CONTEMPORARY METHODOLOGICAL APPROACHES IN EDUCATION SCIENCES

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Contemporary Methodological Approaches in Education Sciences

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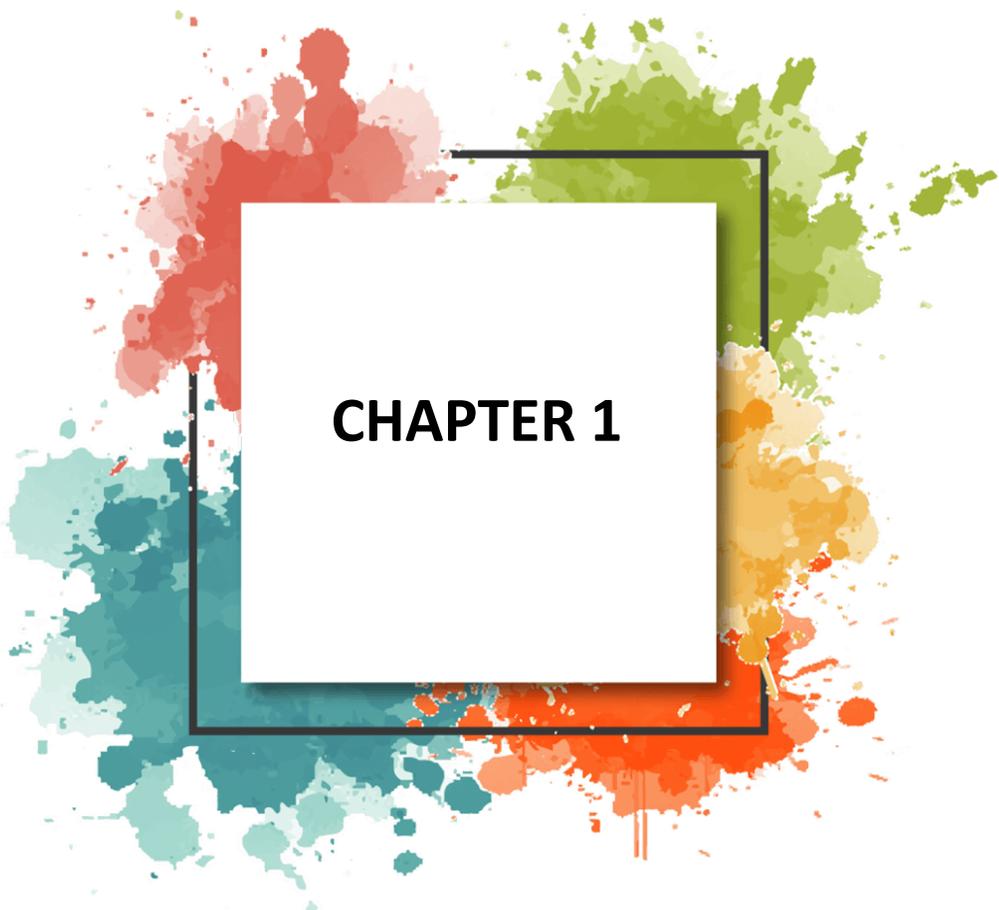
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CHAPTER 1

Write, Generate, Discover: Boosting Student Motivation through AI in Preparatory Efl Programs

Türkan Kaplan[1]

INTRODUCTION

Motivation is a critical driver in second language acquisition. As educational technologies evolve, artificial intelligence (AI) is increasingly used to create interactive, engaging, and personalized learning environments. While much research has focused on AI's cognitive benefits, fewer studies have explored its motivational impact across students of differing achievement levels. This study seeks to address this gap by examining how AI-enhanced tasks influence motivation among EFL students with varying proficiency levels at a Turkish university preparatory program.

Much of the existing research is exploratory, focused on single AI applications, or limited in scope. There is a clear need for comparative, level-specific studies that examine how students at different achievement levels respond to varied AI-enhanced tasks. Furthermore, most existing studies rely on qualitative or anecdotal reports, pointing to the need for quantitative, statistically validated investigations into AI's motivational effects. This study aims to address these gaps by systematically evaluating the motivational impacts of AI-based tasks across three distinct student levels (Alpha, Bravo, Charlie) using a structured, reliable questionnaire.

RESEARCH QUESTION

The study explores the following questions:

RQ1: To what extent does AI-integrated instruction affect student motivation across different proficiency levels?

RQ2: Which specific AI-based tasks or classroom activities are perceived as most motivating by students?

RQ3: How do students at different proficiency levels respond differently to AI versus collaborative classroom tasks?

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LITERATURE REVIEW

The integration of artificial intelligence (AI) into education, particularly in the domain of English as a Foreign Language (EFL), has generated increasing interest among scholars and educators. As global digital transformation reshapes pedagogical approaches, AI tools are emerging not only as facilitators of personalized learning but also as potential enhancers of student motivation, engagement, and creativity. This literature review synthesizes key theoretical frameworks and empirical findings related to student motivation, the role of technology in language learning, and the specific contributions of AI in EFL contexts.

Student Motivation in Language Learning

Motivation is widely acknowledged as a crucial determinant of language acquisition success (Gardner, 1985; Dörnyei, 2001). Among the most influential models is Deci and Ryan's (1985) Self-Determination Theory (SDT), which posits that learners are most motivated when three basic psychological needs are fulfilled: autonomy, competence, and relatedness. Autonomy refers to the sense of volition in one's actions; competence is the feeling of effectiveness in interacting with the environment; and relatedness involves meaningful connections with others. In classroom settings, instructional designs that support these three components foster intrinsic motivation, which leads to higher engagement, persistence, and overall achievement (Ryan & Deci, 2000). In addition to SDT, Dörnyei's L2 Motivational Self System (2005) provides a language-specific motivation model emphasizing three components: the Ideal L2 Self, the Ought-to L2 Self, and the L2 Learning Experience. The Ideal L2 Self embodies the learner's desired future identity as a proficient language user, which serves as a strong internal drive. This concept is particularly relevant when exploring the role of engaging, future-oriented tools such as AI in stimulating motivation among language learners.

Technology and Motivation in Language Learning

Digital technologies have long been associated with motivational benefits in educational contexts (Stockwell, 2012; Reinders & Benson, 2017). Technologies such as interactive whiteboards, learning management systems, mobile apps, and gamified learning platforms have shown promise in enhancing student interest and enjoyment (Chapelle, 2001). More specifically, in the EFL context, studies have highlighted how digital storytelling, web-based projects, and social media integration support authentic language use, collaboration, and learner autonomy (Warschauer & Healey, 1998; Godwin-Jones, 2018). A recurring theme in the literature is that task-based technology integration—where digital tools support meaningful language tasks—aligns well with learner-centered approaches and

communicative pedagogy (Ellis, 2003). When learners use digital tools to solve problems, create artifacts, or interact in meaningful contexts, they experience greater motivation and engagement (Hockly, 2018).

Artificial Intelligence in Education

Artificial intelligence represents the next evolution in educational technology. Defined broadly, AI encompasses technologies capable of performing tasks that typically require human intelligence, such as understanding natural language, recognizing images, and making decisions (Luckin et al., 2016). In education, AI tools such as intelligent tutoring systems, conversational agents, and content generation platforms offer new forms of interaction that are adaptive, responsive, and data-driven.

In recent years, researchers have begun to examine how AI tools affect learner motivation and learning outcomes. For instance, Holmes et al. (2021) outline the potential of AI to personalize learning, provide instant feedback, and promote self-regulated learning. AI chatbots like ChatGPT, for example, allow learners to practice conversation with a responsive interlocutor, reducing anxiety and promoting fluency in low-stakes environments. Similarly, image-generation tools like DALL·E or AI music platforms like Suno can stimulate creativity and linguistic expression, especially in tasks involving descriptions, storytelling, or reflective writing (Zawacki-Richter et al., 2019).

Importantly, AI tools can support personalized learning paths, which in turn promote motivation by honoring individual preferences, pacing, and styles of learning (Xie et al., 2019). These affordances link directly to the SDT dimensions of autonomy and competence. For example, when students choose their own prompts in a chatbot activity or generate their own artwork with AI, they experience ownership over their learning process.

Empirical Studies on AI and Student Motivation

While research on AI in education is expanding, empirical studies specifically examining its impact on motivation in EFL settings remain relatively scarce. Nevertheless, emerging findings are promising. For example, Lin and Siyanova-Chanturia (2023) conducted a quasi-experimental study using an AI writing assistant in an English academic writing course. Their results showed improved learner engagement, confidence, and quality of writing, suggesting a motivational boost stemming from real-time support and autonomy.

