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Evaluating the effectiveness of reading comprehension-based instruction supported by flipped learning model in the 7th grade science course *

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Abstract

Reading comprehension is a crucial skill that underpins the understanding of scientific concepts and processes, facilitates the integration of conceptual knowledge with analytical thinking, and thereby enhances scientific literacy. In this context, the flipped learning model allows students to explore essential concepts at home through digital resources, thus freeing classroom time for targeted interventions. In this study, it was aimed to evaluate the effect of reading comprehension-based science instruction, supported by a flipped learning model, on the learning and reading comprehension skills of 7th-grade students during the 2022-2023 academic year in a boys-only public middle school in Istanbul. By employing an embedded mixed design, the effectiveness of reading comprehension-based instruction was evaluated during and after the implementation stage by conducting an experimental design and collecting both qualitative and quantitative data. In total, 67 students participated. In the experimental groups, students learned basic concepts at home through assignments from the Education Science Network before class, while in-class activities focused on applying reading comprehension skills to scientific content. Data were gathered through various measurement tools, including a reading comprehension skills scale, an achievement test, teacher reflection notes, and semi-structured interviews. The findings showed that students significantly showed improvement in their reading comprehension and science performance. Students stated that they achieved better understanding and learning through reading strategies that they could apply in other courses. In addition, the instruction contributed to their social-emotional development, including self-awareness, social skills and academic motivation.

Keywords

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Teaching science
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Introduction

In today's rapidly evolving world, the emphasis has shifted from merely acquiring knowledge to transforming that knowledge into practical skills. In essence, it's no longer sufficient to simply know facts or theories; individuals must be able to effectively apply their knowledge in various contexts. This entails the ability to navigate through diverse sources of information, evaluate their credibility, and adapt quickly to ongoing changes in society and technology. Therefore, it is crucial for students to master a diverse set of skills—abilities and competencies that empower them to effectively engage in cognitive, social, and physical processes in a coordinated manner (Bakırcıoğlu, 2016; Slavin, 2018). In this context, the Organization for Economic Cooperation and Development (OECD) introduced a learning framework highlighting the importance of skill acquisition within educational frameworks (OECD, 2018) and has been supporting countries in enhancing their education system to meet the demands of the 21st century through the 2030 Future of Education and Skills project (OECD, n.d.). This emphasis on skills has been further supported by the design of international and national assessments such as the Trends in International Mathematics and Science Study (TIMSS), the Programme for International Student Assessment (PISA), and national High School Entrance Exams (HSEE), all of which include questions that assess students' skills rather than just their factual knowledge.

It is well-established that official curricula play an active role in developing essential skills (Green, 2011). Science curriculum is one of the main factors that significantly influence students' performances in national and international assessments. An analysis of the science curricula from countries that performed well in the Trends in International Mathematics and Science Study (TIMSS) reveals an emphasis on skills such as interpretation, inference, experimental design, and classification (Derman, 2019). Given that 35% of the questions in the TIMSS exam relate to reasoning skills (Yıldırım et al., 2016) and that 50-70% of PISA science questions require the ability to design and interpret experiments (Ministry of National Education [MoNE], 2019), it is unsurprising that countries with a skill-based educational system tend to excel in these assessments. Despite the emphasis on skill development in Turkish national curricula since 2004, aimed at helping students acquire essential skills for application in daily life (MoNE, 2005), Turkey's performance in PISA assessments remains below the OECD average. The PISA 2022 results indicate that Turkish students scored an average of 456 in reading and 476 in science, which is lower than the OECD average (OECD, 2023). Even, there has been a decline of 10 points in the reading score compared to the 2018 PISA results (OECD, 2019; 2023). This points out the problems in operational curriculum, which is related to how teachers implement the curriculum and what they teach in classrooms within student and school contexts (Posner, 2004).

Various studies are unveiling the challenges teachers face regarding teaching skills, such as the intensity of content and objectives, ineffective guidance of curriculum or textbooks, insufficient materials and infrastructure, lack of time, and inadequacy of teacher education (e.g. Barası & Erdamar, 2021; Baysal et al., 2017; Erden, 2020). In 2024, Turkish national curricula were renewed based on the K12 skills framework developed with the support of OECD (MoNE, 2023) and learning outcomes, teaching-learning and assessment processes were structured as skill-oriented to achieve the aim of fully realizing skill-based teaching that will respond to the problems mentioned above (MoNE, 2024). The renewed curricula started to be implemented at 1st, 5th, and 9th grade in the 2024-2025 academic year, but the 2018 curricula continue to be practiced at other grade levels. In this regard, while the 2018 Science Curriculum includes life skills, innovative thinking and scientific process skills (MoNE, 2018), the 2024 Science Curriculum, which is much more comprehensive, contains discipline-specific skills, conceptual skills, social-emotional learning skills, literacy skills, dispositions and values (MoNE, 2024).

Teaching skills effectively that the renewed curricula emphasize requires a pedagogical approach that differs significantly from traditional, knowledge-based instruction. Instead of focusing solely on rote memorization and factual recall, educators must adopt strategies that promote critical thinking, problem-solving, collaboration, and hands-on experiences (Saavedra & Opfer, 2012; Snyder &

Snyder, 2008). This shift in teaching methodology is essential to prepare students for the complexities of the modern world, where skillful application of knowledge is key to success in both personal and professional realms. In skill-based instruction, it is important to explain the skills and techniques needed for skill development. However, rather than simply providing this information, it is essential to create opportunities for students to apply these techniques in various situations (Güneş, 2012). Additionally, when teaching skills, it is crucial to develop materials and a learning environment that enhances students' abilities and maximizes their potential, taking into account their differences (Tomlinson & Imbeau, 2010). Furthermore, the measurement and assessment processes should utilize appropriate tools that can serve as evidence of skill attainment. These tools should be designed to assess the transfer of skills to different contexts and real-life situations (Çelik, 2020; Ünlü & Yıldırım, 2017).

Reading comprehension encompasses the cognitive skills necessary to understand, analyze, and synthesize information (Demirel & Şahinel, 2019; Perfetti & Stafura, 2014). It involves making inferences about the text, analyzing relationships within it, and integrating new information with prior knowledge (Cain et al., 2001; Imam et al., 2014; Özbay & Özdemir, 2012; Roman et al., 2016). As a result, interpretation and inference skills are essential components of reading comprehension. These skills are also evident in the HSEE questions in Türkiye, where students are tasked with making comments or inferences based on texts related to real-life scenarios (Şan & İlhan, 2022). Moreover, visualization—the ability to mentally create graphics and diagrams from a reading text—is recommended as an effective reading strategy (Epçaçan & Erzen, 2010). Therefore, visuals, diagrams, tables are frequently included alongside texts to enhance comprehension. Understanding these visuals, graphics, and figures is also considered a sub-skill of reading comprehension and called as visual reading, table reading, graphic reading. The reading comprehension skills assessed in PISA exams reflect students' capabilities to interpret real-life situations derived from texts, graphics, tables, and visuals presented in the assessments (Yıldız et al., 2019). In summary, reading comprehension encompasses not only the ability to read a text but also the ability to interpret figures, graphs, tables, and visuals.

Reading comprehension is a crucial component of science education and has become an essential skill highlighted in both national and international exams. Scientific texts are often dense and filled with specialized terminology, making it challenging for many students to comprehend them. Moreover, factors such as unfamiliar vocabulary and the multimodal structure of scientific writing—which includes text, diagrams, charts, visuals, formulas, and mathematics—can hinder students' learning and retention of scientific knowledge; consequently, students need support from their science teachers to effectively engage with and understand these texts (National Research Council, 2014). Therefore, developing students' reading comprehension skills is essential for helping them grasp complex scientific concepts and texts (van den Broek, 2010).

