students' language proficiency in composing a scientific laboratory report in English.
2. Understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.
4. Develop students' analytical and critical thinking skills in analyzing laboratory data and presenting findings.
5. Provide students with an opportunity to collaborate with their peers to achieve a common goal.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching (TBLT)

5. Learning Process:

5.1 Warm-up

1. The teacher and students greet each other.
2. The teacher engages students in a brief recap discussion of the previous lesson by asking:

"What did we learn in our last session about lab reports?"

"What are the key elements of a lab report?"

"Can you recall any important vocabulary related to lab report writing?"

3. The teacher provides a short model lab report and asks students to identify key elements (e.g., Procedures, Results, Discussion).
4. The teacher sets the context for today's lesson:

"Today, we will focus on writing the Procedures, Results, and Discussion sections using appropriate scientific language."

5.2 Presentation and Tasks completion

Topic: *Investigating the Effect of Light Intensity on Plant Growth*

5. The teacher introduces key writing guidelines for a lab report, focusing on the use of tense and language conventions for each section.

Procedures

Use past simple because the experiment was completed.

Present simple may be used to describe figures or models.

Example: "The solution was heated to 100°C."

Results

Use present simple to explain a table, but past simple to describe findings.

Example: "Table 1 shows the reaction rate at different temperatures."

Example: "The results indicated a significant increase in pH levels."

Discussion

Explain whether the hypothesis was supported.

Interpret results for the reader.

Discuss unexpected findings and suggest improvements.

Example: "The data suggests that temperature plays a crucial role in enzyme activity."

6. The teacher provides authentic examples and uses a sample lab report to demonstrate these principles.

7. The teacher asks students to match sample sentences to the correct sections (Procedures, Results, Discussion).

Task 1: Writing the Procedures

8. Students receive a sample experiment summary and must write the Procedures section using appropriate tense and language.

----------Time: 15 minutes----------

Task 2: Writing the Results & Discussion

9. Students analyze a set of experiment data (e.g., a table, graph, or numerical results).

10. They must write the Results and Discussion sections based on the data.

----------Time: 15 minutes----------

Task 3: Peer Review & Feedback

11. Students exchange their work with a partner.

12. They use a checklist to evaluate whether their partner's writing follows the correct tense, structure, and clarity.

13. They provide peer feedback and discuss possible improvements.

----------Class Discussion & Teacher Feedback----------

14. The teacher selects a few student responses and provides constructive feedback.

15. The teacher clarifies common mistakes and answers student questions.

16. The teacher given the sample of abstract writing, and the students are encouraged to analyzed.

Abstract

This study **investigates** the effect of temperature on the reaction rate of an enzyme-catalyzed reaction. Table 1 shows the reaction rate at different temperatures, illustrating the trend of increasing activity with higher temperatures up to an optimal point. The experiment **was conducted** using a spectrophotometer to measure absorbance changes over time. The results **indicated** that reaction rates increased with temperature until reaching 37°C, beyond which enzyme denaturation led to a decline in activity. The findings **suggest** that maintaining an optimal temperature is crucial for enzyme efficiency in biological systems.

17. Students receive a sample experiment summary and must write the Abstract section using appropriate tense and language.

Task 4: Writing the Abstract

----------Time: 15 minutes----------

18. The teacher selects a few student responses and provides constructive feedback.
19. The teacher clarifies common mistakes and answers student questions.

6.5 Conclusion

16. The teacher engages students in a reflective discussion:

"What was the most challenging part of writing the Procedures/Results/Discussion?"

"How does scientific writing differ from general writing?"

"What strategies can help improve lab report writing?"

17. The teacher reviews the learning objectives and previews the next session.

7. Teaching assessment and evaluation: Writing practice

Objective 1: Rubrics Assessment

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment

Comments

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Lesson Plan No. 5

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 5: Discussing the common errors found in learning practice (Post-Stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: At the end of the lesson, the students will be able to:

- Compose the procedure, results, and discussion in scientific laboratory reports

CLOs:

1. Develop students' language proficiency in composing a scientific laboratory report in English.
2. Understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.
4. Develop students' analytical and critical thinking skills in analyzing laboratory data and presenting findings.
5. Provide students with an opportunity to collaborate with their peers to achieve a common goal.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching

5. Learning Process:

5.1 Opening (Warm-up)

1. The teacher and students greet each other.
2. The teacher reviews key points from the previous lesson.

2. Task Preparation

3. The teacher introduces the guidelines for writing a lab report, focusing on:
The appropriate use of English tense. The use of "I" and "we" in scientific writing.
Language conventions for different sections of the lab report.
4. The teacher provides specific guidance on writing the conclusion section of a lab report.
Conclusion Writing Guidelines: the present perfect may be used to state general findings (e.g., This report has shown...).
The past simple is used to describe what was done or found.
Modal verbs (e.g., might, could, should) are used to suggest further research or add caution.

3. Confronting and Discussing the Task

5. The teacher provides sample lab results and asks students to write a conclusion based on the given data. (Writing task: Individual or group work)

Writing practice: Students have 15 minutes to draft their conclusion.

6. Students submit their work for feedback.

4. Task Rehearsal, Reflection, and Consciousness-Raising

7. Peer and teacher feedback: Students discuss challenges they faced in writing the conclusion.

8. The teacher highlights common errors in students' work.

9. The teacher reinforces key forms and structures to ensure understanding.

Rewriting task: Students revise their conclusions based on feedback.

5. Closing (Reflection and Homework Assignment)

10. The teacher engages students in a reflective discussion on what they have learned.

11. The teacher revisits the lesson objectives and previews the next topic.

6. Teaching assessment and evaluation: Writing practice

Objective 1: Rubrics Assessment

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment.

Comments

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Lesson Plan No. 6

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 1: Providing feedback and revision (Post-Stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: At the end of the lesson, the students will be able to:

- Discuss the common grammatical errors or forms in composing a scientific laboratory report

CLOs:

1. Develop students' language proficiency in composing a scientific laboratory report in English.
2. Understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.
4. Develop students' analytical and critical thinking skills in analyzing laboratory data and presenting findings.
5. Provide students with an opportunity to collaborate with their peers to achieve a common goal.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching

5. Learning Process:

5.1 Warm-up

1. The teacher and students greet each other.
2. The teacher reviews key points from the previous lesson to activate prior knowledge.

5.2 Presentation (Task Preparation)

3. The teacher introduces key concepts related to writing lab report conclusions.

Essential scientific writing elements are explained, such as proper verb tense, pronoun use, and formal language.

Examples of well-structured and poorly structured conclusions are provided for comparison.

5.3 Analyzing and Discussing the Tasks

Group Discussion:

4. Students form small groups and brainstorm common mistakes they encountered while writing lab report conclusions.
5. They discuss specific examples and reasons behind these errors.

Error Analysis:

The teacher provides a handout listing common grammatical and structural mistakes in scientific writing.