Similarly, Xiong et al. (2022) found that AI-driven feedback systems enhanced students' motivation and perceived competence in a reading comprehension course. Their study emphasized that the immediacy and precision

of AI feedback made students feel more in control of their learning, echoing SDT's core assumptions.

In the Turkish context, where the present study is situated, few large-scale investigations have addressed the motivational outcomes of AI in EFL preparatory programs. A study by Yıldız and Tuncer (2022) on AI-based grammar exercises in Turkish prep classes revealed a marked increase in learners' attention and interest, but noted that learner level played a role in engagement levels. Higher-achieving students were more critical of repetitive tasks, whereas lower-achieving students benefited from the structured, supportive environment AI tools provided.

AI, Learner Differences, and Task Design

Recent literature emphasizes the need to consider individual learner differences when integrating AI. Not all students respond uniformly to technological tools; their proficiency levels, cognitive styles, and learning goals mediate the effectiveness of AI-based tasks (Zhang & Aslan, 2023). Lower-achieving students may benefit more from AI's nonjudgmental, adaptive feedback, while higher-achieving learners may crave more complex, cognitively demanding activities such as discussions and debates. Task design is therefore crucial. Combining AI tools with collaborative activities has shown potential for maximizing engagement across proficiency levels. Studies suggest that pairing AI-based individual work (e.g., chatbot conversation) with human-led follow-ups (e.g., group discussion or peer feedback) supports both independent and social forms of motivation (Luo & Wang, 2020).

METHODOLOGY

This research employed a quantitative approach with a cross-sectional design. Participants included 55 students from UTAA's School of Foreign Languages. Three classes were randomly selected from different achievement tiers: Alpha (low-achieving, n=22), Bravo (mid-achieving, n=19), and Charlie (high-achieving, n=14). Each student completed a 20-item Likert-scale questionnaire developed by the researchers to evaluate motivational factors related to AI-integrated instruction.

Research Design

This study employed a quantitative survey research design to explore the motivational impacts of AI-integrated English language instruction among B1-level preparatory class students at UTAA, a foundation university in Ankara, Türkiye. The design was chosen for its ability to systematically collect data from a defined sample and statistically examine patterns, relationships, and differences across learner groups. The goal was to compare the motivational effects of AI-

enhanced learning tasks on students with varying academic achievement levels in a controlled educational setting.

Participants

A total of 55 students were randomly selected from the UTAA School of Foreign Languages and assigned to three pre-existing English classes of differing academic achievement levels. The levels were determined based on institutional placement test scores and mid-term academic performance.

- **Alpha Group (Low Achievers):** 22 students

- **Bravo Group (Mid-Level Achievers):** 19 students

- **Charlie Group (High Achievers):** 14 students

All participants were between the ages of 17 and 21, and they had been classified as B1-level English learners according to the Common European Framework of Reference for Languages (CEFR). The majority of students were Turkish-speaking, with limited previous experience in using AI tools for educational purposes.

AI-Integrated Instructional Context

Over the course of three academic terms (Fall, Spring, and Summer), students participated in weekly 1-hour AI-supported English language sessions, in addition to their standard curriculum. The duration of the study spanned 31 weeks. Each AI session incorporated one or more digital tools and was closely aligned with the language objectives of the main course.

AI tools used included:

- **ChatGPT:** for conversational practice and historical figure interviews.

- **AI Music Generator (e.g., Suno):** for creative lyric writing and audio tasks.

- **CopernicAI:** for reading comprehension and summarization exercises.

- **MagicSchool AI:** for personalized vocabulary tasks and quiz creation.

Each week, a unique task-based lesson was introduced using these tools. Sample tasks included interviewing a historical figure via ChatGPT, creating a thematic playlist with Suno, generating art in response to a reading passage using DALL·E, or solving ethical dilemmas through chatbot discussion.

These activities aimed to stimulate engagement through interactivity, novelty, and creativity. Lessons were delivered by trained instructors who received a two-week orientation on AI integration methods and ethical considerations in digital education.

DATA COLLECTION

The data collection instrument was a 20-item AI Motivation Questionnaire, specifically designed for this study. Items were developed based on constructs drawn from Self-Determination Theory (Deci & Ryan, 1985) and Dörnyei's L2 Motivational Self System (2005), with reference to previous validated motivation scales used in EFL contexts (e.g., Guilloteaux & Dörnyei, 2008).

Participants responded using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). The questionnaire covered five domains:

1. **Engagement with AI Tools**
2. **Creative Expression**
3. **Autonomy and Choice**
4. **Language Confidence**

Preference for Traditional vs. Collaborative Tasks

To ensure reliability, the instrument was piloted with a comparable group of 20 students. Cronbach's Alpha for the pilot was 0.87, indicating high internal consistency. Content validity was confirmed by three experts in EFL and educational technology who reviewed the items for clarity, relevance, and scope.

The final version of the questionnaire was administered in-person during Week 32 of the instructional cycle. Participation was voluntary, and anonymity was preserved. Students were informed that the data would be used strictly for academic purposes, and no grades or evaluations would be affected by their responses. The questionnaire was distributed during class time to ensure full participation. Completion time averaged 10–15 minutes. No personal identifiers were collected.

DATA ANALYSIS

Quantitative data collected through the **AI Motivation Questionnaire** were subjected to a series of descriptive and inferential statistical analyses using **SPSS 28.0.** The questionnaire consisted of 20 items divided into two motivational dimensions:

- **AI-Based Motivation** (Items 1–14): Reflecting learners' affective responses to AI-integrated lessons, including enjoyment,

engagement, autonomy, and perceived usefulness of tools like ChatGPT, AI Music, and CopernicAI.

- **Collaborative Activity Motivation** (Items 15–20): Measuring learners' motivation toward group discussions, peer comparisons, and debates.

Motivational scores for each dimension were calculated by averaging individual responses across items in that cluster. Subsequently, an **Overall Motivation Score** was computed by averaging all 20 items. Group means were calculated for each motivational dimension.

An **independent-samples One-Way ANOVA** was conducted to determine whether statistically significant differences existed between the three achievement-level groups (Alpha = low achievers, Bravo = mid-level achievers, Charlie = high achievers). Post-hoc **Tukey HSD** tests followed to explore specific between-group differences.

The results are presented in the following table:

Table 1. Mean Motivation Scores by Group

Group	AI Motivation (1–14)	Collaborative Motivation (15–20)	Overall Motivation (1–20)
Alpha (n=22)	4.35	3.20	3.95
Bravo (n=19)	3.88	3.72	3.81
Charlie (n=14)	3.62	4.40	4.02

As seen in Table 1:

- **Alpha students** reported the **highest AI Motivation** (M = 4.35), suggesting strong emotional and cognitive engagement with AI-supported language activities.

- **Charlie students** displayed the **highest Collaborative Motivation** (M = 4.40), indicating a stronger preference for socially interactive tasks such as debates, peer feedback, and discussion-based learning.

- **Bravo students** demonstrated balanced motivation in both dimensions, with moderate scores across the board (M = 3.88 for AI and M = 3.72 for collaborative).

The results indicate that Alpha students (low achievers) reported the highest AI motivation scores (M = 4.35), suggesting strong engagement with creative and interactive AI tasks. Charlie students (high achievers) showed greater appreciation for collaborative activities such as debate and peer discussion (M = 4.40). Bravo students had moderately high scores in both categories.

The **One-Way ANOVA** revealed a **statistically significant difference** in **AI Motivation scores** among the three groups:

$F(2, 52) = 6.92$, p < .01

Post-hoc analysis using the **Tukey HSD test** indicated the following:

The **Alpha group** scored significantly higher in AI Motivation than the Charlie group (**p = .004**).

The **Bravo group's** scores were not significantly different from either Alpha or Charlie.

For **Collaborative Motivation**, the ANOVA also yielded significant results:

$F(2, 52) = 8.46$, p < .001

Tukey HSD revealed that:

Charlie students had significantly higher collaborative motivation than **Alpha students (p < .001)**.

Differences between **Charlie and Bravo** were not statistically significant (**p = .17**), nor between **Bravo and Alpha (p = .09)**.

RESULTS

These results align with and extend several strands of research in the field of motivational psychology and second language acquisition.