Reading comprehension-based instruction, which is an approach focused on helping students actively construct meaning from texts by using reading comprehension strategies, rather than passively absorbing information, can address the abovementioned challenges and enable students to better navigate complex scientific texts (Dole et al., 1991; Pearson & Cervetti, 2017). To teach reading comprehension skills, various reading comprehension strategies have been developed. Some of the frequently used strategies are questioning the text, rephrasing content, utilizing graphic organizers, drawing mind mapping, posing questions, visualization of text, and summarizing the text (Herman et al., 2010; Roman et al., 2016; Spörer et al., 2009). Herman et al. (2010) also suggest text annotation or text marking, such as underlining or circling important information, unknown vocabulary, and main ideas.

There are two main approaches in reading comprehension-based instruction: *strategies* and *content* approaches (Liang & Dole, 2006; McKeown et al., 2009). The *strategies approach,* focusing on understanding strategic cognitive processes, entails explicit instruction in specific methods for engaging with a text—such as summarizing, making inferences, and posing questions—while prompting students to reflect on their own thinking processes. In contrast, the *content approach* directs students' attention primarily to the meaning of the text, encouraging them to build mental representations of

ideas through discussion without overt guidance on reading strategies. Research shows that discussions focused on content often lead to more text-based dialogue, encourage longer responses from students, and can match or even exceed the effectiveness of strategy-focused instruction in terms of memory recall (McKeown et al., 2009). In this context, Liang and Dole (2006) present the *combined approach* that combines these two methods by teaching comprehension strategies while learning about a specific topic. Similarly, Duke et al. (2021) highlight the effectiveness of embedding strategy approach when applied in a context that builds content knowledge. Whichever approach is implemented, Dewitz et al. (2009) and Ortlieb and Norris (2012) state that teachers should explain strategies explicitly, use scaffolding methods, be role models, and think aloud while practicing these strategies.

Research suggests that elementary school students frequently perceive reading as tedious or challenging due to the numerous new concepts they encounter (Johnson & Zabrucky, 2011; National Research Council, 2014). This observation underscores the necessity of developing instructional strategies that involve teachers actively guiding these students in the acquisition and application of reading comprehension strategies. Such an approach is essential for enhancing reading comprehension skills and fostering reading among young learners. Research on reading comprehension highlights its importance across all disciplines, even decades ago. In the 80s, Adams (1980) stressed that its deficiency causes low performance in any discipline, and Bloom (1976) introduced reading comprehension as a generalized cognitive entry measure of his mastery learning theory and revealed its significant correlation with literature, science and mathematics. Further studies indicated a notable relationship between reading comprehension and academic achievement in science (e.g. Bayat et al., 2014; Cano et al., 2014; Karasu & Haşıloğlu, 2020; Reed et al., 2017). However, there is evidence of insufficient reading comprehension skills at the secondary school level. For example, Handayani et al. (2018) found that students' science-related reading skills were alarmingly low due to inadequate reading practice in the curriculum, particularly in Physics. Similarly, a study by Ozuru et al. (2009) in a Biology course, along with another study by Imam et al. (2014) in high school science courses, revealed that students exhibited weak reading comprehension skills and these deficiencies had a negative impact on their academic performance. These results highlight the necessity of introducing reading comprehension skills at an early age, particularly in primary education (Käsper et al., 2020).

In examining studies conducted in Türkiye, it is evident that reading comprehension skills are primarily linked to the Turkish language course (e.g. Anılan, 2004; Belet & Yaşar, 2007; Yılmaz, 2008), students' attitudes toward reading (e.g. Sallabaş, 2008; Ürün Karahan & Taşdan, 2015), reading anxiety (e.g. Esen Aygün, 2021; Katrancı & Kuşdemir, 2016; Türkben, 2020; Yamaç & Sezgin, 2018) and reading comprehension strategies (e.g. Bayram & Kanmaz, 2022; Tok & Beyazıt, 2007). Within the realm of science education, most research tends to be correlational, focusing on its relationship with science and mathematics scores on national or international exams (e.g. Bayat et al., 2014; Günaydın & Başaran, 2022; Karacaoğlu & Kasap, 2023) or achievement tests and scales (e.g. Durgun & Önder, 2019; Karasu & Haşıloğlu, 2020), while there is a noticeable lack of experimental studies (e.g. Koray & Çetinkılıç, 2020). This situation highlights the need for experimental research in this area, especially considering that the new 2024 curricula are skill-based. It is anticipated that practical studies in this area will provide essential guidance for educators and contribute significantly to the existing literature on science education in Türkiye.

Although studies show the benefits of reading comprehension-based instruction, research indicates that teachers in Türkiye often express concerns about the time constraints imposed by the intensive Science Curriculum, which hinder the implementation of any innovations (Avci et al., 2014; Elmas et al., 2014; Semercioğlu, 2025). The flipped learning model serves as an effective solution in this context. This approach encourages students to explore essential concepts at home through digital resources, thereby allowing classroom time to be dedicated to active participation, collaboration, and activities that foster higher-order thinking (Delanoy et al., 2024; Erbil, 2020; Tucker, 2012; Zeybek, 2021). This student-centered method not only enhances engagement and personalizes the learning experience but is also recognized as an effective form of blended learning (Erbil, 2020; Lo & Hew, 2017). Moreover,

research has shown that applying the flipped learning model in science education positively influences both students' academic achievement and their motivation (Al-Momani, 2022; Anjass et al., 2025; Delanoy et al., 2024).

In light of this information, it was hypothesized that a reading comprehension-based instruction supported by flipped learning model significantly improves learning and reading comprehension skills. To this end, a reading comprehension-based instructional design supported by flipped learning model was developed and implemented for the "Reproduction, Growth, and Development in Living Things" unit of the 7th-grade Science course. The objective was to evaluate the effects of teaching science through reading comprehension skills on students' learning and their reading comprehension abilities. The following research questions guided this study:

1. What is the effect of reading comprehension-based instruction supported by flipped learning model on learning?
    a. Is there a significant difference between the experimental and control groups in terms of academic achievement?
    b. How is the development of students' learning during the instruction according to the teacher's reflections?
2. What is the effect of reading comprehension-based instruction supported by flipped learning model on students' reading comprehension skills?
    a. Is there a significant difference between the reading comprehension pre and post-test scores of students in the experimental group?
    b. How is the development of students' reading comprehension skills during the instruction according to the teacher's reflections?
3. What are the students' opinions about reading comprehension-based instruction supported by flipped learning model in the Science course?

Methods

Research Design

Mixed method research that aims to elaborate and deepen research through qualitative and quantitative research approaches was used in the study. The research design was an embedded mixed design in which both qualitative and quantitative research methods are used, and one method is embedded in another method (Creswell & Plano Clark, 2017). In this study, qualitative methods are used as a supplementary stand to the main quasi-experimental design. The research process presented in Figure 1 consisted of three main stages: planning, implementation, and evaluation. During the planning and implementation stage, a reading comprehension-based instructional design was developed and implemented for four weeks (15 hours). The effectiveness of reading comprehension-based instruction in science teaching was evaluated during and after the implementation stage by conducting a quasi-experimental design with a control group and collecting both qualitative and quantitative data.