Example mistakes include:

Incorrect verb tense (e.g., "has been" instead of "was")

Misuse of pronouns (e.g., switching between "we" and "I")

Informal language (e.g., slang or conversational tone)

Misunderstanding lab report structure

5.4 Reflecting and Refining the Task Performance

Peer Review & Revision:

6. Students pair up to exchange and review their lab report conclusions.
7. They use a checklist (provided by the teacher) to identify and correct errors.

Self-Reflection:

8. Each student writes a short reflection on their learning experience, highlighting:

Common mistakes they made

What they learned from peer feedback

How they can improve their scientific writing

5.5 Closing

9. The teacher facilitates a class discussion on key takeaways.
10. Students summarize what they learned and ask any final questions.
11. The teacher assigns a follow-up task or homework for further practice.

6. Teaching assessment and evaluation: (Question and Answering)

Objective 1: Rubrics Assessment

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment.

Comments

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Lesson Plan No. 7

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 7: Showcasing Your Lab Report Mastery (Post-Stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: At the end of the lesson, the students will be able to:

- Present the finished laboratory reports verbally

CLOs:

1. Develop students' language proficiency in composing a scientific laboratory report in English.
2. Understand and use scientific language and terminology related to laboratory experiments.
3. Enhance students' understanding of the scientific laboratory report writing process.
4. Develop students' analytical and critical thinking skills in analyzing laboratory data and presenting findings.
5. Provide students with an opportunity to collaborate with their peers to achieve a common goal.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching

5. Learning Process:

5.1. Warm-up

1. The students and the teacher greet each other.
2. The teacher reviews what they had learned from the previous class.

5.2 Presentation

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5.4 Learning Activity (Class Presentations)

1. **Group Practice:** Divide students into small groups and have them each choose a specific aspect of lab report writing they excelled in (e.g., organizing the results section, writing accurate conclusions). Within their groups, students can share the techniques and strategies they found most effective for mastering this aspect.
2. **Gallery Walk:** After group practice, set up a "Gallery Walk" where each group creates a poster or presentation highlighting their chosen technique. Encourage students to visit each station, learn from their peers, and ask questions.
3. **Preparation:** Give students ample time to rehearse their presentations, emphasizing clear and concise delivery, effective use of visuals (e.g., graphs, charts), and appropriate

scientific language. Encourage them to focus on the key findings and conclusions of their lab reports.

4. **Peer Feedback:** Implement a peer review process where students provide constructive feedback on each other's presentations. This can involve using a rubric focusing on delivery, content clarity, and visual aids.
5. **Formal Presentations:** Dedicate class time for students to present their lab reports to the entire class. Encourage active listening and respectful questioning to foster a collaborative learning environment.

5.5 Conclusion (Presentation Reflection)

1. **Individual Reflection:** Ask students to write a short reflection on their presentation experience. They can consider their strengths and weaknesses in delivering their reports, the effectiveness of the peer feedback, and areas for improvement in future presentations.
2. **Class Discussion**: Facilitate a class discussion where students share their reflection insights and collectively identify valuable lessons learned from the presentation process. Encourage them to connect their presentation skills to effective scientific communication in real-world contexts.

6. Teaching assessment and evaluation: (Question and Answering)

Objective 1: Rubrics Assessment

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment.

Comments

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Lesson Plan No. 8

English: 3 **Code:** E32101 **Level: Grade** 11 **Program:** Science and Mathematics
Foreign Language Department **Semester:** 2nd **Academic year:** 2023 **Duration:** 2 hours
Unit 7: Post-test and Semi-structured Interview Administration (Post-Stage)

1. Standards: Use foreign language to link knowledge with other learning areas as a foundation for further development, seeking knowledge, and widening one's worldview.

2. Learning objective: At the end of the lesson, the students will be able to:

- Post-test and Semi-structured Interview Administration

CLOs:

6. Develop students' language proficiency in composing a scientific laboratory report in English.
7. Understand and use scientific language and terminology related to laboratory experiments.
8. Enhance students' understanding of the scientific laboratory report writing process.
9. Develop students' analytical and critical thinking skills in analyzing laboratory data and presenting findings.
10. Provide students with an opportunity to collaborate with their peers to achieve a common goal.

3. Learning Materials: PowerPoint, Projector, Outline sheet, Speaker

4. Learning Methodology: Task-Based Language Teaching

5. Learning Process:

5.1. Warm-up

1. The students and the teacher greet each other.
2. The teacher reviews what they had learned from the previous class.

5.2 Presentation

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5.4 Learning Activity

(Post-Test)

1. The students are required to do sit separately and individually.
2. The students are given the posttest: writing the scientific laboratory report.

---------- Fifty minutes for posttest----------

(Semi-Structured Interview)

1. **Guiding the Exploration:** Develop an interview guide with interviews questions like "How did TBLT impact your lab report writing?" or "Which tasks helped you most?" Encourage honest feedback and explore both successes and challenges.

2. **Creating a Safe Space:** Conduct interviews in a comfortable, familiar setting. Foster open dialogue and active listening through a non-judgmental approach. Utilize audio recordings or detailed notes for thorough data capture.

5.5 Conclusion (Reflection and Reporting: Sharing the Story)

1. Student Voices Amplified: Encourage students to reflect on their learning journey, highlighting personal growth in writing skills, newfound confidence in scientific communication, and impactful tasks or activities.

2. Compiling the Narrative: Synthesize data from the post-test, interviews, and student reflections into a comprehensive report. Paint a nuanced picture of the TBLT intervention's effectiveness, discussing strengths, limitations, and implications for future research and educational practice.

3. Knowledge Dissemination: Share your findings through conferences, publications, or even presentations within your school community. This knowledge sharing can inspire further refinement of TBLT strategies and empower other educators to unlock the scientific writing potential in their students.

6. Teaching assessment and evaluation: (Question and Answering)

Objective 1: Rubrics Assessment

Excellent 5 points	Good 4 points	Fair 3 points	Poor 2 points
Advanced attempt to provide clear and accurate meaning and explanation	Proficient attempt to provide accurate meaning and explanation with the capacity to advance.	Adequate attempt to provide some relevant information	Minimal attempt to accurately explain the information

*Note: three points or higher are the passing criteria for rubric assessment.