Support for Self-Determination Theory

According to Self-Determination Theory (Deci & Ryan, 1985), learners are intrinsically motivated when their needs for autonomy, competence, and relatedness are met. In this study:

- Alpha students appeared particularly responsive to AI tools that offered personal control (e.g., customizing chatbot prompts), non-threatening practice environments, and autonomy over learning—hallmarks of intrinsic motivation (Ryan & Deci, 2000).

- These learners may have found AI tasks less cognitively intimidating and more creatively freeing, which in turn boosted their emotional and

motivational engagement—corroborating Holmes et al. (2021), who argued that digital personalization supports learner autonomy and self-expression.

Role of Achievement Level and Learner Identity

For Charlie students, the high scores in collaborative tasks indicate a preference for social interaction, intellectual stimulation, and critical thinking—skills that often flourish in group discussions and debates. This supports Dörnyei's (2005) L2 Motivational Self System, particularly the Ideal L2 Self component. High-achieving students may be more goal-oriented and inclined to simulate authentic communication contexts, as shown in Ushioda (2011).

Interestingly, these students were less engaged with AI tasks, suggesting that while digital tools may promote surface-level excitement or novelty, higher-level learners crave dialogic interaction and deep processing more than passive creativity.

Echoes in Task-Based Learning Research

Research on Task-Based Language Teaching (Ellis, 2003) has emphasized that learners thrive when tasks are relevant, varied, and cognitively engaging. This study confirms that low achievers benefit from tasks that scaffold fluency and offer creativity, while high achievers favor open-ended discussion and problem-solving tasks. The mixed results from Bravo students suggest that a blended instructional model, combining AI-based individual tasks and collaborative classroom activities, may cater to a wider range of learner needs.

Therefore, these findings provide nuanced insights into the relationship between learner achievement level and motivational preference:

- Low-achieving students (Alpha) appear to benefit most from AI-supported instruction, as these tools likely reduce language anxiety and provide nonjudgmental, individualized practice opportunities. Their high engagement with creative, visual, and conversational AI tasks reflects an appreciation for novelty and autonomy in learning.

- High-achieving students (Charlie) prefer collaborative activities, suggesting that while they find AI useful, they are more motivated by intellectually challenging and socially rich environments such as discussions, debates, and group tasks where critical thinking and peer comparison are emphasized.

- Mid-level students (Bravo) exhibit a balanced motivational profile, valuing both AI-enhanced individual learning and interpersonal

interaction. This suggests that they may represent the most flexible group in terms of instructional method adaptation.

DISCUSSION & CONCLUSION

The findings highlight the differential motivational impact of AI-based versus collaborative activities across varying proficiency levels. For Alpha-level students, AI tools offered novelty, personalization, and creativity, all of which aligned with intrinsic motivators described in Self-Determination Theory (Deci & Ryan, 1985). These students felt empowered by the ability to control content, visualize learning through AI-generated media, and engage in non-threatening, autonomous practice.

In contrast, Charlie students preferred intellectually engaging and socially interactive tasks such as classroom debates and discussions. Their higher scores for collaborative motivation support the idea that these learners are more stimulated by cognitive challenge and social dialogue (Dörnyei, 2005). Thus, instructional design must be differentiated: lower achievers benefit more from AI support, while high achievers flourish when technology is paired with human interaction.

This study demonstrates that AI-integrated lessons can significantly boost motivation in preparatory EFL classes. However, the impact varies by proficiency level. Lower-achieving students responded positively to AI tools that encouraged creativity, self-direction, and emotional engagement. Higher-achieving students preferred tasks involving critical thinking and collaboration. These findings emphasize the importance of tailoring AI-enhanced instruction to match students' motivational profiles. Future work should explore long-term impacts and refine strategies for personalized learning.

EDUCATIONAL IMPLICATIONS

This research offers several practical recommendations for educators and curriculum designers seeking to incorporate artificial intelligence or other authentic content into English language programs especially in preparatory settings::

1. AI tools such as ChatGPT, MagicSchool, and AI Music generators can reignite motivation, particularly for students who may struggle in traditional classroom settings.

2. However, over-reliance on AI tools may leave higher-achieving students under-challenged or disengaged. To address this, integrating AI with discussion-based tasks can serve both motivational clusters.

3. Instructors should consider differentiated instruction: deploying AI tools more heavily in lower-level classes, while embedding them into complex, social problem-solving tasks for higher-level students.

By implementing these strategies, educators can create learning environments that are both linguistically rich and personally meaningful.

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APPENDIXES

Appendix A: AI Motivation Questionnaire

Dear Student,

This survey is designed to gather your thoughts and experiences about the integration of artificial intelligence (AI) tools into English language lessons. Your responses will help us understand how these tools influence student motivation at different levels. The survey is anonymous, and there are no right or wrong answers.

Please read each statement carefully and select the option that best reflects your opinion. Use the following scale:

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree

		1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
1	I enjoy lessons that use artificial intelligence tools.					
2	AI tasks help me stay focused during lessons.					
3	I feel more motivated when lessons include creative AI activities.					
4	AI tools make learning English more fun.					
5	Chatting with AI helps me improve my English					
6	I prefer AI tasks over traditional					

	textbook activities					
7	AI tasks allow me to express my creativity.					
8	I like generating music, images, or videos using AI tools.					
9	I feel more autonomous in lessons with AI tasks.					
10	AI lessons make me curious to learn more.					
11	I find AI tools useful for vocabulary learning.					
12	Using AI helps me understand grammar better.					
13	I feel confident using English during AI activities.					
14	I like interacting with AI to practice speaking.					
15	I prefer group discussions and debates more than AI tasks.					
16	Collaborating with classmates motivates me more than AI tools.					

17	I enjoy comparing my ideas with classmates in discussions.					
18	Debates and discussions help me think critically					
19	I want more lessons to combine AI tasks with discussion.					
20	Overall, I am more motivated when different activities are combined.					
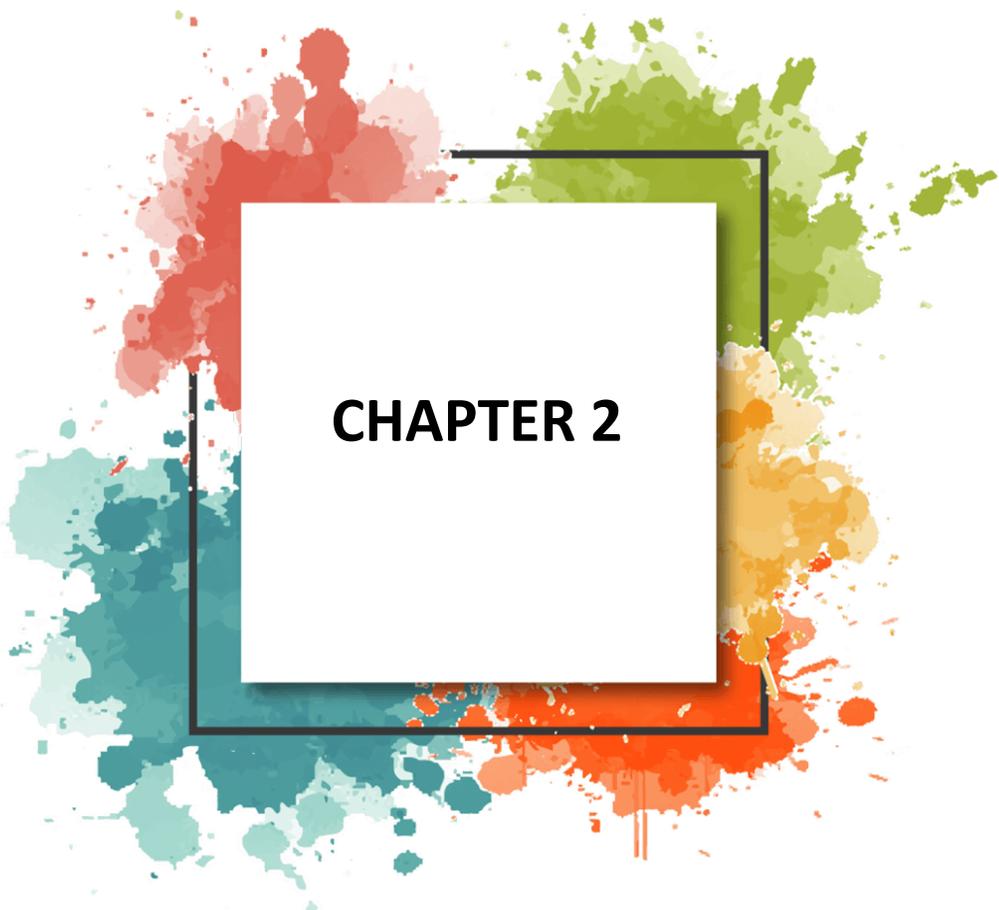
CHAPTER 2

The Impact of Science Activities in Early Childhood On Language Development and Concept Learning From A Child Development Perspective

Pelin Yıldırım[1]

INTRODUCTION

Early childhood (ages 0-6) is regarded as a critical developmental stage in the field of child development, during which the foundations of cognitive, linguistic, social, and emotional development are established and learning occurs in the most rapid and lasting manner (Atış Akyol & Çiçek Habeş, 2025; Likhar et al., 2022). During this period, children make sense of the world through their interactions with their environment, develop concepts based on their experiences, and learn to use language not only as a means of communication but also as a fundamental cognitive tool that structures thinking, problem solving, and learning (Darling-Churchill & Lippman, 2016).