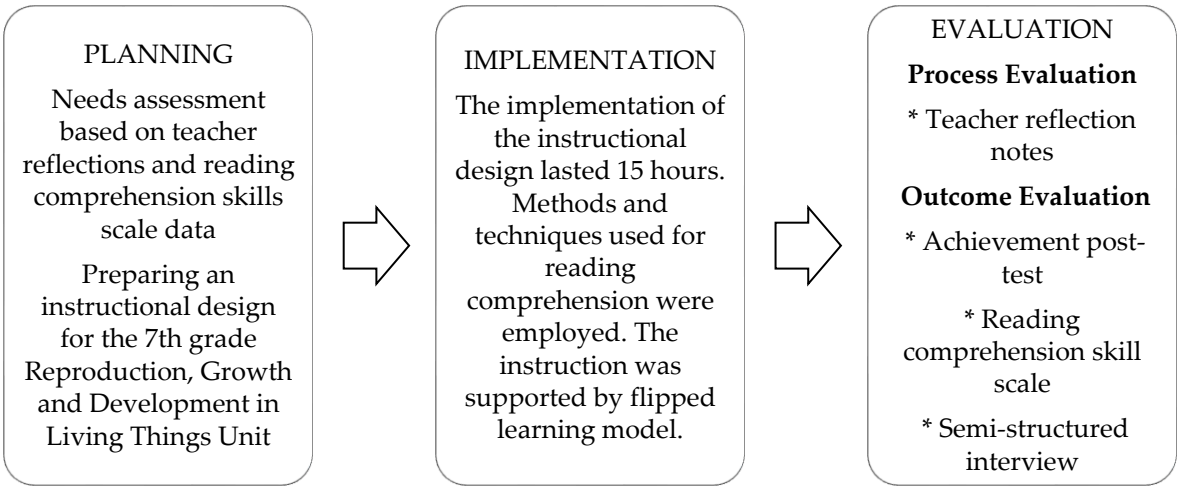

Figure 1. Research Process

Participants

The study utilized a convenient sampling method, which is an easy and quick way to reach participants (Patton, 2014). The study group comprised 67 7th-grade students from a boys-only public middle school in Istanbul and was conducted during the 2022-2023 academic year. There were two seventh-grade classes at the school. The names of the classes were written on pieces of paper, and one piece of paper was randomly selected to determine the experimental group. One class, designated as the control group, included 33 male students, while the other class, the experimental group, consisted of 34 male students. All students were aged 12 to 13 years. The students' academic achievement and socio-economic status were similar, and there were no students with special needs.

To evaluate the effectiveness of the teaching science based on reading comprehension skills, face-to-face interviews were also conducted with students selected through a criterion sampling method. The criteria for selection were being in the experimental group, actively participating in all lessons and class activities and being a volunteer. In this way, six students were selected for face-to-face interviews.

Procedure

The 2018 Science curriculum was in effect when this study was implemented. Initially, the 7th-grade Science Curriculum was examined to identify the topics and their durations. For the "Reproduction, Growth, and Development in Living Things" unit, a four-week (15 hours in total) reading comprehension-based instructional design was prepared based on a needs assessment, which was gathered through science teachers' reflections and the reading comprehension scale pre-test results. In designing instruction, the *combined* approach that integrates both strategy and content approaches was utilized. Two types of learning outcomes, one related to the Unit objectives in Science Curriculum and one related to reading comprehension skills were determined. Details regarding the four week-lesson flow are given in Table 1.

Table 1. Lesson Flow in the Experimental Group

Week	Hour	Learning Outcomes	Material	Teaching Methods/ Techniques and Reading Comprehension Strategies
1	1	Pretest and Introduction to Reading Comprehension Skills		
1	2	Reading comprehension skills: • Aware of the importance of reading comprehension skills • Text reading and comprehension • Inference making	In-class materials; • News on newspaper • Text about technological development in the TUBITAK Science and Child magazine • Text analysis worksheet	Teaching methods: • Discussion Reading comprehension strategies: • Text analysis • Underlining important parts and put asterisks etc. • Showing evidence based on scientific studies
2	2	• Explains the structures and organs that enable human reproduction by showing them on a diagram. • Explains the relationship between sperm, egg, zygote, embryo, fetus and baby. Reading comprehension skills: • Visual reading and comprehension • Text reading and comprehension • Inference making • Interpretation	Watching videos before class In-class materials; • Development Process worksheet • Reproductive System Diseases worksheet	Teaching methods: • Thinking aloud • Question and answer • Case study method Reading comprehension strategies: • Silent reading • Text analysis • Defining unknown words based on the text • Extracting information given in the text • Interpreting visuals • Making inferences from visuals
2	2	• Discusses the precautions that must be taken for the healthy development of the embryo, based on research data. Reading comprehension skills: • Table reading and comprehension • Graphics reading and comprehension • Interpretation	Watching videos before class In-class materials; • Birth statistics 2020 documents • Birth statistics worksheet	Teaching methods: • Thinking aloud • Question and answer • Discussion • Fishbone technique for problem solving Reading comprehension strategies: • Silent reading • Text analysis • Defining unknown words based on the text • Extracting information given in the text • Interpreting the table • Interpret data on the graphics • Relating verbal information with tabular and graphical data

Table 1. Continued

Week	Hour	Learning Outcomes	Material	Teaching Methods/ Techniques and Reading Comprehension Strategies
3	2	• Explain the process of sexual reproduction in plants. • Draws the growth cycle in plants. • Compares sexual reproduction in plants and animals. Reading comprehension skills: • Visual reading and comprehension • Text reading and comprehension • Classification • Inference making • Interpretation	Watching videos before class In-class materials; • Reproduction, Growth and Development in Flowering Plants worksheet • Reproduction, Growth and Development in Animals worksheet	Teaching methods: • Thinking aloud • Question and answer • Discussion Reading comprehension strategies: • Silent reading • Text analysis • Transform verbal expression into visual • Fill in the missing part logically • Interpreting the text • Creating a similar image by interpreting the given images • Classifying the given data
3	2	• Compares the types of reproduction in plants and animals. • Explains the growth and development processes in plants and animals by giving examples. • Explains the basic factors affecting growth and development in plants and animals. Reading comprehension skills: • Text reading and comprehension • Classification • Inference making • Interpretation	Watching videos before class In-class materials; • Asexual Reproduction Characteristics and Types worksheet • Genetic and Environmental Factors in the Growth of Living Things worksheet	Teaching methods: • Thinking aloud • Question and answer • Discussion • Brainstorming Reading comprehension strategies: • Silent reading • Text analysis • Filling in the missing part logically • Classifying the given data • Matching visual with verbal expression • Making inferences from the text
4	2	All objectives in the Unit Reading comprehension skills: • Text creation skills • Visual expression skill	•Group Work Performance Task Worksheet	Teaching methods: • Cooperative learning Reading comprehension strategies: • Collaborative reading • Text analysis • Creating a visual or text based on their readings
4	2	Presentation of performance tasks, general evaluation of course, and administration of post tests		

- ***The first week:*** As suggested by Ortlieb and Norris (2012), the lesson began by highlighting the importance and necessity of reading comprehension skills, along with explaining strategies that students could use to improve these skills. Following the guidance of Dewitz et al. (2009), the teacher served as a role model during this process.
- ***Second-to-fourth weeks:*** A flipped learning model was implemented, which shifts the traditional lecture format to at-home activities, allowing class time for hands-on activities (Talbert, 2017). This model ensured that students learned the basic concepts related to the subject before arriving in the classroom, providing ample time for studying science through reading comprehension skills in the class. All assignments were given to students for completion at home from the Education Science Network (EBA), an online learning platform for teachers and students in Türkiye. The teacher monitored students to ensure they watched videos or read presentations.

  In the classroom, teaching methods and reading comprehension strategies proposed by the National Research Council (2014) and Herman et al. (2010), such as text analysis, in-class discussions, think aloud, cooperative learning, brainstorming, question-answer sessions, think-pair-share activities, silent reading, and mind mapping were employed. Worksheets were prepared in alignment with the teaching methods and reading comprehension strategies outlined for each session, as detailed in Table 1. Initially, these worksheets were guided by the teacher but later transitioned to activities involving both individual and group work. The worksheets including reading materials (texts, visuals, graphs, tables) were used for applying specific reading comprehension strategies, answering related questions and discussing answers. Each reading materials was designed to correspond with the topics and objectives in the Science Curriculum. Additionally, open-ended questions stimulating reading comprehension strategies were formulated based on the reading materials. The reading materials were developed from scientific sources, tailored to the students' proficiency levels, and underwent an expert review process. The reading materials and questions were evaluated by two science teachers: one with 20 years of experience and another who holds a master's degree in Curriculum and Instruction in terms of congruence with the objectives of the unit and scientific accuracy. A Turkish teacher also evaluated these worksheets in terms of readability and understandability.