Comments

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APPENDIX D

Semi-structured Interview protocol and interview guideline

Interview Protocols on Task-Based Language Teaching (TBLT) on The Scientific Laboratory Report Writing

The researcher conducts individual interviews lasting approximately five minutes with each student. These interviews aim to gather the students' opinions regarding the utilization of Task-Based Language Teaching (TBLT) in high school students. The interview protocol utilized in this study is adopted from Acar and Tarhan (2007) and is presented in the Table below:

Semi-structured interview questions
1. What are your perceptions of the course which is taught by the application of TBLT? (นักเรียนมีมุมมองอย่างไรต่อการกระบวนสอนแบบเน้นภาระงานในเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์)
2. How do you feel about how the lesson played out? (นักเรียนมีความรู้สึกอย่างไรเกี่ยวกับการกระบวนสอนแบบเน้นภาระงานต่อบทเรียนเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์)
3. How do you find TBLT help you to improve the laboratory report writing ability? (นักเรียนคิดว่ากระบวนการสอนแบบเน้นภาระงานส่งผลต่อความสามารถการเขียนสรุปรายงานเชิงวิทยาศาสตร์หรือไม่ อย่างไร)
4. What happens within the course that assists you increase your understanding inwriting a scientific laboratory report? (นักเรียนคิดว่าส่วนไหนหรือองค์ประกอบใดของการเรียนการสอนแบบเน้นภาระงานส่งผลดีต่อความเข้าใจเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์)
5. Would you like to study English subject regarding the TBLT for a scientific laboratory report writing again? (นักเรียนมีความประสงค์อยากเรียนเรื่องเขียนสรุปรายงานเชิงวิทยาศาสตร์โดยการสอนแบบเน้นภาระงานอีกหรือไม่ เพราะอะไร)
6. What suggestion do you have about the TBLT in laboratory report writing? (นักเรียนมีข้อเสนอแนะหรือคำแนะนำต่อกระบวนสอนแบบเน้นภาระงานต่อบทเรียนเรื่องเขียนสรุปรายงานgเชิงวิทยาศาสตร์หรือไม่ อย่างไร)

Interview guideline

1. Welcoming and greeting the students.

- How are you?
- How’s your study so far?

2. Clarifying the reasons and the objectives of the semi-structured interview. Informing the confidentiality of the interview data.

3. Interview session

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4. The students are invited to give additional suggestions and comments.

5. Expressing gratefulness the students.

APPENDIX E

The results of the back-translation method following a semi-structured interview.

Back translation in semi-structured interview data ensures the accuracy, reliability, and validity of translations by preserving the original meaning of questions and responses across languages. It identifies discrepancies, ensures cultural appropriateness, and validates content for multilingual research, maintaining data integrity. Serving as a quality control measure, back translation enhances the credibility and consistency of data for rigorous analysis. The ways of back-translation were adopted from Chen and Boore (2007; 2008), and the results were shown as follows:

Student	Original	Initial translation	Back-translation 1	Back-translation 2	Justification
opinions					
Low No. 1	"...เมื่อฉันได้มีโอกาสลองทำจริง ๆ ฉันพบว่ามันค่อนข้างท้าทาย.....แต่สิ่งนี้ต้องอาศัยการฝึกฝนและความพยายาม...."	"When I had chance to try for real, I found it so challenge, but it need practice and try hard."	"Once I had the chance to try it for real, I encountered it was challenging, but it required practice and perseverance."	"....Once I had the chance to try it for real, I **found** it was **quite** challenging,....but it required practice and perseverance....."	√
Low No. 2	"....ฉันคิดว่างานที่ได้รับมานั้นสามารถจัดการได้.....แต่มีบางบทเรียนที่ฉันพบว่ายากที่จะเข้าใจ"	"I think the work I got is okay to handle, but some lessons I feel hard to understand."	"I think that the workload I have gotten is manageable, but there are certain lesson that I find challenging to comprehend."	"....I think that the workload I have **received** is manageable, but there are certain **lessons** that....I find challenging to comprehend."	√
Moderate No. 1	".....ในความคิดของฉัน ฉันได้เรียนรู้คำศัพท์ใหม่จำนวนมาก.....และความซับซ้อนของเนื้อหาที่ฉันได้เรียนรู้ช่วยพัฒนาความสามารถทั้งในการเขียนและการอ่านคำศัพท์ใหม่ในรายงานห้องปฏิบัติการเ".....	"In my opinion, I learn a lot of new words, and the hard content I learn made me better at writing and reading lab report vocab."	"In my perspectives, I have learned a significant number of new vocabulary words, and the complexity of the content I have learned it improved my capacity to both write and read new vocabulary words in writing a lab report."	"In my **opinion**, ...I have learned a significant number of new vocabulary,....and the complexity of the content I have learned it improved my **ability** to both write and read new vocabulary words in writing a lab report...."	√

Moderate No. 2	"....นี่เป็นประสบการณ์การเรียนรู้และการสอนที่ลงมือทำจริง...ซึ่งช่วยเสริมทักษะเชิงปฏิบัติ ต้องการความเข้าใจที่ลึกซึ้งในเทคนิคและคำศัพท์....ซึ่งสามารถนำไปใช้ได้อย่างมีประสิทธิภาพในอนาคต"	"It's more about real learning, it improve skills for practice. You need know more deeply techniques and new vocab to use in the future good."	"It's a hands-on learning and teaching experience that enhances practical skills. It require a deeper understanding of techniques and vocabulary, which can be applied effectively in the future."	"....It's a hands-on learning and teaching experience that enhances practical skills.....It **requires** a deeper understanding of techniques and vocabulary, which can be applied effectively in the future....."	√
High No. 1	**".....**ฉันคิดว่านี่เป็นวิธีการเรียนรู้และการสอนที่มีประสิทธิภาพ.....เพราะไม่เน้นการประเมินผลด้วยการสอบแบบดั้งเดิม....แต่เน้นที่การเขียนรายงานและการฝึกอบรมเชิงปฏิบัติ...."	"I think this way of learning and teaching work well because no need for traditional test much. It's focus on writing report and training practical."	"I think that It is an effective learning and teaching approach because there is minimal reliance on traditional exams for assessment. Instead, the focus is on report writing and practice training."	".....I think that It is an effective learning and teaching approach .....because there is minimal reliance on traditional exams for assessment..... Instead, the focus is on report writing and **practical** training....."	√
High No. 2	".....ฉันคิดว่า TBLT มีประสิทธิภาพมาก เพราะช่วยให้ฉันมีความรู้มากขึ้นเกี่ยวกับ....วิธีเขียนรายงานในรูปแบบที่ถูกต้อง....และฉันได้เรียนรู้มากเกี่ยวกับคำศัพท์ทางเทคนิคและโครงสร้างของรายงาน...."	"I think TBLT is very good way because I get more how to write lab report correct and learn many technical word and report structure too."	"I think the TBLT is quite effective because of it helps me gain more knoledge of how to write lab report in a proper way and I learnt much about technical words and structure of the reports."	"....I think the TBLT is quite effective **.....because** it helps me gain more knoledge of how to write lab report in a proper way and I **have** learned much about technical words and **the** structure of the reports....."	√
Feelings					
Low No. 1	"...มันท้าทายมาก.....และฉันได้รับงานที่หนักที่ต้องทำ....แต่สิ่งนี้เปิดโอกาสให้ฉันพัฒนาและเพิ่มพูนทักษะของตัวเอง..."	It is very challenging, and I have a heavy workload. However, it provides an opportunity to develop and enhance my skills.	It is very challenging, and I have a hard workload. However, it provides an opportunity to develop and enhance my performance."	".....It is very challenging, and..... I have a **heavy** workload. However, it provides an opportunity to develop and enhance my **skills**....."	√
Low No. 2	"....มันยากมากที่จะเขียนรายงานตามรูปแบบ แต่การฝึกฝนผ่านงานเขียนที่ได้รับมอบหมายช่วยฉันได้มาก...."	"It is very hard to write the reports following the patterns but practicing through the assigned	"It is very stuggling to write the reports following the patterns but practicing through the assigned writing works helps me a lot."	".....It is very **hard** to write the reports following the patterns but practicing through the assigned writing **task** helps me a lot...."	√