Language development and concept learning are two core developmental domains that mutually support one another and progress within a holistic developmental process in early childhood (Finders et al., 2023; Sun & Yin, 2022). Language development plays a critical role in the expansion of vocabulary, the labeling of concepts, the expression of cause-effect relationships, and children's ability to verbally structure their thoughts (Hansen & Broekhuizen, 2021; Jago et al., 2025; Köken, 2024). Concept learning, on the other hand, enables children to classify, compare, and organize the objects, events, and situations they encounter in their environment, transforming these experiences into mental schemas (Alessandroni & Rodríguez, 2020).

Research indicates that concepts acquired at an early age form a strong foundation for later academic achievement, scientific thinking, and problem-solving skills (Grenell et al., 2024; Güngör et al., 2022). In this context, the quality of learning experiences provided in educational environments that support child development has a decisive influence on children's linguistic and conceptual development.

Science education emerges as an important learning domain that supports child development in a multidimensional manner by fostering children's natural

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curiosity and inclination to explore and by providing learning opportunities based on inquiry, observation, and experimentation (National Science Teachers Association [NSTA], 2014; Sowmya & Rani, 2025). While science activities enable children to actively use language, learn new vocabulary, and become familiar with scientific concepts (Eti & Sigirtmac, 2021; Zhao et al., 2025), they also support concept learning by allowing abstract concepts to be meaningfully constructed through concrete experiences (Delserieys & Kampeza, 2025; NSTA, 2014).

In this process, the teacher's guiding role, the quality of the language used, and the richness of the learning environment stand out as key factors that enhance the impact of science activities on children's linguistic and cognitive development (Mercer et al., 2019; van der Wilt et al., 2022). Therefore, science activities should be addressed within the context of child development not only as a means of conveying scientific knowledge but also as an educational tool that holistically supports linguistic and cognitive development (Eshach & Fried, 2005).

This book chapter presents a theoretical review that explores the effects of science activities on children's language development and concept learning within the context of child development in early childhood. The chapter examines the fundamental characteristics of language development and concept learning, the importance of science education in early childhood, the contributions of science activities to developmental domains, and the teacher's guiding role, all in light of the existing literature.

FUNDAMENTAL CHARACTERISTICS OF LANGUAGE DEVELOPMENT AND CONCEPT LEARNING IN EARLY CHILDHOOD

Early childhood is regarded as a critical period during which language and conceptual development progress in the most rapid and pronounced manner. The linguistic and conceptual skills acquired during this period form the foundation of children's cognitive, social, and communicative development and lay the groundwork for lifelong learning processes. Supporting language development can be achieved not only through interaction with environmental stimuli but also through age-appropriate activities aligned with the child's interests and motivation. In this process, children learn to make sense of spoken and written expressions in their environment, associate words with different contexts, and organize these relationships mentally (Ayrancı, 2018).

Language development is not limited to the ability to produce grammatically correct sentences. Children recognize phonemes, the smallest meaningful units of language, and use them to form words and assign meaning. For example, the

word "cat" consists of three phonemes (/c/ /a/ /t/). In this process, children first learn the articulation of phonemes, then combine these sounds to form a meaningful whole, and gradually acquire an understanding of singular and plural forms. The correct use of morphemes and their appropriate sequencing within sentences support the systematic learning and generalization of linguistic structures (Robinson, 1982).

Linguistic errors observed in early childhood indicate that children's language-cognitive processes are not yet fully mature and appear in similar ways across children learning different languages. The acquisition of language structures follows a gradual process; for example, the development of negation and interrogative forms exhibits a specific systematic pattern. This systematic acquisition allows researchers to understand how children discover language rules and generate meaning for communicative purposes (Başaran, 2021). Between the ages of 3 and 5, dramatic developments are observed in semantic, phonological, syntactic, and pragmatic domains. While children gain the ability to classify, relate, and apply words and concepts across different contexts, chronic hearing problems or language learning difficulties may negatively affect this process (Menyuk & Brisk, 2005).

Language development also directly supports conceptual learning. Concepts, as mental structures representing the shared and variable characteristics of objects, events, ideas, and phenomena in the environment, play a central role in children's cognitive development. Concepts are defined as units of meaning that are potentially accessible to conscious thought and are shaped through processes of observation, experience, and relational generalization (Akman et al., 2018; Alessandroni & Rodríguez, 2020]. Classified according to concrete and abstract qualities, concepts include concrete concepts based on observable objects and abstract concepts that refer to relationships between objects or to abstract cognitive structures (Smith & Medin, 1981).

Concepts function as cognitive tools that enable the systematic organization of information in the mind and support children's understanding of objects, phenomena, and events in their environment (Gopnik & Wellman, 2012; Şahin et al., 2010). According to Gagné's theory of the conditions of learning, concept learning is a discrimination-based mental process in which learners identify distinguishing features among different stimuli and form consistent classifications based on these distinctions (Gagné, 1965/1992). This approach emphasizes that concepts are mental tools that allow individuals to make sense of information, events, and phenomena by categorizing the relationships among them.

Concept formation begins at birth; children acquire knowledge through innate biological and hereditary characteristics in interaction with sensory experiences

from their environment, develop awareness of objects, and construct conceptual structures (Alessandroni & Rodríguez, 2020; Beyazıt & Ayhan, 2020). Perceptual development, the diversification of experiences, and the expansion of vocabulary directly support concept development. The richness of vocabulary is considered a strong indicator of conceptual development (Arslan, 2008; Coşkun, 2011; Üstün & Akman, 2003).

Concepts acquired in early childhood directly support children's problem-solving skills, creativity, and understanding of cause-effect relationships (Şahin et al., 2010; Yoleri, 2014). Play environments are critical experiential contexts in which children attribute new meanings to objects and situations and learn social rules through both real and imaginary roles. This process facilitates the internalization of concepts and supports children's acquisition of academic concepts during the school years (Fleer, 2011). Research indicates that basic concepts acquired in early childhood are strongly associated with academic achievement in later educational stages (Clements & Sarama, 2011; Liu et al., 2025).

THE IMPORTANCE OF SCIENCE EDUCATION IN EARLY CHILDHOOD

The early childhood period is considered a critical stage in which the foundations of an individual's cognitive, emotional, social, and motor development are established (Phillips & Shonkoff, 2000). This period represents a phase during which neurological development occurs most rapidly, synaptic connections form intensively, and the capacity for learning reaches its maximum level. During this stage, children acquire knowledge through environmental experiences and construct their cognitive structures based on these experiences, in line with Piaget's Cognitive Development Theory (Piaget & Cook, 1952). In this context, science education conducted during early childhood is regarded as a fundamental learning tool that supports children's cognitive structures and develops their problem-solving and critical thinking skills.

Science education allows children to question, examine, and make logical inferences about the relationships between objects, events, and situations in their environment. This process not only facilitates knowledge acquisition but also systematically develops cognitive skills such as logical thinking, classification, and comparison. Vygotsky's Social Development Theory posits that children's cognitive development is supported through social interaction (Vygotsky, 1978). Therefore, teacher guidance and peer interaction emerge as key factors enhancing the effectiveness of science activities. For example, during a simple magnet activity, children do not merely observe whether different materials are attracted to the magnet; they formulate hypotheses, evaluate the results, and make inferences based on their experiences. These experiences lay the foundation for

children's scientific thinking skills and are consistent with Piaget's constructivist approach (Bruner, 1961).