  In all lessons, students engaged in text analysis. During these analyses, they used various reading comprehension strategies, such as identifying the main idea, inferring cause-and-effect relationships, distinguishing between information that is included in the text and information that is not, and determining which statements are true or false based on the text. In some texts, students were also asked to classify, interpret, and infer the information presented, as suggested by Spörer et al. (2009). Additionally, they were encouraged to graph and visualize the information as recommended by Roman et al. (2016). Beyond written texts, tables, graphs, and visuals were utilized to enhance graphic and visual reading comprehension. After completing worksheets, students participated in discussions to share their responses. Through these class discussions, students were encouraged to express their thought processes and share the strategies they used to deepen their understanding.

  In the fourth week, students were assigned a performance task. They were divided into groups of four or five and given the opportunity to choose a task that aligned with their interests. Options included writing a news article, composing poetry or a story, creating a concept map, or designing a cartoon. Each group was responsible for selecting a specific learning outcome they would use to complete their task and had to finish it within the allotted time.
- ***The last week:*** Each group presented their products to their classmates. Lastly, the reading comprehension-based instruction was evaluated in class.

Data collection

Reading Comprehension Skill Scale

A scale was developed by the researchers to measure students' reading comprehension skills such as making inferences about the text, analyzing relationships within it, integrating new information with prior knowledge, interpretation, create graphics and diagrams from a reading text, and visual, graph, table reading. It was initially used before implementation to prepare instructional design, and then it was applied as a pretest and posttest comparison to obtain information about the progress of students' reading comprehension skills. It consisted of 20 items graded on a 5-point Likert scale (1: never, 2: rarely, 3: sometimes, 4: often, 5: always). The scale items were reviewed by two experts for content validity and were evaluated by two students for their intelligibility, and revisions were made in line with their comments. Some of the items included in the scale are as follows: "I am able to divide the text into sections that are appropriate to its meaning.", "I am able to establish a relationship between text and graphics.", "I am able to predict how the text will continue." etc.

For the construct validity of the scale, the scale was administered to two groups: 102 students in the first and 105 students in the second study group. Exploratory Factor Analysis (EFA) was done with data obtained from the first study group. As a result of EFA, the KMO value was found to be .920, and Barlett's test was significant (χ^2=1585.592 p<.001). This showed that the data set was suitable for factor analysis. As a result of the principal components analysis performed with Varimax rotation, it was seen that the one-factor structure was appropriate. The factor loadings ranged between .62 and .85, and the total variance explained was .58. The Cronbach-alpha value of this scale was .98. Afterwards, Confirmatory Factor Analysis (CFA) was conducted with the second study group data. The fit indices values obtained from CFA (χ^2/sd = 1.08 < 2; RMSEA = .028 < .05; SRMR = .050 < .05; GFI = .958 > .95; CFI = .992 > .95; IFI = .992 > .95; NNFI = .998 > .95) showed that the one-factor model showed excellent fit (Byrne, 1998; Hu & Bentler, 1999; Tabachnick & Fidell, 2001). Cronbach-alpha value was .94, and item-total correlation values ranged between .47 and .77. As a result, the 20-item, 5-point Likert scale with a single factor was found to be valid and reliable (Büyüköztürk, 2024; Field, 2018).

Achievement Test

In this study, a skill-based achievement test related to "Reproduction, Growth, and Development in Living Things" unit was developed by three science teachers. While writing items, reading comprehension skills such as table reading and comprehension, visual reading and comprehension, text reading and comprehension, classification, inference-making, and interpretation skills were also taken into account, as well as the Unit objectives given in the Science Curriculum. For content validity, two science teachers reviewed the item-objective consistency, two science teachers checked item-skill coherence, one measurement and evaluation expert evaluated their suitability for measurement, and finally, two students evaluated the intelligibility of the questions. After making revisions based on their comments, the test was administered to 320 students. According to item analysis results, the difficulties of the items ranged between 0.21 and 0.86, indicating heterogeneity of the items' difficulties. The discrimination indices were calculated between 0.20 and 0.70. As acceptable value is higher than 0.30, the items with a discrimination index value between 0.20 and 0.30 were edited (Finch & French, 2019). The reliability of the final achievement test, KR-20, was found to be .75, which is acceptable (Nunnally & Bernstein, 1994).

Teacher Reflection Notes

These reflection notes were recorded by the teacher after each session regarding the lesson and the students' participation, performance, and reactions. It also consisted of the teacher's notes about students' progress on the worksheets.

Semi-structured Interview Form

A nine-question interview form was prepared by the researchers. The questions were about how students evaluate the science instruction based on reading comprehension skills and whether they can transfer reading comprehension strategies gained in this course to other courses and their lives. Opinions of experts in curriculum and instruction and science teaching were obtained, and some

probing questions were added. A pilot study was conducted with one student to get an idea about the duration, the clarity of the questions and the determination of the probing questions. The final form was used in the semi-structured individual interviews with students.

Data analysis

Data analysis was conducted separately for quantitative and qualitative data. To evaluate whether significant differences existed between the control and experimental groups regarding achievement test scores, an independent samples t-test was employed. Additionally, a dependent samples t-test was used to assess the differences between reading comprehension pre-test and post-test scores within the experimental group. Before the analyses, the normality assumption was checked. For the reading comprehension scale, the results of skewness, kurtosis, and the Shapiro-Wilk test were .319, .010, and .984 ($p > .05$) for the pre-test, and .048, -.013, and .975 ($p > .05$) for the post-test. Concerning the achievement test, the values obtained were .518, -.123, and .957 ($p > .05$) for the control group and -1.917, .551, and .918 ($p < .05$) for the experimental group. It is notable that the Shapiro-Wilk test yielded significant results solely for the achievement test scores of the experimental group; however, all skewness and kurtosis values remained within the acceptable range of -1 to 1 (Büyüköztürk et al., 2014). Consequently, it was determined that the normality assumption was satisfied. Furthermore, the independent samples t-test met the assumption of equality of variances as indicated by Levene's test result ($F = .552$, $p > .05$).

The qualitative data obtained from semi-structured interviews were subjected to analysis using content analysis. This method allows for a comprehensive and deep examination of the data (Bryman, 2016). During this process, the interviews were transcribed and subsequently coded utilizing open coding. The interrelationships among these codes were then established through axial coding, leading to the formation of categories from which overarching themes were extracted. A sample of this analysis is presented in Table 2. Additionally, the teacher's reflective notes were examined through descriptive analysis.

Table 2. Sample table of content analysis

Data	Code	Category	Theme
S4: Previously, you were writing on the board and we were writing in the notebook, and there were many unknown words/terms. But when those terms were given in the text, it was better understood and become more permanent in my mind.	Better understanding Permanent learning	Effective learning	Contribution to cognitive development
S4: The preliminary work we did before coming to class was effective, and success increased when we came to class ready.	Coming to class prepared		
S1: Since reading books allows our brain to think more, our vocabulary improves and we can speak better. …. The best part was that our vocabulary improved first.	Vocabulary improvement Effective communication	Social skills	Contribution to social-emotion development
S2: Long-text skill-based questions were scary. Now I understand and I can do them. My fear passed and my interest increased.	Increased academic self-efficacy Reduced test anxiety Increased interest in solving questions	Increase in academic attitudes	

Table 2. Continued

Data	Code	Category	Theme
S3: Active brainstorming created a fun and curious environment.	Brainstorming Fun environment Curious environment	Active learning methods Positive learning environment	Teaching-learning process
S3: ...We learned a lot from the questions and answers in the discussion environment….	Question-answer Discussion	Active learning methods	
S4: I think the time was short. It was not enough to analyze and discuss the texts. It wasn't enough for you to talk longer either.	More time for activities	Duration	Recommendation

Internal and External Validity

Both qualitative and quantitative data were collected to ensure triangulation. Expert opinions were taken in all steps of the study. Content validity was ensured through a pilot study and expert opinions. One of the researchers entered both groups as a teacher to prevent the teacher effect. The transferability of the study was strengthened by presenting a thick description of the methodology.