		writing task helps me a lot.”			
Moderate No. 1	"....ฉันรู้สึกลังเลเล็กน้อย เพราะมันยาก....บางครั้งฉันไม่ค่อยเข้าใจและรู้สึกไม่มั่นใจว่าจะทำงานต่อไปอย่างไร...แต่ฉันมีมุมมองเชิงบวก.....เพราะมองว่านี่เป็นโอกาสในการฝึกฝนตัวเองและพัฒนาทักษะ.....”	"I hesitate a bit because it is difficult. Sometimes, I do not quite understand and feel unsure about how to proceed with the task. However, I have a positive outlook, as I see it as an opportunity to self-train and improve."	"I hesitate a bit because it is hard. I do not quite understand and feel unsure about how to proceed with the task. However, I have a positive outlook, as I see it as an opportunity to self-train and improve.	"....I hesitate a bit because it is **difficult**. ....**Sometimes,** I do not quite understand and feel unsure about how to proceed with the task. .....However, I have a positive outlook, as I see it as an opportunity to self-train and improve....."	√
Moderate No. 2	"....ฉันรู้สึกว่าวิธีการสอนนี้.....ดีแต่เนื้อหาของงานค่อนข้างท้าทาย โดยเฉพาะเรื่องภาษาและรูปแบบการเขียน....ถ้าไม่มีความช่วยเหลือจากครู มันจะยากมาก....."	“I feel that this teaching method is good but the task is quite challenging in terms of the language and the pattern in writing, without help from teacher it will be very difficult.”	“I think that this teaching method is good but the task is quite challenging in terms of the language and the pattern in writing, without help from teacher it will be very difficult.”	“....I **feel** that this teaching method is good but.....the task is quite challenging in terms of the language and the pattern in writing,.....without help from teacher it will be very difficult.....”	√
High No. 1	"......มันค่อนข้างท้าทาย ..... แต่ก็เป็นประสบการณ์ที่ดีที่ช่วยกระตุ้นให้เราได้สำรวจและพัฒนาทักษะใหม่ ๆ ด้วยตัวเอง และมันท้าทายมากจริง ๆ ถ้าไม่มีความช่วยเหลือ มันจะยากมากที่จะทำสำเร็จ...."	"It can be quite challenging, but it is a positive experience that encourages us to explore on our own and acquire new skills, and it's incredibly challenging. Without assistance, it would be extremely difficult to accomplish."	"It could be quite challenging, but it is a positive experience that encourages us to explore on our own and acquire new skills, and it's challenging. Without assistance, it would be extremely difficult to accomplish."	".....It **can** be quite challenging,.....but it is a positive experience that encourages us to explore on our own and acquire new skills, and it's **incredibly** challenging. Without assistance, it would be extremely difficult to accomplish....."	√

High No. 2	".....ฉันรู้สึกว่างานเขียนนี้สามารถจัดการได้ เพราะต้องค้นคว้าข้อมูลอย่างกว้างขวาง.....แต่จะยิ่งท้าทายมากขึ้นหากไม่มีคำแนะนำเพื่อความถูกต้อง...."	"I feel that the writing task is a manageable and workable due to the need for extensive research, and it becomes particularly challenging without guidance to ensure accuracy."	"I feel that the writing task is a manageable and workable due to the need for much research, and it becomes particularly challenging without guidance to ensure accuracy."	".....I feel that the writing task is manageable and workable due to the need for **extensive** research, ...and it becomes particularly challenging without guidance to ensure accuracy....."	√
Influence of The Treatment					
Low No. 1	".....มันมีผลกระทบ..... เพราะช่วยให้ฉันเข้าใจและปฏิบัติตามหลักการเขียนที่ถูกต้องได้ดีขึ้น..."	"It make impact because it help me understand and follow correct writing rules better."	"It has had an impact because it has improved my comprehensing of and adherence to correct writing theories."	".....It has had an impact..... because it has improved my **understanding** of and adherence to correct writing **principles.....**"	√
Low No. 2	".....มันมีผลกระทบเพราะวิธีการสอนนี้เน้นการฝึกฝนบ่อยๆ.....เมื่อเราลองทำงานด้วยตัวเอง.....เราก็มีความชำนาญมากขึ้นและสามารถจดจำคำศัพท์ได้เร็วขึ้น...."	"It have impact because this way focus on practice a lot. When we try task by ourselves, we get better skills and faster to remember vocabulary."	"It has had an impact because this teaching method emphasizes frequent practice. When we attempts tasks ourselves, we gain expertise and improve our ability to memorize vocabulary."	".....It has had an impact because this teaching method emphasizes frequent practice..... When we **attempt** tasks ourselves, we gain expertise and improve our ability to memorize vocabulary more **rapidly....."**	√
Moderate No. 1	".....มันมีผลกระทบเพราะเน้นที่งานปฏิบัติจริง.....ฉันได้โอกาสในการเขียนรายงาน.....ซึ่งช่วยให้ฉันเข้าใจการสรุปผลการทดลองทางวิทยาศาสตร์ได้ดีขึ้นมาก....."	"It make impact because it focus on real practice. I got chance to write reports, and it make me understand scientific experiment reports much better."	"It has had an impact due to it focuses on practical work. It has provided opportunities to write reports, which improved my understanding of scientific experiment summary reports significantly."	".....It has had an impact **because** it focuses on practical work..... It has provided opportunities to write reports, which improved my understanding of scientific experiment summary reports significantly....."	√
Moderate No. 2	".....มันมีอิทธิพลต่อความสามารถในการเขียนของฉันอย่างมาก....เพราะฉันได้ฝึกเขียนบ่อย ๆ....."	"It influence my writing skill a lot because I practice writing many time."	"It affacts a lot on my writing ability because I get to practice frequently."	".....It **influences** a lot on my writing ability .....because I get to practice frequently....."	√
High No. 1	".....มันมีผลกระทบอย่างมาก งานที่ได้รับนี้เปิดโอกาสให้เราเข้าใจเนื้อหา	"It make big impact. This work give us chance to	"It has had a significant impact. Having this workload has provided	".....It has had a significant impact. Having this workload	√