Science activities stimulate children's natural curiosity, turning them into active learners. The Montessori approach emphasizes allowing children to explore at their own pace and interact directly with their environment (Montessori, 1967). From this perspective, experimental science activities provide children with opportunities for inquiry, investigation, and problem solving. For instance, during a water cycle experiment, children observe the processes of evaporation and condensation, analyze cause-and-effect relationships, and reinforce knowledge through their experiences. This process contributes to the active construction of children's cognitive structures and extends learning beyond abstract concepts.

The impact of science education is not limited to cognitive development; it also supports social and emotional growth. During group activities, children learn to share their ideas, listen to others' perspectives, and collaborate. Moreover, experiments that yield unexpected outcomes help children develop resilience, flexibility, and problem-solving skills (Delserieys & Kampeza, 2025). This process demonstrates, within the framework of Vygotsky's "zone of proximal development", that children can advance their abilities with appropriate guidance and interaction.

Science education also provides a multidisciplinary learning environment. Science experiences integrated with mathematics, art, and language activities allow children to develop multiple intelligences and apply knowledge across various contexts (Gardner, 1983). For example, a color-mixing experiment teaches both scientific concepts and artistic creativity while supporting language skills as children describe their observations. In this way, children learn meaningfully by engaging with their environment, rather than merely acquiring knowledge passively (Yalman, 2018).

Active participation in science activities is directly related to experiential learning (Dewey, 1938). Children interact with their environment, base their learning on personal observations, formulate hypotheses, and test outcomes. For example, a child observing plant growth conducts regular measurements, records data, and evaluates changes. This process supports the understanding of cause-and-effect relationships and the development of scientific process skills (Aktaş Arnas et al., 2018).

Finally, science experiences acquired in early childhood lay the foundation for lifelong critical thinking, scientific inquiry, and problem-solving skills. Science education contributes to children's positive attitudes toward learning, builds self-confidence, and enables them to understand their environment consciously.

Therefore, early science education is a strategically important domain for individual development and lifelong learning (Bilgiç & Soslu, 2024; United Nations Children's Fund [UNICEF], 2018).

THE IMPACT OF SCIENCE ACTIVITIES ON LANGUAGE DEVELOPMENT AND CONCEPT LEARNING

In early childhood, children's language development is closely associated with cognitive development and progresses particularly rapidly between the ages of 3 and 6 (Kol, 2011; Surakka et al., 2025). Science activities support language development by providing children with opportunities to observe, understand cause-effect relationships, and express their experiences. During experimentation and observation processes, children are required to describe what they see, explain their predictions, and verbally express the results of experiments. This process enriches children's vocabulary, strengthens their expressive skills, and enables them to use scientific terminology within meaningful contexts (Guo et al., 2016; Méndez et al., 2023). For example, as children become familiar with concepts such as "melting", "sinking", "floating", "change", and "movement", teachers' open-ended questions and rich language modeling encourage them to articulate their thoughts in greater detail (Ömeroğlu & Dere Çiftçi, 2003; Peterson & French, 2008).

Language development is directly related to children's ability to transform the experiences gained through science activities into conceptual understanding. Through science activities, children learn basic concepts through hands-on experiences; concepts such as color mixing, big-small, hot-cold, and heavy-light are concretized through observation and experimentation and cognitively internalized. In this process, children use cognitive skills such as observation, comparison, and classification to explore relationships among concepts and reinforce their ability to explain their own experiences (Kol, 2011). Moreover, the repetitive nature of science activities and their connection to daily life enhance the permanence of concept learning. Children can apply and generalize the concepts they acquire through experience across different contexts (Delserieys & Kampeza, 2025). This holistic process demonstrates that language development and concept learning form a mutually reinforcing structure. Science activities strengthen the foundations of learning in the preschool period by enabling children to both express their thoughts and develop conceptual meanings (Trundle & Sackes, 2021).

THE ROLE OF THE TEACHER AND THE QUALITY OF THE LEARNING ENVIRONMENT

The effectiveness of science education in early childhood is largely associated with the role assumed by the teacher and the quality of the learning environment

that is created. In science education, the teacher emerges as the primary agent who motivates and encourages children, provides guidance, and supports the development of their scientific process skills (Konstantinos, 2017). In this context, teachers' attitudes toward science education directly influence children's learning experiences and the perceptions they develop regarding the field of science. Early childhood teachers' positive attitudes toward science constitute an important factor in determining the quality and continuity of science activities (Maier et al., 2013).

Research indicates that teachers' negative attitudes toward science education may lead to ineffective planning of educational content, limitations in fostering higher-order thinking skills, difficulties in organizing learning environments in accordance with content, and the development of negative attitudes toward science among children (Chen et al., 2025; Mostert, 2018). This situation highlights the critical importance of the teacher's role not only as a transmitter of knowledge but also as a guide who plans, directs, and structures the learning process.

Three core competencies are emphasized as essential for teachers in science education. The first is subject-matter competence. A high level of pedagogical content knowledge in early childhood education and a strong understanding of children's developmental characteristics enable teachers to implement science activities in ways that are appropriate to children's age and developmental level. The second competency involves the effective design of educational content. Teachers are expected to plan instructional content in accordance with the principle of relativity, ensuring alignment with children's interests, needs, and developmental levels. The third competency is the creation of an appropriate learning environment. Teachers who possess adequate subject knowledge and make informed content selections are better able to organize learning environments that are engaging, safe, and supportive of children's freedom of movement (Önal & Sarıbaş, 2019).

Another important role of the teacher is to support children in constructing new concepts based on their existing knowledge and experiences. Presenting new concepts by linking them to children's prior knowledge facilitates conceptual construction and promotes meaningful and lasting learning (Calışandemir & Bayhan, 2011; Dubosarsky, 2011). In this process, teachers should foster scientific thinking skills such as skepticism, observation, testing information, decision-making, and reorganizing acquired knowledge. However, this guidance should be provided without placing pressure on children and should take into account their individual interests and needs (Beatty, 2005).

For an effective learning process in science education, the quality of the learning environment is at least as important as the teacher's role. The

environment in which science activities are conducted should be organized in accordance with children's developmental levels and the content to be presented. The materials used should be attractive to children while also being safe and free of risk (Dağlı, 2014; Konstantinos, 2017). Nevertheless, research shows that teachers experience various challenges in organizing in-class science learning corners, often due to insufficient physical space and a lack of materials (Babaroğlu & Metwalley, 2018; Orhan, 2019).

Science activities do not necessarily require laboratory settings or complex equipment. In early childhood education, science instruction can be implemented effectively using inexpensive, easily accessible, and limited materials (Campbell et al., 2015). At this point, it is important for teachers to benefit from practical examples in the literature and to develop creative solutions. Indeed, the Preschool Education Program places special emphasis on science teaching, and science centers are included among the learning centers recommended for classroom settings (Ministry of National Education [MoNE], 2024).

The inclusion of materials such as geometric shapes, magnets, balances, magnifying glasses, plants, stones, animal visuals, and various natural objects in science centers enables children to explore scientific concepts through concrete experiences (Orhan, 2019). Moreover, science activities are not limited to indoor classroom settings. Out-of-class learning environments — such as nature observations, marketplaces, animal habitats, or public spaces connected to daily life — offer rich learning opportunities for science activities. In planning such activities, it is of great importance for teachers to assume responsibility for safety, organization, and guidance (Buldu, 2020).

CONCLUSION AND RECOMMENDATIONS

Early childhood is a critical developmental stage in which individuals' linguistic and conceptual development progresses most rapidly and the fundamental cognitive structures related to learning are formed. The theoretical findings addressed in this book chapter reveal that the quality of learning experiences provided during early childhood plays a decisive role in children's language development and concept learning. In particular, science activities offer a powerful learning context that supports children's natural curiosity and exploratory tendencies, enabling them to use language actively, verbally express their experiences, and make sense of concepts through concrete experiences.

During science activities, children simultaneously engage in cognitive and linguistic processes such as making observations, formulating predictions, establishing cause–effect relationships, and explaining experimental results. This indicates that science activities are not solely aimed at imparting scientific knowledge; rather, they function as an educational tool that holistically supports

language development and concept learning. Experience-based learning opportunities enrich children's vocabulary while enhancing the permanence of conceptual learning, allowing abstract concepts to be constructed through concrete experiences. This process clearly demonstrates the dynamic and reciprocal relationship between language development and concept learning in early childhood.