Ethical Issues

Ethical considerations were taken into account during interviews. For the students to feel safe, interviews were held in a quiet environment. To eliminate the impact of possible grading anxiety among participants, interviews were conducted after the grading process. Students were allowed to express themselves impartially. In addition, information about the experimental process was given to the students and their parents in detail, and their informed consent was obtained. In the presentation of qualitative data, student names were kept confidential and coded as S1...S6. An approval from the Ethical Committee indicating that the research is following ethical rules was also obtained.

Results

Findings regarding The Effect of Reading Comprehension Skill-Based Instruction on Learning

At the end of the implementation, an achievement test for the "Reproduction, Growth, and Development in Living Organisms" unit, was administered to both the experimental and control groups. In order to answer research question related to the sub-objective of the effect of reading comprehension-based instruction on students' learning, the difference between groups was compared by independent samples t-test. The findings are presented in Table 3.

Table 3. Independent sample t-test results

Groups	n	$\bar{X}$	ss	t	df	p	$Cohen's\ d$
Experiment	34	14.794	3.023	4.314	65	<.001*	1.054
Control	33	11.879	2.472				

*p<.05

According to Table 3, the mean score of the experimental group on the achievement test ($\bar{X}$= 14.51) was higher than the mean score of the control group ($\bar{X}$= 11.88). Independent samples t-test showed a significant difference in favor of the experimental group (t = 4.314, p < .05). Additionally, the effect size, Cohen's d = 1.054, indicated that the instruction has a large effect (Cohen, 1988) on achievement. In other words, students who were exposed to reading comprehension-based instruction attained the objectives significantly better than those who did not.

According to the teacher's notes, having students come to class prepared by watching videos and reading texts facilitated the use of time in class efficiently for applying a variety of teaching methods

to acquire the Science Curriculum objectives. Techniques such as brainstorming, think-pair-share, and frequent use of large group discussions in the classroom allowed students to pose questions about anything they didn't understand or were curious about. This enabled the unit to be presented in a rich, detailed manner, reflecting various perspectives and highlighting its relevance to everyday life. As a result, students had the chance to learn the unit comprehensively. The students' questions posed during discussions, and the products students created throughout the unit showed their progress in learning in a variety of ways. Examples of student products about the topic of reproduction from the "Reproduction, Growth, and Development in Living Organisms" unit are presented in Table 4.

Table 4. Students' products

	An example of a poem written by students about reproduction	**Example of a newspaper article written by students about reproduction in plants**
Turkish-original version	Kimi canlı tek şekilde, Kimisi ise çeşit çeşit ürer. Bitkiler ürer ister tohumla ister dalla, Hayvanlar ürer ister içte ister dışta. Kimisi bakar yavrusuna, yedirir, korur, Kimisi bilmez, kendi yavrusunu yer. Hepsi küçük başlar yola büyür, gelişir, Ama bazıları bar başkalaşır da gelişir. İşte böyledir canlılık, Yoktur tek bir yol hayatta kalmak için.	"ŞOK! ŞOK! ŞOK! Bitkiler çift cinsiyetliymiş! Botanikçilerin yapmış olduğu araştırmalar neticesinde bitkilerin dişi veya erkek olabileceği gibi hem dişi hem de erkek üreme organlarını beraber taşıyabilecekleri kanıtlanmıştır. Bu tip bitkilere tam çiçek denirken, tek cinsiyetli olanlar kusurlu çiçek olarak adlandırılmıştır. Aman diyelim, insanlara da kusurlu sıfatı ilerleyen yıllarda kullanılmasın."
English-translated version	Some living things reproduce in a single way, Some reproduce in various ways. Plants reproduce by seed or by branches, Animals reproduce both internally and externally. Some care for their young, feed them, and protect them, Some, unaware, eat their own young. All start small and grow and develop along the way, But some become different and develop as well. This is how life is. There is no single path to survival.	**SHOCKING! SHOCKING! SHOCKING!** Plants are hermaphrodites! As a result of studies conducted by botanists, it has been proven that plants can be either male or female, or they can carry both male and female reproductive organs at the same time. Such plants are called **perfect flowers**, while those with only one sex organ are referred to as **imperfect flowers**. Just a heads-up — let's hope the term "imperfect" won't be used for humans in the years to come!

The poem given in Table 4 shows that students learned about sexual and asexual reproduction, internal and external fertilization, metamorphosis, and the existence of organisms capable of multiple reproductive methods. Another example of a newspaper article written by students about reproduction in plants in Table 4 indicates that students acquired knowledge about the reproductive organs of plants. The slogans created by students to promote healthy development are as follows: "Mother, stay healthy so your baby can be healthy too." and "Remember, harmful foods, radiation, and chemicals are your enemies!". These slogans suggest that students were able to gain knowledge about maternal and infant health and concisely summarize this understanding.

The visuals of the cartoons created by the students on the subject of reproduction in humans are given in Figure 2. In these cartoons, it is seen that students acquired the knowledge of metamorphosis, external fertilization and reproduction by division. As can be seen from these studies, students not only acquired information but also were able to produce different products by interpreting them.