	ได้ลึกซึ้งขึ้น เรียนรู้วิธีค้นหาคำตอบด้วยตัวเอง ค้นพบสิ่งใหม่ ๆ ที่อยู่นอกเหนือจากห้องเรียน และพัฒนาทักษะที่ทำให้การเรียนในอนาคตง่ายขึ้น .....ความรู้และงานวิจัยจากงานที่ทำก่อนหน้านี้ช่วยให้เราทำงานได้มีประสิทธิภาพมากขึ้น....."	understand subject more deep, find answers by self, learn new things not in class, and build skills for easy learning in future. Research and knowledge from tasks before help us work better now."	us with opportunities to gain a deeper understanding of the subject matter, learn to find answers independently, discover new insights beyond the classroom, and acquire skills that make future learning easier. The research and knowledge gained from previous tasks have made us more efficient at our work."	has provided us with opportunities to gain a deeper understanding of the subject matter, learn to find answers independently, discover new insights beyond the classroom, and acquire skills that make future learning easier. .....The research and knowledge gained from previous tasks have made us more efficient at our work....."	
High No. 2	"....ฉันคิดว่า TBLT มีผลดีต่อความสามารถในการเขียนของฉัน เพราะมันทำให้ฉันต้องฝึกเขียน และได้เรียนรู้หลายอย่าง.....เช่น รูปแบบการเขียน ไวยากรณ์สำหรับรายงานในห้องปฏิบัติการ และคำศัพท์....."	"I think TBLT give good impact on my writing skill because it make me practice writing and learn many things like writing style, grammar tense for lab report, and words."	“I must say that TBLT has a positive impact on my writing perfromace due to it requires me to practice writing and I have many things such as writing patterns, tenses for lab reports and vocabulary.”	“.....I **would** say that TBLT has a positive impact on my writing perfromace due to it requires me to practice writing and I have many things .....such as writing patterns, tenses for lab reports and vocabulary.....”	√
Aspects of the Treament					
Low No. 1	".....มันเป็นงานกลุ่มที่เราทำการค้นคว้าและนำเสนอเป็นภาษาอังกฤษ เราเจาะลึกในแต่ละส่วนของรายงานทางวิทยาศาสตร์ของกลุ่มเรา และเรารวบรวมข้อมูลผ่านการพูดคุยและการนำเสนอร่วมกับเพื่อนในห้องเรียน....."	"It’s group work where we research and present by English. We go deep into part of group scientific report and collect information by talk and present with friends in class."	“It's a group project where we research and present using English. We delve deep into each section of our group's scientific report, and we gather information from discussions and presentations with our peers in the room."	“.....It's a group project where we research and present using English. We delve deep into each section of our group's scientific report, and we gather information **through** discussions and presentations with our peers in the room....."	√
Low No. 2	".....มันเป็นช่วงที่เราลองทำก่อนในระหว่างงาน จากนั้น.....ครูจะตรวจสอบและช่วยให้เราเข้าใจมันได้ดีขึ้น....."	"It in during-task step, we try do it first, then teacher check and help us to understand more."	"It is during-task phase that we get to try doing it first, and then the teacher informs it, helping us understand it better."	".....It is during-task phase that we get to try doing it first, and then..... the teacher **reviews** it, helping us understand it better....."	√
Moderate No. 1	".....ฉันคิดว่าเมื่อครูและพวกเราได้ลองทำก่อน	"I think when teacher and us try	"I think when the teacher and we get to	".....I think when the teacher and we get to	√

	และจากนั้นครูก็ตรวจงาน มันช่วยให้เราเข้าใจได้ดีขึ้น...."	do it first, then teacher check it, it help us understand better."	try doing it first, and then the teacher reviews it, helping us understand it better."	try doing it first,.....and then the teacher reviews it, helping us understand it better....."	
Moderate No. 2	".....ฉันคิดว่าเมื่อครูตรวจสอบบทเรียน.....มันช่วยพัฒนาการเขียนของฉันได้มาก....."	"I think when teacher check lesson, it improve my writing much."	"I think when the teacher reviwes the lesson and it proves my writing a lot.	".....I think when the teacher reviwes the lesson.....and it proves my writing a lot.....	√
High No. 1	".....ฉันคิดว่ามันเป็นช่วงก่อนเริ่มงานที่ครูแนะนำคำศัพท์ใหม่ ๆ.....ซึ่งช่วยเสริมความเข้าใจในการเขียนและความสามารถในการนำไปใช้.....ครูยังสนับสนุนให้เราตั้งคำถามและมีส่วนร่วมในกระบวนการเรียนรู้ด้วยกัน....."	"I think it in pre-task step when teacher show new words, it make me know writing better and use it. Teacher also let us ask questions, make us join more in learn."	"I think it is the pre-task phase when the teacher introduces new vocabulary, it enhances our understanding of writing and our ability to apply it. Teacher also encourages us to ask questions, actively engaging with us in the learning process."	".....I think it is the pre-task phase when the teacher introduces new vocabulary....., it enhances our understanding of writing and our ability to apply it.....**The** teacher also encourages us to ask questions, actively engaging with us in the learning process....."	√
High No. 2	".....มันเป็นช่วงระหว่างงานที่สนับสนุนกระบวนการเขียนรายงานการทดลองด้วยตัวเอง.....จากนั้นส่งให้ครูตรวจสอบและได้รับคำแนะนำเกี่ยวกับข้อผิดพลาด ซึ่งช่วยเสริมความเข้าใจของฉันได้มาก....."	"I think it in pre-task step when teacher show new words, it make me know writing better and use it. Teacher also let us ask questions, make us join more in learn."	"It is the during-task phase that foster the process of writing experiment reports on my own, submitting them for evaluation by the teacher, and subsequently receiving feedback on my mistakes has been instrumental in enhancing my understanding	".....It is the during-task phase that **encourages** the process of writing experiment reports on my own....., submitting them for evaluation by the teacher, and subsequently receiving feedback on my mistakes has been instrumental in enhancing my understanding....."	√
Willingness To Experience The Treatment Again					
Low No. 1	".....มันดีมาก...ที่จะเรียนรู้และเตรียมตัวสำหรับการเรียนในมหาวิทยาลัยในอนาคต....."	"It good to learn and get ready for study in university in future."	"It's effective to learn and prepare for future studies at the university."	".....It's **good** to learn... and prepare for future studies at the university....."	√
Low No. 2	".....มันดี...ที่จะเรียนรู้วิธีเขียนรายงานห้องปฏิบัติการอีกครั้ง .....เพราะจะช่วยเตรียมตัวสำหรับการเรียนในมหาวิทยาลัยในอนาคต....."	"It good to study how write lab report again, it will help prepare for study in university later."	"It's good to study how to write lab report again it will prepare for future studies at the university."	".....It's good to study how to write lab report again .....it will prepare for future studies at the university....."	√
Moderate No. 1	".....ฉันอยากเรียน..... เพราะมันจะช่วยให้ฉันพัฒนาตัวเองในหลายด้าน	"I want to learn because it help me improve myself in	"I want to learn because it will allow me to develop ourself	".....I want to learn .....because it will allow me to develop	√