The findings indicate that the effectiveness of science activities largely depends on the teacher's guiding role and the quality of the learning environment. The quality of the language used by the teacher, the use of open-ended questions to support children's thinking processes, the structuring of learning experiences by considering children's prior knowledge, and the creation of safe and enriched learning environments strengthen the linguistic and conceptual gains derived from science activities. In this context, the teacher should be positioned not as a transmitter of knowledge, but as a learning partner who guides children's processes of exploration and meaning-making.

Within this framework, several fundamental recommendations emerge regarding the planning and implementation of science activities in early childhood educational settings. Science activities should be structured in ways that are appropriate to children's developmental levels and interests, connected to daily life, and repeatable. It is important for teachers to employ questioning strategies that encourage children to use language actively during science activities and to allow them to construct concepts through experiential learning. In addition, enriching science centers and classroom learning environments with easily accessible and safe materials, as well as making use of out-of-class learning environments, will support children in experiencing science concepts across different contexts.

Including practice-oriented content in teacher education programs that emphasizes the relationship between science activities and language development and concept learning is important for strengthening teachers' subject-matter knowledge and pedagogical competencies. Furthermore, future research that examines the effects of science activities on language and conceptual development in early childhood through longitudinal and experimental designs is expected to make significant contributions to the literature.

In conclusion, science activities in early childhood should be regarded as a strategic educational tool that holistically supports children's language development and concept learning, making learning meaningful and lasting. The planned, deliberate, and high-quality implementation of science education from an early age is of critical importance for strengthening the foundations of children's lifelong learning skills.

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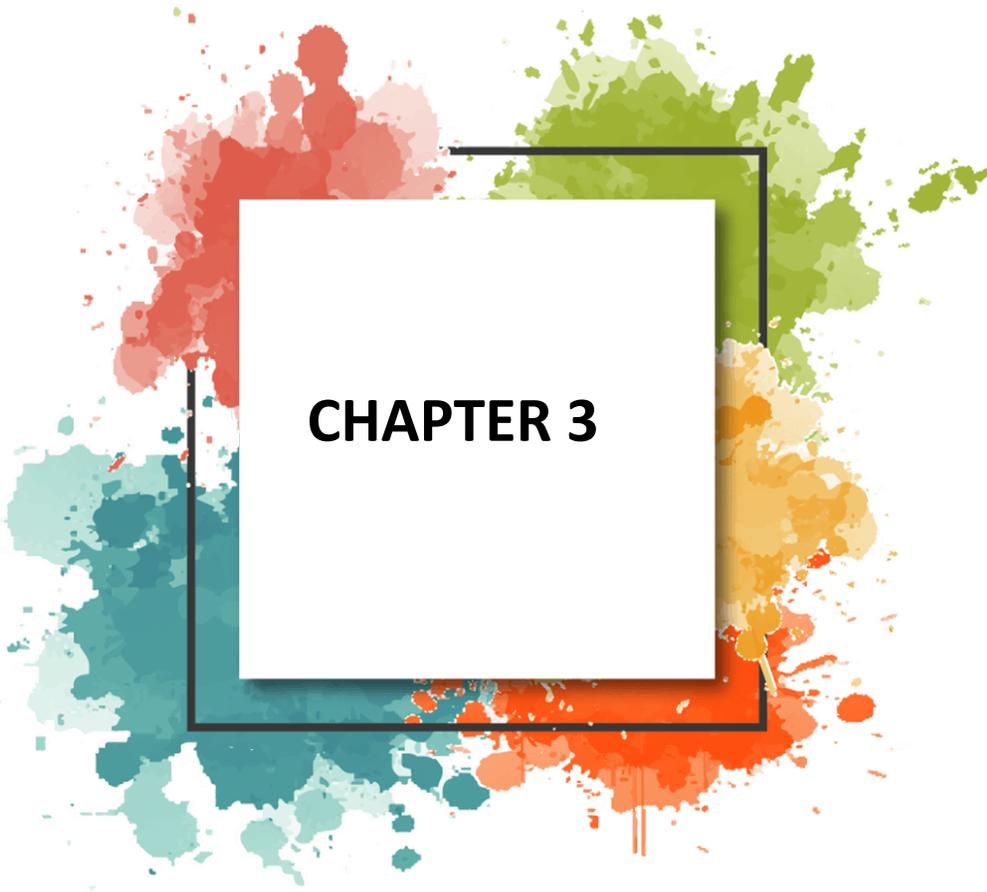
CHAPTER 3

What Does it Mean to be a Citizen Today? A Critical and Integrative Review of Social Studies Education Research in the Age of Artificial Intelligence

Fatih Pala[1]

Introduction

Artificial intelligence (AI)–based technologies have increasingly become a central topic of discussion in the field of education in recent years, promising transformation across multiple dimensions, including instructional processes, assessment practices, content production, and learning analytics (Luckin et al., 2016; Selwyn, 2019). However, this transformation is not limited to the diversification of pedagogical tools. AI also makes visible new forms of power related to the production, circulation, and governance of knowledge, reshaping individuals' participation in public life, decision-making processes, and citizenship practices (Williamson, 2017; Zuboff, 2023). In this context, the role of AI in education should be examined not only in terms of how it is used, but also through its social, ethical, and political implications (Selwyn, 2021).

Social studies education has historically been one of the key fields through which democratic values, conceptions of citizenship, and forms of social participation are taught and cultivated (Hahn, 1998; Parker, 2003). Research on citizenship education has generated a broad body of literature around concepts such as nation-state formation, critical thinking, human rights, digital citizenship, and global responsibility (Banks, 2008; Westheimer & Kahne, 2004). Nevertheless, despite the increasingly central role of AI in educational contexts, there remains a notable lack of integrative and critical reviews within social studies education research that examine how these technologies re-conceptualize citizenship. Much of the existing literature approaches AI primarily through the lenses of pedagogical efficiency, personalized learning, or individual skill development, while the technology's implications for power relations, equity, access, and representation are often treated as secondary concerns (Knox, 2020; Williamson & Eynon, 2020).

This article aims to offer a critical and integrative review of how citizenship is addressed in social studies education research in the age of artificial intelligence. The study analyzes the dominant theoretical frameworks in the

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literature, the narratives through which AI is positioned, and the ways in which certain student groups or social contexts are rendered visible or invisible (Apple, 2012; Ladson-Billings, 2014). In addition, it interrogates how the research methods employed enable particular forms of knowledge production while systematically excluding certain questions or perspectives. In this respect, rather than merely summarizing the existing literature, the article seeks to provide a conceptual framework for rethinking citizenship, technology, and power relations within the field of social studies education.

Theoretical Frameworks of Citizenship

Citizenship has long been approached in educational research not as a singular and static concept, but as a plural construct that is defined in different ways according to historical, political, and cultural contexts. This plurality directly shapes the aims of citizenship education, its pedagogical orientations, and the types of behaviors that are valued within learning environments (Biesta, 2011). With the increasing prevalence of AI-based educational practices, these theoretical differences have become more visible, and the question of which conceptions of citizenship align with particular technologies has emerged as a central concern in the educational literature.

Within the literature, citizenship is most commonly conceptualized through liberal, republican, and critical/transformative approaches. These perspectives offer distinct interpretations of the relationship between the individual and the state, the meaning of participation, and the role of education in cultivating citizens (Isin & Turner, 2007; Westheimer & Kahne, 2004).

Liberal Citizenship

The liberal conception of citizenship is grounded in principles of individual rights, responsibilities, and legal equality. Within this framework, the "good citizen" is defined as an individual who complies with social rules, fulfills personal duties, and participates in a largely passive yet compliant manner within the democratic system. Education, from this perspective, is viewed as a means of equipping individuals with knowledge, enabling rational decision-making, and ensuring their functional integration into the existing social order (Marshall & Bottomore, 1950).

AI-based learning environments demonstrate a high degree of alignment with liberal citizenship. The reduction of student behaviors to measurable indicators, the data-driven monitoring of participation, and the evaluation of performance through standardized criteria reinforce the liberal emphasis on individual responsibility and conformity (Selwyn, 2019). However, this alignment also carries the risk of marginalizing the critical and collective dimensions of citizenship.

Republican Citizenship

The republican approach to citizenship prioritizes the common good, public responsibility, and active participation over individual rights. In this conception, the citizen is not merely a rule-abiding individual, but an active agent in public life. Education is positioned as a space that encourages students to engage in public deliberation, reflect on shared problems, and participate in democratic processes (Oldfield, 1998).

From a republican perspective, artificial intelligence occupies a more ambivalent position. On the one hand, digital platforms and data-driven tools may facilitate participation and support learning processes; on the other hand, the algorithmic structuring of participation risks confining citizenship practices within predefined patterns. Such structuring has the potential to limit the openness and plurality of public deliberation (Williamson, 2017).