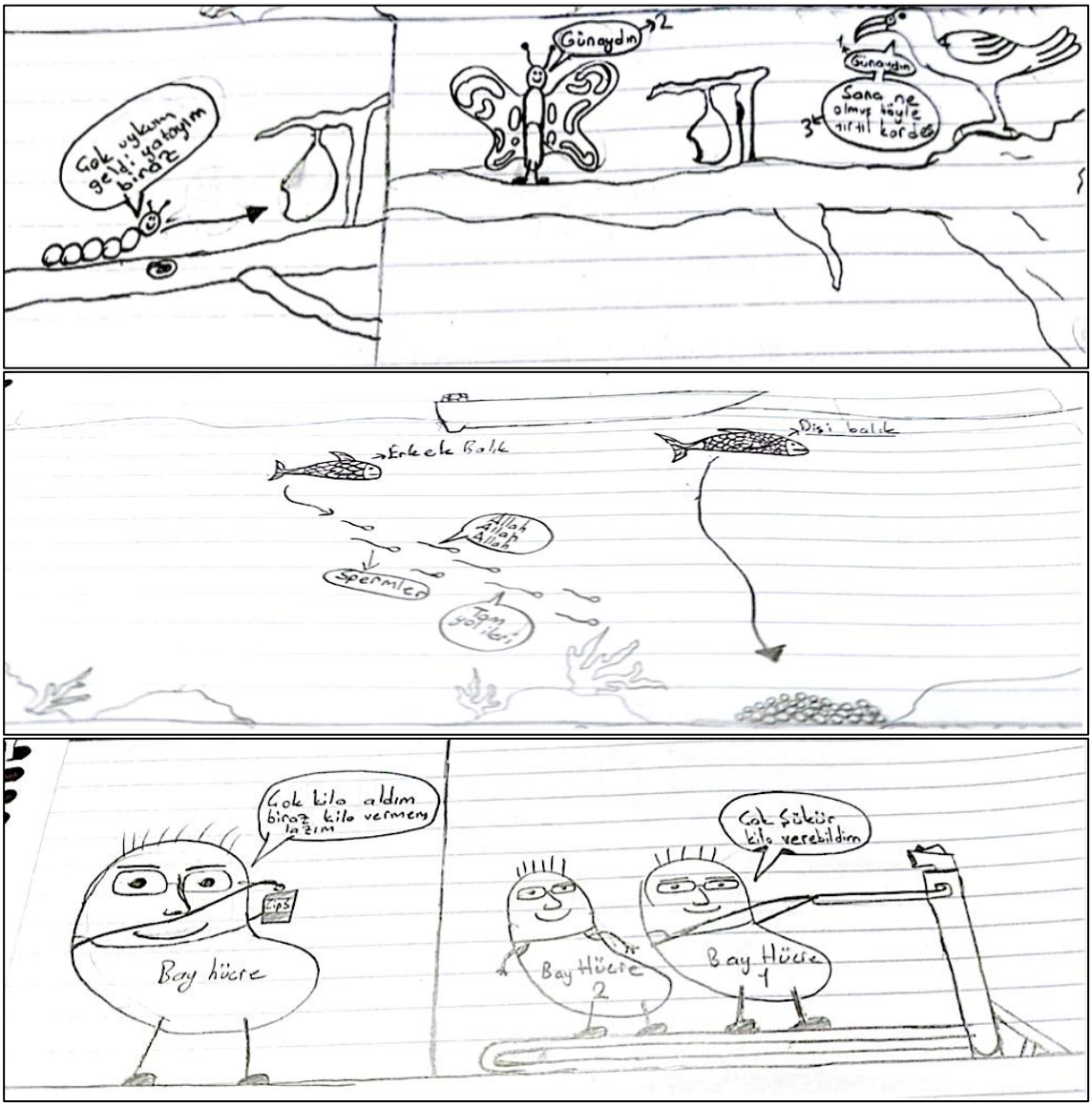

Figure 2. Examples of cartoons on human reproduction

Findings regarding The Effect of Reading Comprehension Skill-Based Instruction on Students' Reading Comprehension Skills

Before the implementation, the reading comprehension skills scale was administered to the students for needs analysis. Moreover, this data was utilized as a pretest and at the end of the implementation, this scale was administered as a posttest. To answer research question related to the effect of reading comprehension-based instruction on students' reading comprehension skills, a dependent sample t-test was conducted, and the results are presented in Table 5.

Table 5. Dependent sample t-test results

Group	Posttest		Pretest		t	p	$Cohen's\ d$
	$\bar{X}$	ss	$\bar{X}$	ss			
Experiment	68.5	6.146	43.5	7.597	21.585	.000*	3.502

*p<.05

As it can be seen from Table 5, the analysis results indicated a significant improvement in reading comprehension skills ($t = 21.585$, $p < .05$). The effect size, measured by Cohen's $d = 3.502$, demonstrated a positive and huge impact of the instruction on students' development, following Cohen's (1988) criteria.

Additionally, the teacher's reflection notes indicate that throughout the study, students improved their ability to answer questions correctly and find evidence from the text or visual elements to support their answers during discussions. After learning reading strategies such as underlining important parts, marking sections with asterisks, and extracting information from the text, students began to apply these techniques effectively. Initially, the worksheets showed no markings; however, in subsequent worksheets, as shown in Figure 3, students had underlined and circled various sections. They also took notes on the texts and visual elements as reminders. Furthermore, there was a significant decrease in the number of unfamiliar words encountered during classroom discussions. The number of unclear sections related to the text and the questions asked about confusing parts also reduced notably.

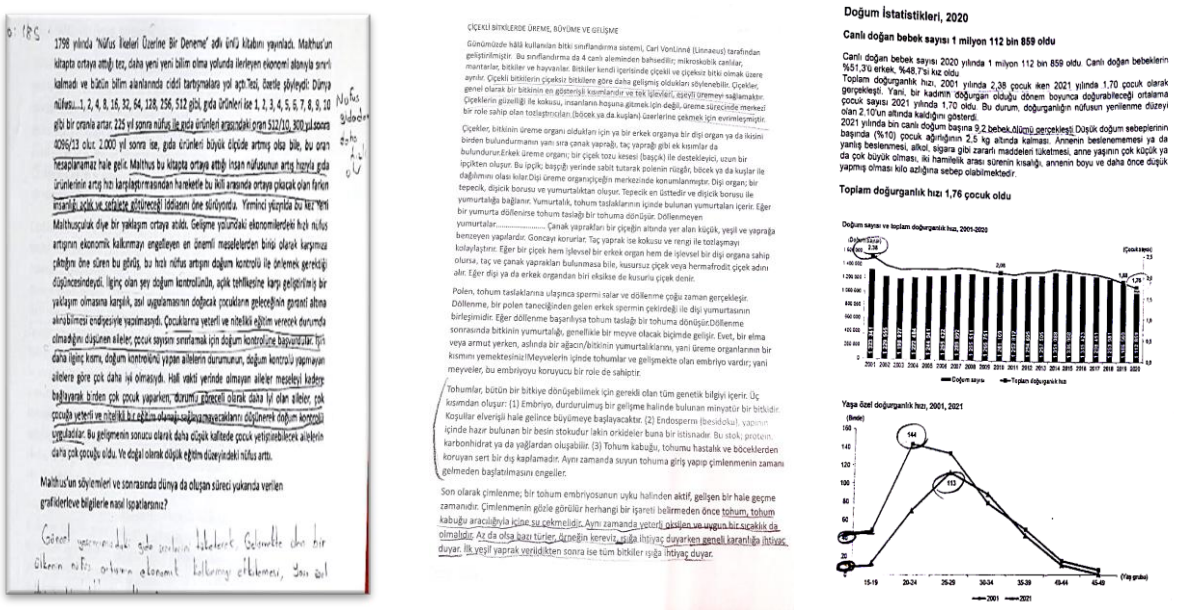

Figure 3. Examples of worksheets

Findings regarding Student Opinions on Reading Comprehension Skill-Based Instruction

As a result of the analysis of the data obtained from face-to-face interviews with students, four main themes were extracted: contribution to cognitive development, contribution to social-emotional development, teaching- learning process and suggestions. Codes and findings are presented under the relevant theme.

Theme 1. Contribution to cognitive development

As a result of the interviews with the students, it was determined that reading comprehension-based instruction contributed to students' cognitive development in various ways. The codes and categories obtained are given in Table 6.

Table 6. Codes and categories related to the theme of contribution to cognitive development

Theme	Category	Code
Contribution to cognitive development	Improvement in reading comprehension skills and strategies	Identify important place in text
		Guessing the unknown word
		Converting written text to visual
		Convert table to text
		Predicting the meaning of unknown words
		Associating information within the text
		Making inferences
		Interpretating
		Analyzing
		Predicting
	Effective learning	Better understanding
		Permanent learning
		Understanding exam questions
		Coming to class prepared
		Becoming successful
		Relating to existing knowledge and experience
	Learning new information	Obtaining information about daily life
		Accessing scientific information not in the book
	Transfer of knowledge and skills	Use reading strategies in courses other than science
		Ability to transfer to daily life

As can be seen from Table 6, students have reported notable cognitive developments in both reading comprehension and science learning. They indicated enhancements in their reading comprehension strategies, which include the capacity to infer the meanings of unfamiliar words, identify key points, and transform written texts into visual representations or convert tables into written formats. Some students indicated that they used these skills in other courses. Interviews highlighted that the utilization of these strategies also contributed to improvement of analyze, inference, interpretation and prediction skills among students. Students underscored that the acquisition of reading comprehension strategies has resulted in a better understanding of topic and exam questions, academic success and more enduring learning. They noted that arriving in class prepared by engaging with instructional videos assigned by the teacher significantly enhanced their academic performance and facilitated their recognition of key components of the material during class sessions. In terms of scientific learning outcomes, they stated that they gained valuable knowledge concerning various diseases and the anatomical structures of plants. They articulated that they were able to relate their newly acquired knowledge to prior information and experiences. Furthermore, they indicated that their understanding of plant structures could be effectively applied in rural contexts.