	เช่น การพัฒนาทักษะการพูดและการสื่อสารได้อย่างมาก....."	many ways, like make my speaking and communication skill better a lot."	in various aspects, such as improving my speaking and communication skill significantly."	**myself** in various aspects, such as improving my speaking and communication **skills** significantly....."	
Moderate No. 2	".....ฉันอยากลองเรียนอีกครั้งเพราะฉันอยากพัฒนาทักษะการเขียนรายงานห้องปฏิบัติการของตัวเอง ฉันคิดว่ามันสำคัญมากสำหรับอนาคตของฉัน....."	"I want to try again because I want to make my lab report writing skill better. I think it very important for my future."	"I want try again because I want to improve my lab report writing skill. I think it is very important for my future"	".....I want try again because I want to improve my lab report writing skill. I think it is very important for my future....."	√
High No. 1	".....ฉันอยากเรียนรู้เพิ่มเติม.....เพราะมันเป็นวิธีการสอนที่มีประสิทธิภาพที่ทำให้เนื้อหาดูง่ายขึ้น โดยแบ่งออกเป็นขั้นตอนที่จัดการได้ และช่วยให้เราได้ฝึกเขียนรายงานจริง อย่างไรก็ตาม.....ฉันต้องให้ความสำคัญกับบทเรียนการเขียนมากขึ้น โดยเฉพาะคุณลักษณะทางภาษาสำหรับรายงานห้องปฏิบัติการ รวมถึงการฝึกฝนเพิ่มเติม....."	"I want learn more because this teaching way good, it make subject easy, break to small steps, let us practice real report writing. But I need focus more on writing lesson, like language part for lab report and do more practice."	"I want to learn more because it's an effective teaching method that simplifies the subject matter, breaking it down into manageable steps, allowing us to practice real report writing. however, I need to pay attention to the writing lesson especially linguistic features for lab report including extra practices "	".....I want to learn more.....because it's an effective teaching method that simplifies the subject matter, breaking it down into manageable steps, allowing us to practice real report writing. however,..... I need to pay **more** attention to the writing lesson especially linguistic features for lab report including extra practices...."	√
High No. 2	".....ฉันอยากเรียนเพราะมันจะช่วยให้ฉันได้รับความรู้.....เพิ่มความเข้าใจและเรียนรู้คำศัพท์ใหม่ ๆ รวมถึงการเคลื่อนไหวเชิงวาทศิลป์ของการเขียนในบริบททางวิทยาศาสตร์..... "	"I want learn because it help me know more, understand better, and learn new words and how to write in science way."	"I want to learn because it will help me gain knowledge, improve my understanding, and learn new vocabulary and the rhetorical moves of writing in a science context."	".....I want to learn because it will help me gain knowledge,..... improve my understanding, and learn new vocabulary and the rhetorical moves of writing in a science context....."	√
Suggestions					
Low No. 1	".....ฉันอยากได้คำแนะนำที่ละเอียดมากขึ้นและเรียนซ้ำบทเรียนมากขึ้นเพื่อช่วยให้ฉันเข้าใจงานได้ดีขึ้น....."	"I want more detailed guidance and repeat lessons more to help me understand task better."	"I would like more detailed guidance and repeat the lesson more that helps me understand the task better."	".....I would like more detailed guidance and repeat the **lessons** more that helps me understand the task better....."	√
Low No. 2	".....ครูควรอธิบายมากขึ้นเป็นภาษาไทยเพราะบางคำศัพท์มันยากที่จะใช้ในการเขียน....."	"Teacher should explain more in Thai because some words difficult to use in writing."	“The teacher should explain more in Thai beause some words are difficult to use in writng.”	“.....The teacher should explain more in Thai beause some words are difficult to use in writng.....”	√

Moderate No. 1	".....ฉันคิดว่าครูควรมีตัวอย่างเพิ่มเติมในส่วนการเขียน.....และบางบทเรียนน่าจะมีคำอธิบายที่ง่ายขึ้น....."	"I think teacher should give more examples in writing part and some lesson should explain simpler."	"I think a teacher should provide more examples in writing parts and I think some lesson should have a simpler explanation."	".....I think a teacher should provide more examples in writing parts.....and I think some lesson should have a simpler explanation....."	√
Moderate No. 2	".....ฉันคิดว่าการมีตัวอย่างเพิ่มเติมในแต่ละบทเรียนนั้นเป็นประโยชน์....."	"I think more examples in each lesson is good."	"I think having more examples in each lesson is beneficial."	".....I think having more examples in each lesson is beneficial....."	√
High No. 1	".....ฉันคิดว่า.....บางครั้งงานเขียนที่ได้รับมอบหมายมีรายละเอียดเยอะเกินไป.....ทำให้รู้สึกหนักและยากที่จะจัดการ และฉันต้องใช้เวลามากขึ้นในการจำ....."	"I think sometimes writing task have too many details, it make too much and hard to manage, I need more time to remember."	"I think that sometimes the assigned writing task has too many details, making it overwhelming and challenging to handle and I need to take more time to remember."	".....I think that..... sometimes the assigned writing task has too many details, ...making it overwhelming and challenging to handle and I need to take more time to remember....."	√
High No. 2	".....ฉันชอบงานเดี่ยวมากกว่างานกลุ่มเพราะมันช่วยให้ฉันมีสมาธิมากกว่า....."	"I like individual task more than group work because it helps me focus better."	"I prefer individual tasks over group work because this helps me concentrate more."	".....I prefer individual tasks over group work because this helps me concentrate more....."	√

APPENDIX F

Letters of Invitation to Experts for Evaluating the Quality of Research Instruments

ที่ อว๗๐๒๙/e ๑๕๓

คณะศิลปศาสตร์
สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง
เลขที่ ๑ ซอยฉลองกรุง ๑
แขวงลาดกระบัง เขตลาดกระบัง กรุงเทพฯ ๑๐๕๒๐

๒๐ กุมภาพันธ์ ๒๕๖๗

เรื่อง ขอเชิญเป็นผู้ทรงคุณวุฒิตรวจสอบคุณภาพเครื่องมือเพื่อการวิจัย (วิทยานิพนธ์)

เรียน ดร. ศักดิ์ชัย ราชนิยม
ครูประจำวิชาฟิสิกส์ กลุ่มสาระการเรียนรู้วิทยาศาสตร์และเทคโนโลยี
โรงเรียนเฉลิมพระเกียรติสมเด็จพระศรีนครินทร์ จังหวัดภูเก็ต

อ้างถึง ประกาศ ผลสอบหัวข้อและเค้าโครงวิทยานิพนธ์ สุนัย สิงห์ทอง

สิ่งที่ส่งมาด้วย ๑. Index of Item Objective Congruence of Rubric.pdf
๒. Index of Item Objective Congruence Lesson plans.pdf
๓. Index of Item Objective Congruence (IOC) of Interview Protocol .pdf

ด้วยนายสุนัย สิงห์ทอง รหัสประจำตัว ๖๔๖๑๔๐๐๖ นักศึกษาระดับบัณฑิตศึกษา หลักสูตรศิลปศาสตรมหาบัณฑิต สาขาวิชาภาษาศาสตร์ประยุกต์-ภาษาอังกฤษเพื่อวัตถุประสงค์ทางวิชาชีพ คณะศิลปศาสตร์ สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง ได้รับอนุมัติให้ทำวิทยานิพนธ์เรื่อง "การสอนภาษาแบบเน้นภาระงานเพื่อการเขียนรายงานเชิงปฏิบัติการทางวิทยาศาสตร์สำหรับนักเรียนไทยระดับมัธยมศึกษาตอนปลาย (IMPLEMENTING TASK-BASED LANGUAGE TEACHING OF SCIENTIFIC LABORATORY REPORT WRITING IN HIGH SCHOOL STUDENTS)" โดยมีผู้ช่วยศาสตราจารย์ ดร.ฐปนีย์ เขมานุวงศ์ เป็นอาจารย์ที่ปรึกษาวิทยานิพนธ์