Critical and Transformative Citizenship

The critical approach to citizenship does not view citizenship as merely reproducing the existing social order; rather, it conceptualizes it as a practice that questions injustice, renders power relations visible, and seeks social transformation. Within this framework, citizenship encompasses not only participation, but also voice, recognition, and the right to dissent (Biesta, 2011; Isin & Nielsen, 2008).

This perspective is the one that experiences the greatest tension with AI-based educational environments. Algorithmic systems are often built upon normative learner profiles, which may inadequately represent diverse learning practices, cultural experiences, and marginalized voices. For students with learning difficulties in particular, the forms of recognition and participation required by critical citizenship may be constrained by algorithmic criteria (Longworth, 2021; Noble, 2018).

In this sense, critical citizenship does not constitute a rejection of artificial intelligence in education; rather, it offers a normative framework for questioning the values according to which technology should be redesigned. When educational research approaches AI not merely as a pedagogical tool but as a political actor that shapes citizenship practices, it can provide a stronger theoretical foundation for the construction of inclusive and just learning environments.

Tensions Between Artificial Intelligence and Theories of Citizenship

The increasing use of artificial intelligence in educational settings has renewed questions about how citizenship is defined and which forms of citizenship practice are legitimized. The liberal, republican, and critical

approaches to citizenship discussed in the previous section establish varying degrees of alignment and tension with AI-based systems. These tensions are shaped not only by pedagogical choices but also by the data infrastructures, algorithmic assumptions, and governance logics upon which educational technologies are built (Williamson, 2017; Selwyn, 2019).

Liberal Citizenship and Algorithmic Alignment

Dominant narratives in the literature on the use of AI in education demonstrate a strong convergence with liberal conceptions of citizenship. The continuous monitoring of students' individual performance, the evaluation of learning processes through measurable indicators, and the reduction of responsibility to individual achievement reinforce the liberal emphasis on compliance, predictability, and individual competence (Marshall, 1950; Selwyn, 2021).

In this context, AI reconstitutes the "good citizen" as an individual who operates in alignment with the system, is convertible into data, and whose behaviors are predictable. However, this process of reconstitution risks subordinating the public, collective, and critical dimensions of citizenship, reducing citizenship to a set of individual performance metrics.

Republican Citizenship and the Problem of Artificial Participation

The republican approach to citizenship exhibits a more limited and conditional compatibility with artificial intelligence. Digital platforms may enable students to engage in discussion around public issues and to participate in civic processes; however, such participation is often pre-structured, bounded, and algorithmically regulated (Biesta, 2011).

As a result, participation may increase quantitatively while narrowing qualitatively. AI-based systems tend to reduce public deliberation to measurable interactions, thereby excluding key elements of democratic life such as uncertainty, conflict, and negotiation. Under these conditions, citizenship risks being transformed into a technical procedure under the discourse of active participation (Isin, 2008).

Critical Citizenship and Algorithmic Exclusion

Critical and transformative conceptions of citizenship experience the deepest tensions with artificial intelligence. This perspective frames citizenship not as alignment with the existing social order but as a practice of questioning injustice and pursuing social transformation. Algorithmic systems, however, are inherently built upon normative models and therefore tend to code critique, dissent, and difference as forms of "deviation" (Noble, 2018; Benjamin, 2019).

This dynamic becomes particularly pronounced for students with learning difficulties. When algorithmic assessment systems fail to recognize diverse forms of participation and expression, the possibilities for recognition and voice required by critical citizenship are constrained. In this sense, AI may inadvertently narrow the pedagogical spaces that make critical citizenship possible.

Structural Tensions in the Literature

The existing literature indicates that the use of AI in education systematically amplifies certain conceptions of citizenship while marginalizing others. Whereas liberal citizenship aligns naturally with algorithmic systems, republican and critical approaches remain in tension with them. This imbalance makes visible the fact that technology is not neutral; rather, it actively reproduces particular citizenship ideals (Williamson & Eynon, 2020).

The analysis presented in this section demonstrates that AI-based educational practices must be evaluated not only in terms of their pedagogical outcomes but also in relation to the citizenship theories with which they align. The following section will provide an integrative examination of how these tensions are addressed in the literature, which student groups and social contexts are systematically overlooked, and which blind spots continue to shape the field.

Blind Spots, Silences, and Future Directions in the Literature

Although the literature on the use of artificial intelligence in education has expanded rapidly, a significant proportion of this body of work remains concentrated around particular assumptions, methodological preferences, and normative frameworks. As a result, certain student groups, conceptions of citizenship, and pedagogical questions are systematically rendered invisible. This section adopts an integrative perspective to examine the major blind spots, areas of silence, and future research directions emerging from the existing literature.

Visible Students, Invisible Experiences

The majority of studies on AI-supported educational practices are conducted based on "average" or "typical" learner profiles. These studies tend to focus on academic achievement, learning speed, and measurable indicators of participation, while students with learning difficulties, neurodiverse learners, and marginalized groups are positioned at the periphery of analysis (Florian, 2014; Slee, 2018).

This invisibility is not merely a matter of representation; it is fundamentally an epistemological issue. Decisions about which forms of learning count as "data," which behaviors are considered meaningful, and which citizenship practices are deemed measurable directly delimit the scope of research. In this

sense, the AI-in-education literature frequently frames inclusion as a problem of technical accessibility, while sidelining dimensions of citizenship related to recognition, voice, and participation (Selwyn et al., 2020).

The Technicization of Citizenship and the Fading of the Political

Another critical blind spot concerns the growing tendency to reduce citizenship to a technical matter within the literature. In discussions of AI-based systems, citizenship is often defined in terms of individual competencies such as "digital skills," "ethical awareness," or "safe technology use." This framing obscures the historical, political, and collective dimensions of citizenship (Biesta, 2011; Isin, 2008).

Such technicization renders power relations and structural inequalities largely invisible in debates about AI in education. Questions regarding whose values are embedded in algorithmic systems, which citizenship ideals they reproduce, and which groups they systematically exclude remain insufficiently explored in the literature (Benjamin, 2019; Noble, 2018).

Methodological Constraints and Dominant Research Designs

A substantial portion of existing studies relies on quantitative measurements, experimental designs, and impact evaluations. While these approaches are valuable for identifying the effects of AI on specific learning outcomes, they remain limited in their capacity to capture citizenship as a complex, contextual, and relational concept. Qualitative studies, critical discourse analyses, and theoretical inquiries are comparatively underrepresented (Williamson & Eynon, 2020).

This methodological imbalance has led to a literature dominated by the question of "what works," while marginalizing more critical questions such as "what is made possible" and "what is rendered invisible." In the context of review-oriented research, particularly within journals such as Review of Educational Research, this latter set of questions is essential for the theoretical development of the field.

Directions for Future Research

This review demonstrates that the gaps and silences in the literature call for more inclusive and critically oriented research agendas concerning the use of artificial intelligence in education. Future studies should approach AI not merely as a pedagogical innovation, but as a political actor that shapes citizenship practices, forms of participation, and social inequalities.

Research that foregrounds the experiences of students with learning difficulties can offer particularly valuable insights by interrogating the inclusivity

claims of algorithmic systems. In addition, comparative and theoretical studies that explicitly link different citizenship theories to AI design and implementation can deepen the conceptual foundations of the field.

In this regard, the future of AI and education research lies not only in developing more sophisticated algorithms, but in critically examining the values guiding their design, the populations they serve, and the citizenship models with which they are aligned.

Theoretical Contributions, Implications for the Field, and Conclusion

This integrative review departs from dominant strands of the literature that frame AI in education primarily in terms of pedagogical effectiveness or technical innovation. Instead, it seeks to reconceptualize artificial intelligence through the lenses of citizenship theory, inclusivity, and invisibility. The analyses presented throughout the review demonstrate that AI-based educational practices are not neutral tools; rather, they operate as socio-political structures that reinforce certain conceptions of citizenship while systematically excluding particular student groups and forms of participation.

Theoretical Contributions

The first and central theoretical contribution of this review lies in making explicit the relationship between artificial intelligence and citizenship—an association that is often treated implicitly in the literature. The frequently assumed "technology–education alignment" has been reinterpreted through liberal, republican, and critical conceptions of citizenship. This analysis demonstrates that AI aligns most closely with liberal models of citizenship, while generating structural tensions with critical and transformative citizenship practices.