> *"S1: My skills have improved with this lesson. When we read the text and answered the questions in every lesson, our skills improved. For example, while I could not answer the questions well in the first text study, I got better in the last text study. I learned some strategies. First, I read the question then I read the text and underlined them. I try to guess the words I don't know if they are not proper nouns. Now, questions with text are easier."*

> *"S4: I used to forget what I read, but in this lesson, we were constantly exposed, we read, we discussed, and thus the retention rate increased. The preliminary studies we did before coming to the lesson were effective, and my success increased when I came to the lesson ready. I can identify important points more easily now. I had difficulty in determining the subject and main idea of the reading texts. For example, I had difficulty in setting up equations in equation questions. After this study, I realized that I could do it more easily in both Turkish and mathematics. When the functions of organs are written in the form of notes, they remain memorized, but when they are given about the text, it is easier to understand and easier to relate them. We practiced making inferences and interpretations."*

"S3: If you were to give a simple lecture, you would only tell us the things on the exams. After this study, I started to make fewer mistakes in the skill-based book. But now what I read started to retain in my mind. We analyzed what we read and discussed the questions. We learned what we should pay attention to, so the parts that we need to keep in mind remain in our minds, and I can solve the questions with a single reading."

"S4: The preliminary work we did before coming to the lesson was effective, and my success increased when I came to the lesson ready. I can identify important places more easily now."

Theme 2. Contribution to social-emotional development

Interview results showed that the instruction aimed at improving reading comprehension skills resulted not only in cognitive gains but also contributed to the social-emotional development of the students. Table 7 shows the categories and codes related to the contribution to social-emotional development.

Table 7. Codes and categories related to the theme of contribution to social-emotional development

Theme	Category	Code
Contribution to social-emotional development	Awareness of reading comprehension	Aware of its impact on understanding the question posed
		Aware of its impact on solving exam questions
		Aware of its impact on understanding what is listened
		Aware of its impact on understanding the books you read
	Increase in academic attitudes	Reduced exam anxiety
		Increased academic self-efficacy
		Increased interest in solving questions
		Motivated to learn
		Enjoy the lesson
		Positive attitude towards the course
	Improvement in social skills	Socialization
		Effective communication
		Vocabulary development
		Participate in different conversations
		Effective listening

As can be seen from Table 7, students reported an increased awareness of the importance of reading comprehension in both academic and social contexts. Academically, they recognized the significance of understanding the questions posed in lessons and in exams to answer them correctly. They realized that they did not fully grasp the books they read or the conversations they had before, which underscored the value of reading comprehension in their interactions with others. Furthermore, students indicated a reduction in exam anxiety, attributing this to their enhanced understanding of both the course material and the questions they faced. Their interest in problem-solving, motivation to learn, and overall attitudes toward the course improved as a result. Additionally, they noted that active teaching methods, such as group work and discussions, made them more socially engaged. These methods encouraged greater participation in class activities, as well as improved listening and speaking skills. One student specifically mentioned that their vocabulary expansion contributed to better communication skills, particularly in speaking.

"S2: I thought I understood what I was reading, but I realized that I did not, I noticed the points I missed. My awareness has improved."

"S6: We have HSEE ahead of us, and 2/3 of this exam is reading comprehension. If you don't understand the text, if you don't understand the question, you can't solve the question, so it was useful to be successful in that exam, it was a skill that had to be learned"

"S5: Your activities were interesting. This activity made me like it."

"S3: Group work and discussions socialized me, and this increased my love."

"S1: Since reading books allows our brain to think more, our vocabulary improves, and we can speak better. …. The best part was that our vocabulary improved first..."

Theme 3. Teaching-learning process

Regarding the teaching-learning process of reading comprehension-based instruction, students' opinions were classified under three categories: active learning methods, positive learning environment and instructional materials. The codes and categories obtained are given in Table 8.

Table 8. Codes and categories related to the teaching-learning process theme

Theme	Category	Code
Teaching - learning process	Active learning methods	Brainstorming
		Discussion
		Group activities
		Question and answer
	Positive learning environment	Fun environment
		Curious environment
		Diversity of methods and materials
		Active participation
		Attracting attention
	Effective instructional materials	Articles with different information from book
		Texts about current life
		Attractive
		Diversity

The codes presented in Table 8 indicated that students highlighted that brainstorming, discussion, group work, and question-and-answer methods used in the class were highly effective, leading to their active participation in the lessons. They reported that this active engagement created a positive learning environment, enhanced by various activities and materials that fostered curiosity and made learning enjoyable. It is clear that this supportive atmosphere significantly impacted their learning, skill development, and attitudes toward the course. Furthermore, students mentioned that the information in the provided materials was current and interesting, which contributed to the overall effectiveness of the learning process.

"S5: … It was not a boring, classical lesson anymore. We both solved questions and had fun, so I think it was useful, and my success improved."

"S3: If you have a simple lesson, you would only tell us the things that appear in the exams. But the fact that we came with the knowledge of the subject because we had studied it beforehand gave you time to share the thoughts of scientists with us in this study, and we learned."

"S1: The papers were interesting. There was information on the paper that was not in the book. There were two sources."

"S2: We were reading texts every lesson, but we were turning them into different activities. We were either drawing, interpreting graphics or discussing. Especially in the last activity, we had a lot of fun together. I came wondering about the text of the next lesson, and I saw things that there were not in school or test books."

Theme 4. Suggestions

Although students indicated that this course improved their reading comprehension skills and enhanced their overall learning, they also provided suggestions for making the instruction more effective and efficient. The codes and categories obtained in this context are presented in Table 9.

Table 9. Codes and categories related to the suggestions theme

Theme	Category	Code
Suggestions	Duration	More time for activities
	Activities	Interdisciplinary approach
		Cooperative learning
		Drama
		More read aloud
	Materials	Material with more different information
		Material with more discussion questions

Suggestions given in Table 9 show that according to students, the duration of the sessions was insufficient, indicating a preference for extended discussions and additional time dedicated to the development of reading comprehension skills. Moreover, they proposed the implementation of an interdisciplinary approach to enhance these skills, suggesting the integration of reading comprehension with mathematics instruction. Additionally, students recommended the incorporation of diverse teaching methods related to reading comprehension, such as drama, collaborative learning, and strategies that involve reading aloud with emphasis to facilitate the understanding of key concepts. They acknowledged that the materials provided information not typically found in school textbooks, but they also articulated a desire for an even greater variety of content. Furthermore, they advocated for an increase in the number of questions posed during discussions to deepen engagement and enrich the overall learning experience.

> *"S6: It would have been better if there was a study that included other subjects. It could have been a text in which numbers could be included in different subjects. We could have been more active. For example, we could have written like a drama, and we could have played it. It could have been more understandable when it was active. I think the last group work was very good, and more work like that could have been done."*

> *"S5: We learned from the information on the paper there were interesting texts, and they were memorable. There could have been more questions related to the texts, questions that would lead to different discussions."*

On the other hand, it was also stated that in-class discussions can sometimes distract attention and cause disengagement from the subject. For this reason, one of the students, who was easily distracted, suggested that the lesson should be taught and summarized by the teacher.

> *"S2: The bad thing is that you do not have time to explain, so it can be difficult to understand. Our work may be insufficient. Even if you explain after the text, we cannot catch the integrity…I needed it to be explained holistically by you."*

Discussions

This study was conducted to evaluate the effects of reading comprehension-based instruction supported by flipped learning model in the 7th-grade Science curriculum, specifically in the unit on "Reproduction, Growth, and Development in Living Organisms." The findings indicated that the reading comprehension-based instruction supported by flipped learning not only contributed to the attainment of the unit objectives but also improved their reading comprehension skills. The academic success of students in the class where reading comprehension skills were embedded was significantly higher than that of students in the class with traditional teaching methods. Additionally, teacher's reflection notes and student products demonstrated that learners could showcase their understanding in various ways. Indeed, students' opinions gathered through interviews also supported these results and also provided insight underlying them.