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จึงเรียนมาเพื่อโปรดพิจารณาอนุเคราะห์ และขอขอบพระคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

(ดร.เอกรัตน์ สุวรรณกูล)
คณบดีคณะศิลปศาสตร์
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Signature Code : NAAyA-EQANA-AwAEY-ARgA5

งานบริหารวิชาการและบัณฑิตศึกษา
เจ้าหน้าที่ประสานงาน : น.ส. ศุทธภา จันทร์ปลั่ง
โทร. ๐๘๗-๖๘๐๔๔๖๘

ที่ อว๗๐๒๙/e ๑๕๐

คณะศิลปศาสตร์
สถาบันเทคโนโลยีพระจอมเกล้าเจ้าคุณทหารลาดกระบัง
เลขที่ ๑ ซอยฉลองกรุง ๑
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๒๐ กุมภาพันธ์ ๒๕๖๗

เรื่อง ขอเชิญเป็นผู้ทรงคุณวุฒิตรวจสอบคุณภาพเครื่องมือเพื่อการวิจัย (วิทยานิพนธ์)

เรียน Miss Zin Mar Soe
ครูประจำวิชาวิทยาศาสตร์ (English Program) กลุ่มสาระการเรียนรู้ภาษาต่างประเทศ โรงเรียนนวมินทราชินูทิศสวนกุหลาบวิทยาลัยปทุมธานี จังหวัดปทุมธานี

อ้างถึง ประกาศ ผลสอบหัวข้อและเค้าโครงวิทยานิพนธ์ สุนัย สิงห์ทอง

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เจ้าหน้าที่ประสานงาน: น.ส.ศุทธภา จันทร์ปลั่ง
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APPENDIX G

Samples of Science Writing Tasks/Learning contents/Assignments

Here is a set of writing tasks focusing on forms, language use, and specific terminologies of scientific writing patterns for Thai high school students in the science and mathematics program, aligned with the areas of assessment in your study:

1. Samples of learning activities and learning contents

Task 1: Abstract Writing

Objective: Summarize the key points of a study in a concise manner.
Instructions:

1. Provide students with a short research paper or article.
2. Ask them to identify the key components (objective, methodology, findings, and conclusion).
3. Guide them to write a 150-word abstract using specific sentence structures, such as:
   - *The study aims to...*
   - *This research employed...*
   - *The results indicate that...*

Task 2: Writing an Introduction

Objective: Develop an introduction that captures the background, research gap, and objectives.
Instructions:

1. Provide a prompt (e.g., "Write an introduction for a study about the effects of social media on education").
2. Teach them how to use appropriate forms:
   - *Recently, there has been growing interest in...*
   - *However, limited research has explored...*
   - *Thus, this study aims to...*
3. Ask them to practice identifying and writing a hook, background information, and thesis statement.

Task 3: Describing the Methodology

Objective: Use precise and objective language to describe procedures.
Instructions:

1. Assign students a simple research scenario (e.g., "Study the effects of caffeine on alertness in students").
2. Provide a template with phrases like:
   - *This study adopted a... approach.*
   - *The participants were selected based on...*
   - *Data were collected using...*
3. Encourage them to focus on past tense and passive voice (e.g., *The data were analyzed using statistical methods*).

Task 4: Reporting Results

Objective: Use clear and concise language to present findings.
Instructions:

1. Provide a table or chart summarizing hypothetical research findings.
2. Teach them phrases for describing data:
   - *The results show that...*
   - *An increase of 15% was observed in...*
   - *There was no significant difference between...*
3. Ask them to write a short results section based on the provided data.

Task 5: Writing a Discussion

Objective: Analyze results and connect them to the study's objectives.
Instructions:

1. Provide a set of hypothetical findings.
2. Teach them to use transition words (e.g., *However, In contrast, Additionally*).
3. Encourage them to answer these questions in their discussion:
   - What do the results mean?
   - How do they compare with previous studies?
   - What are the implications?

Task 6: Conclusion Writing

Objective: Summarize findings and suggest future research directions.
Instructions:

1. Provide a short research scenario.
2. Ask students to write a conclusion with sentences like:
   - *In conclusion, this study has demonstrated...*
   - *These findings suggest that...*
   - *Future research should focus on...*

Task 7: Format and Organization Practice

Objective: Apply proper formatting and logical organization.

Instructions:

1. Share an example of a poorly formatted research paper.
2. Have students identify and correct issues related to organization (e.g., headings, paragraph structure, citation style).

Task 8: Linguistic Features and Vocabulary Building

Objective: Enhance academic language style and vocabulary.

Instructions:

1. Provide a list of academic phrases and vocabulary (e.g., *significant, illustrates, demonstrates*).
2. Ask students to rewrite informal sentences into formal academic language.
   - Example: *The experiment was cool → The experiment provided valuable insights.*

2. Samples of a fill-in-the-blank exercise for high school students, focusing on forms, tenses, and vocabulary across the research sections:

Topic: Investigating the Effect of Light Intensity on Plant Growth

Introduction

1. The purpose of this experiment was to _____ (investigate/analyze) how different levels of light intensity affect plant _____ (growth/photosynthesis).
2. Previous studies have _____ (shown/showed) that light intensity plays a significant role in photosynthetic activity.

Method

3. **Materials Used**: Three potted plants, a light source, a _____ (ruler/scale), and a timer.
4. The plants were _____ (placed/placing) at different distances from the light source: 10 cm, 20 cm, and 30 cm.
5. Measurements were _____ (take/taken) every day for one week using a _____ (measuring device/ruler).

Results

6. The plant placed at 10 cm _____ (grew/grow) the most, showing an increase of 5 cm in height.
7. The plant at 30 cm _____ (exhibited/exhibit) the least growth, with only a 1 cm increase.
8. These results _____ (indicate/indicating) that closer proximity to the light source promotes greater growth.

Discussion

9. The findings _____ (suggest/suggested) that light intensity is directly proportional to plant growth within a certain range.
10. However, further studies could _____ (examine/examined) the effects of extreme light intensities to _____ (confirm/refute) the hypothesis.

Conclusion

11. In conclusion, the experiment _____ (demonstrates/demonstrate) that light intensity significantly affects plant growth.
12. Future research should _____ (focus/focused) on other factors such as water availability and soil nutrients.

Answers with Explanations

Introduction

1. **investigate** – Formal academic word suitable for stating the purpose. **growth** – Key term related to the experiment topic.
2. **shown** – Present perfect tense used to reference past research relevant to the present experiment.

Method

3. **ruler** – Appropriate tool for measuring height.
4. **placed** – Past tense passive form to describe actions performed.
5. **taken** – Correct past participle for passive voice; **ruler** – Specific measurement tool.

Results

6. **grew** – Simple past tense for reporting what happened.
7. **exhibited** – Academic term describing plant behavior.
8. **indicate** – Formal word used to state results objectively.

Discussion

9. **suggest** – Present tense to state general findings based on results.
10. **examine** and **confirm** – Future focus for further research, matching the tone of the section.

Conclusion

11. **demonstrates** – Present tense verb to summarize findings formally.
12. **focus** – Appropriate verb in the context of recommendations for future studies.

3. Cloze and Matching Test and Matching Exercise: Laboratory Report Writing Vocabulary

Cloze Test: Fostering Vocabulary

Fill in the blanks with the correct word from the box below. Each word can only be used **once**.

Word Bank: aim, results, equipment, experiment, procedure, observed, measured, analyzed, hypothesis, conclusion

1. The _____ of this study was to investigate the effect of water temperature on solubility.
2. The necessary _____ included a beaker, thermometer, and stirring rod.
3. The _____ involved heating water to different temperatures and recording solubility levels.
4. During the process, we _____ how solubility increased as the temperature rose.
5. Data were carefully _____ using a digital scale.
6. The _____ showed that substances dissolved faster in warmer water.
7. The data were _____ to identify patterns and trends.
8. Based on the _____, the initial hypothesis was confirmed.
9. The _____ proposed that higher temperatures lead to increased solubility.
10. In the _____, it was recommended to test other factors like stirring speed.

Matching Exercise: Laboratory Report Vocabulary and Definitions

Match the words in **Column A** with their definitions in **Column B**.

Column A	Column B
1. **Abstract**	A. Tools and materials required for an experiment.
2. **Methodology**	B. Section summarizing the purpose, method, and key findings of the study.
3. **Hypothesis**	C. A logical prediction about the outcome of the experiment.
4. **Results**	D. Detailed description of the experiment procedure.
5. **Conclusion**	E. Summary of findings and their implications.
6. **Equipment**	F. Recorded data and observations from the experiment.

Answer Key:

1. B
2. D
3. C
4. F
5. E
6. A

Complete the sentences by filling in the blanks with the correct form of the word in parentheses.

1. The _____ (analyze) of data showed a clear pattern in plant growth.
2. The experiment was _____ (design) to test the effect of light on photosynthesis.
3. The _____ (observe) indicated that the reaction was faster at higher temperatures.
4. All procedures were carefully _____ (document) in the lab manual.
5. The researcher emphasized the _____ (important) of using accurate measurements.

Reorder the words to form coherent sentences related to lab reports.

1. aim / The / was / the / to / determine / temperature / sugar / solubility / of / effect / the.
2. accurately / experiment / The / was / measured / during / data / the.
3. in / section / methods / describes / The / detail / the / procedures.
4. of / summarized / findings / The / in / the / were / conclusion / report / the.

Answer Key:

1. The aim was to determine the effect of temperature on sugar solubility.
2. The data was accurately measured during the experiment.
3. The methods section describes the procedures in detail.
4. The findings were summarized in the conclusion of the report.

4. Samples of Analysis Exercise: Understanding Lab Report Writing

Instructions: Read the excerpts below from a lab report on the effect of soil pH on plant growth. Analyze the text by answering the questions provided. Each question focuses on the structure, purpose, and linguistic features of the lab report sections.

Excerpt 1: Abstract

> "The aim of this experiment was to investigate how soil pH affects plant growth. Soil pH is essential in determining the availability of nutrients to plants. The results showed that plants grew best in slightly acidic soil with a pH of 6.5. These findings suggest that soil pH plays a significant role in plant health."

Questions:

1. What is the purpose of the **Abstract** in a lab report?
2. Identify the verbs used in the abstract. What tense are they in? Why?
3. Highlight any keywords that help convey the aim, results, and implications of the experiment.
4. Suggest one way the **Abstract** could be improved to include more details.

Excerpt 2: Introduction

> "Soil pH is a critical factor that influences plant nutrient uptake. The aim of this study was to examine plant growth in soils with different pH levels. Three types of soil were chosen to investigate this relationship: acidic (pH 4.5), neutral (pH 7.0), and alkaline (pH 8.5)."

Questions:

5. What key move is being made in the **Introduction**, and how is it achieved?
6. Identify the tense of the verbs used in this excerpt. Why is this tense appropriate?
7. How does the writer establish the importance of soil pH?
8. Suggest one way to expand this **Introduction** to include more background information.

Excerpt 3: Methods

> "First, seeds of the same species were placed in pots filled with different soil types. Each pot was watered with equal amounts of water daily. Plant height was measured every three days for four weeks."

Questions:

9. What is the purpose of the **Methods** section in a lab report?
10. Analyze the sentence structure. What is the predominant voice (active/passive), and why is it used?
11. Identify any linking words or phrases that guide the reader through the procedure.
12. How could the description of the methods be improved to make the process more reproducible?

Excerpt 4: Results

> "Plants in acidic soil (pH 4.5) performed poorly, with an average height of 5 cm. The maximum height was observed in plants grown in neutral soil (pH 6.5). These findings indicate that soil pH between 6.0 and 7.0 is optimal for plant growth."

Questions:

13. What is the primary purpose of the **Results** section in a lab report?
14. What tense is used to describe the findings, and why?
15. Identify any numerical data or comparisons made in the excerpt. How do these enhance the clarity of the results?
16. Suggest one way to visualize the results for better comprehension (e.g., graph, table).

Excerpt 5: Discussion

> **"The results are consistent with existing research, which shows that plants thrive in slightly acidic soil. The study highlights the importance of testing soil pH before planting crops. Future studies should examine the effects of soil pH on different plant species."**

Questions:

17. What key moves are present in the **Discussion** section?
18. Identify the verbs and their tenses. How do they differ from those in the **Results** section?
19. How does the writer link the findings to broader implications or future studies?
20. Suggest one additional point that could be included in the **Discussion** to strengthen the argument.

Answer Key (Guidance)

Abstract:

1. Summarizes the aim, key results, and implications.
2. Verbs: "was," "is," "showed," "suggest." Past tense for results, present tense for general statements.
3. Keywords: "aim," "results showed," "suggest."
4. Add specific numerical data or brief method details.

Introduction:

5. Establishing the topic's importance and stating the aim.
6. Present tense for background, past tense for specific study aim.
7. Uses "critical" to highlight importance and defines pH as a factor.
8. Add a definition of pH or previous research findings.

Methods:

9. To detail the procedure for reproducibility.
10. Passive voice ("were placed") for objectivity.
11. Linking words: "first," "each," "daily."
12. Include specific amounts, such as water volume or soil weight.

Results:

13. Presents and describes the findings.
14. Past tense for observed results.
15. Numerical data: "5 cm," "6.5." Comparisons clarify findings.
16. Suggest a bar graph comparing plant heights across soil types.

Discussion:

17. Links findings to theory, discusses implications, and suggests future research.
18. Verbs: "are," "shows" (present tense); "should examine" (future recommendation).
19. Links findings to research, broadens significance.

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