Numerous studies have convincingly demonstrated a strong link between students' academic success in science and their reading comprehension skills (Akbaşlı et al., 2016; Baştuğ, 2014; Bayat et al., 2014; Cano et al., 2014; Imam et al., 2014; Karasu & Haşıloğlu, 2020; Meneses et al., 2018; Reed et al., 2017). Engaging students in reading comprehension activities that utilize scientific texts, combined with

the strategies highlighted in this study, can effectively boost student performance, not only in science but across all verbal-content subjects (Holliday & Cain, 2012). This approach is crucial because it has been shown that understanding scientific texts is often more difficult than interpreting non-scientific ones (Cromley et al., 2010; Handayani et al., 2018; Johnson & Zabrucky, 2011). In this context, Fang (2006) points out that as students transition from elementary to middle school, they shift from "learning to read" with the language of ordinary life to "reading to learn" through expository language found in the curriculum. This shift can lead to significant linguistic challenges for students encountering middle school science texts. Moreover, Fang emphasizes the vital connection between reading comprehension skills and scientific process skills, suggesting that mastering reading comprehension skills is key to achieving greater academic success in science classes. Consequently, as this study has demonstrated, it can be inferred that the implementation of reading comprehension strategies enhances the clarity of scientific texts, thereby facilitating the learning process.

Reading comprehension encompasses more than vocabulary knowledge, fluent reading, and awareness of the topic; it also involves the ability to relate information to personal experiences, make inferences, interpret, classify, and summarize (Lyon, 1998; McCarthy & Yan, 2024). In this study, the findings indicate that the positive effects of the implemented instruction extend beyond academic success to also encompass enhancements in reading comprehension skills. Students indicated improvement in their reading comprehension skills, including visual, text, and table reading, converting table to text and vice versa, and making inferences, interpretations and predictions. There are also studies indicating that the strategies used in teaching reading comprehension effectively enhance these skills. Kanmaz (2012) conducted a study in a Turkish language course aimed at improving reading comprehension and unveiled that students acquired and retained this skill. Furthermore, students reported that they applied the strategies in other subjects, indicating that they were able to transfer these strategies. Obalı (2009) also demonstrated that students who used reading comprehension skills in Turkish and Mathematics were able to transfer these skills to comprehend reading in science.

This study underscores that, in addition to promoting cognitive development, enhancing academic achievement, and improving reading comprehension skills, reading comprehension-based instruction significantly contributes to students' social-emotional development. Research by Sparapani et al. (2018) indicates a noteworthy correlation between social-emotional skills and reading proficiency. Participants in this study articulated the multifaceted benefits of reading comprehension instruction on their overall growth, particularly highlighting enhancements in their social skills, such as listening and communication abilities. In this context, Epçaçan (2018) points out that the cultivation of reading comprehension skills not only improves language use and self-expression but also enhances the ability to understand oral communication and appreciate diverse perspectives. Another significant finding indicates that although students may initially believe they possess a strong understanding of the material they read or hear, their experiences during instruction focused on reading comprehension reveal that their actual comprehension was not as robust as they initially perceived. This reflects an increase in their self-awareness, aligning with literature that supports the notion that reading comprehension skills contribute to enhanced self-awareness (Fisher & Frey, 2014; Kanmaz, 2012). In this regard, Bandura (1997) further explained that individuals who possess strong reading comprehension skills tend to evaluate their self-efficacy more effectively. Additionally, responses from students revealed that instruction focused on reading comprehension decreased exam anxiety, increased academic self-efficacy, stimulated interest in problem-solving, motivated them to learn, and encouraged active participation in class activities. These behaviors that foster a desire for learning among students serve as indicators of academic motivation (Long et al., 2007). This motivation is one of the underlying factors elucidating the reason for students' positive attitudes toward their courses or school (Gülle, 2021), as demonstrated in the current study. According to the students' responses, their academic motivation increased because they could understand what they read and successfully solved the questions by using reading comprehension strategies. This demonstrates positive improvement in students' perception regarding their self-efficacy, defined as individuals' judgments about their potential to succeed or fail (Bandura & National Inst. of Mental Health, 1986). Self-efficacy significantly

influences students' effort in various activities, their perseverance, their interest, and ultimately their success (Schunk & DiBenedetto, 2020); and therefore, possessing high self-efficacy results in rise in academic motivation (Haidari et al., 2023; Li et al., 2024).

Students have also shared their opinions regarding the teaching-learning process of reading comprehension-based instruction. They expressed that the learning environment was engaging due to active teaching methods, diverse materials, and the use of various texts. Specifically, methods and techniques such as question-and-answer sessions, brainstorming, discussions, think aloud and group work were emphasized as underlying reason for active participation. The findings show that these methods contributing to a positive teaching environment enhanced students' learning, reading comprehension, and affective skills. Similar results are evident in the literature, indicating that active teaching methods, such as brainstorming, question-and-answer, discussions, and group work, positively contribute to reading comprehension skills (Galimpin, 2024; Ghabanchi & Behrooznia, 2014; Jalilifar, 2010; Syamsir et al., 2021). Regarding question-and-answer technique, which was used in all lessons, it is stated that its use for texts in the Science curriculum can impact both reading comprehension and academic achievement (Gudelos, 2023; Kinniburgh & Shaw, 2009). Another reading strategies employed in this study was think-aloud reading; each reading text was approached first through silent reading, followed by think-aloud activities. Similarly, studies conducting think-aloud analyses on texts showed its positive impact on the development of students' reading comprehension skills (Kucan & Beck, 1997; Kumar & Dhar, 2023).

Furthermore, it is important to acknowledge that the implementation of the flipped learning model has contributed to the abovementioned favorable results associated with reading comprehension-based instruction. The primary objective of benefitting from this model was to allocate sufficient time for effective reading comprehension instruction, particularly given the curriculum's demanding content. The findings showed that the model allowed educators to utilize classroom time more efficiently, while prior preparation by students facilitated enhanced focus and comprehension during lessons. Existing literature also underscores several advantages of the flipped learning model, including increased time for engaging in tasks, improved classroom interaction, and the promotion of active, deeper learning (Horn, 2013; McLean et al., 2016; Michaelsen, 2020). Empirical research further reinforces that this instructional approach positively impacts students' attitudes toward the classroom environment, boosts motivation, and contributes to overall academic achievement (Alsancak Sırakaya, 2015; Duman, 2019; Kaya, 2018).

The students interviewed not only recognized the value of reading comprehension-based instruction in science but also proposed several recommendations to enhance the effectiveness of the course. They particularly stressed the importance of allocating additional time for various activities. Furthermore, they call for more reading materials and more diverse activities such as read-aloud sessions, drama, and interdisciplinary approaches. This demand signifies their motivation to learn and their favorable disposition towards reading comprehension-based instruction.

The findings from this study suggest that reading comprehension-based instruction, supported by the flipped learning model in science, can enhance the holistic development of students across academic, cognitive, social, and emotional dimensions. Furthermore, it has a positive impact on the overall teaching and learning processes. However, it is important to acknowledge certain limitations regarding the generalization of these results. This research was conducted in a boys-only middle school setting, which indicates that testing this approach in mixed-gender or girls-only schools would be beneficial for the generalization of the findings and enabling a comparative analysis between genders. Additionally, this study examines only a single unit within the 7th grade Science curriculum. Therefore, implementing this methodology on a larger scale is essential for a more comprehensive investigation of its effects and outcomes. In response to the feedback provided by students, it is recommended that future researchers consider conducting this study across multiple subjects simultaneously and enriching the educational experience with diverse activities, such as drama. This approach could further enhance the learning environment and outcomes for students. The results of this study, in conjunction

with relevant literature, underscore the necessity of disseminating reading comprehension-based instruction beyond the realm of science to other academic disciplines. Additionally, the adoption of a flipped learning model may be proposed to create more time for reading comprehension tasks. In this context, the development of pre-service or in-service teacher training programs, as well as guidebooks, could be instrumental in establishing instruction that incorporates reading comprehension-based instruction and the suggested activities. These resources would empower educators to utilize methods and techniques that effectively support the enhancement of reading comprehension skills across various subjects.

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