Second, the review reveals that discussions of inclusivity in the AI literature are largely confined to technical accessibility, while political dimensions such as recognition, voice, and citizenship remain underexplored. By reframing inclusivity around the question of who is recognized as a citizen and who is rendered invisible, this study offers a deeper and more critical reading of AI's role in education—particularly in relation to students with learning difficulties.

Implications for the Field

The findings of this review carry significant implications for educational research. First, it is evident that evaluating AI-based educational practices solely through learning outcomes and individual performance indicators is insufficient. Future research must more explicitly address which conceptions of citizenship AI supports, which it constrains, and how these dynamics affect different student populations.

Second, there is a clear need for greater methodological diversity. Alongside quantitative and experimental approaches, theoretical analyses, critical discourse studies, and historical perspectives can play a complementary role in understanding the social and political implications of AI in education. Studies that center the experiences of marginalized student groups, in particular, hold strong potential for reducing areas of invisibility within the literature.

Finally, this review offers important considerations for AI designers, policymakers, and educators. Questions concerning which values are embedded in AI systems, which behaviors are coded as "good citizenship," and which forms of participation are excluded are not merely technical—they are ethical and political. The inclusive use of AI in education requires that these questions be placed at the center of both design and implementation processes.

Conclusion

In conclusion, this integrative review seeks to enrich the literature by examining the role of artificial intelligence in education through the combined lenses of citizenship theory and inclusivity. Moving beyond portrayals of AI as an inevitable agent of educational transformation, the review critically interrogates for whom this transformation occurs, under which conceptions of citizenship, and at what cost.

This interrogation provides not only new research questions for future studies, but also a robust theoretical foundation for the construction of more just, inclusive, and critically oriented learning environments. For educational research to fulfill its democratic and social responsibilities, artificial intelligence must be evaluated not only in terms of what it does, but also in terms of what it makes possible—and what it renders invisible.

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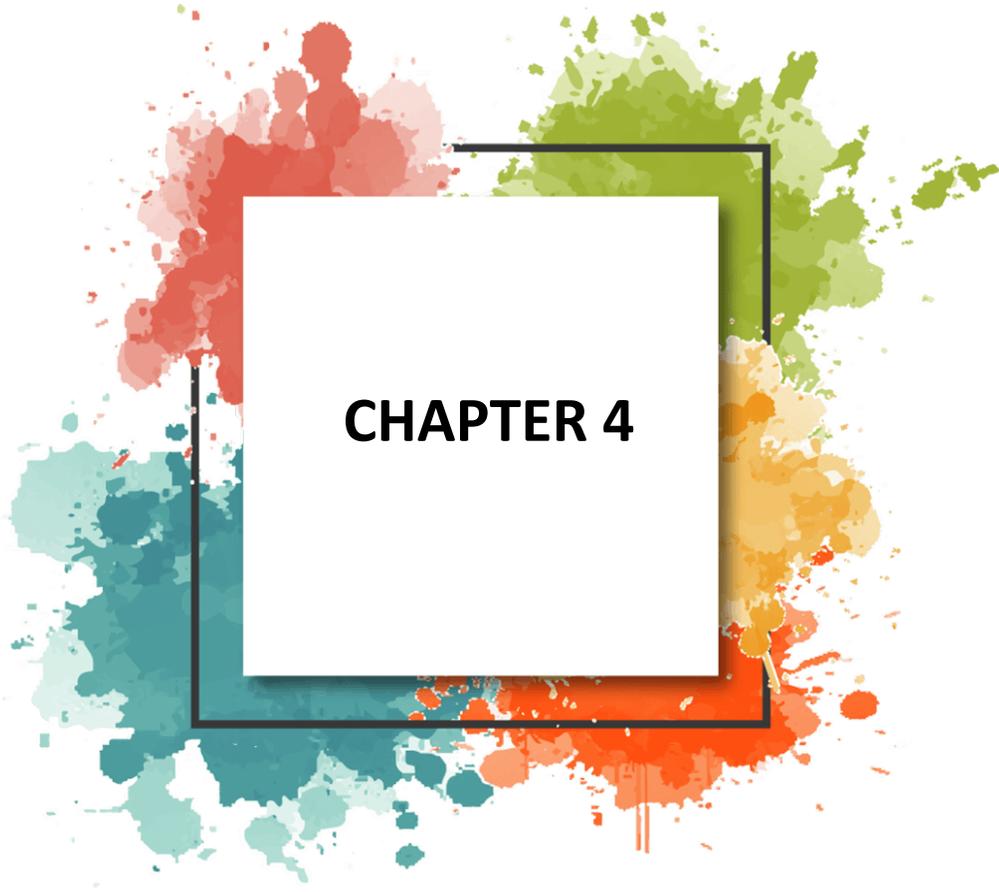
CHAPTER 4

Conceptual Difficulties, Mental Models, and Enriched Learning Environments in Teaching the Sun-Earth-Moon System[*]

Ayşegül Uğraş[1] & Nejla Gültepe[2]

Introduction

The Sun–Earth–Moon system includes celestial phenomena that students frequently observe in everyday life, such as the apparent rising and setting of the Sun, changes in the Moon's appearance, and seasonal variations. Despite this familiarity, it remains one of the most conceptually challenging domains to understand scientifically. This difficulty cannot be explained solely by a lack of information; more fundamentally, it arises from the need to move from visible patterns (the descriptive level) to invisible mechanisms (the explanatory level). In astronomy, students rarely observe the phenomenon itself; instead, they observe its appearance and often treat what they see as a direct indicator of cause. Consequently, a critical epistemic threshold in Sun–Earth–Moon instruction lies in distinguishing observation from inference and in linking observational data to models that explain how the system operates (Driver et al., 1994; Vosniadou & Brewer, 1992, 1994).

This epistemic threshold also helps explain the persistence of alternative explanations in Sun–Earth–Moon learning. Students' statements such as "the seasons are caused by distance," "the phases of the Moon are Earth's shadow," or "the Sun moves" are not random errors; rather, they reflect coherent explanatory structures that appear convincing because they align with everyday experience. New information is often assimilated into these structures without transforming them; even when scientific terminology is introduced, explanations may remain anchored in appearance-based reasoning. For this reason, instruction that emphasizes pattern description alone (e.g., cyclicity) is insufficient. Without explicitly supporting the construction of the mechanisms that generate these patterns, teaching risks leaving students' explanations at a descriptive level and giving the impression that naming a pattern amounts to explaining it.

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The conceptual challenge of the Sun–Earth–Moon system is further intensified by the simultaneous cognitive demands inherent in the topic. Students are expected to reason about cosmic-scale quantities, to relate Earth-based observations to events occurring in space, and to connect multiple cyclical motions (day–month–year) within a single explanatory framework. When quantities such as distance, size, and duration exceed students' everyday reference systems, intuitive plausibility often favors non-scientific explanations. Thus, the challenge is not merely learning concepts, but constructing the relational network that carries these concepts through appropriate representations and justifications.

From this perspective, enriched learning environments are not merely supportive but constitutive of astronomy instruction. Enrichment does not mean presenting visually appealing technological materials; rather, it refers to a pedagogical design space in which students' explanations are made visible, tested against evidence, and reconstructed through representational translation that necessitates mechanism building. Components such as observation records, scaled modeling, multiple representations, and structured discussion or argumentation can support the transformation of intuitive explanatory structures into more relational, model-based explanations (Osborne, Erduran, & Simon, 2004; Paivio, 1991; Toulmin, 1958). Moreover, the sense of wonder inherent in astronomy should be seen not only as a motivational factor, but as a learning resource that sustains students' efforts to construct explanations and to revisit them when evidence challenges an initial account**.**

This chapter integrates discussion of Sun–Earth–Moon instruction along three interconnected axes: 1. students' conceptual difficulties and explanatory patterns, 2. mental models as an analytic lens for understanding these patterns, and 3. design principles for enriched learning environments aimed at transforming explanatory structures. The following section details the cognitive and epistemic demands that challenge learners in the Sun–Earth–Moon context and situates common explanatory patterns within this framework to justify enriched instructional design.

Conceptual Difficulties and Skills in the Sun–Earth–Moon System

The Sun–Earth–Moon system is grounded in phenomena that students continuously observe in everyday life; paradoxically, this visibility often complicates rather than facilitates learning. What students directly experience is usually not the phenomenon itself but its appearance: the illuminated and dark portions of the Moon, the apparent daily motion of the Sun, or its path across the sky. The mechanisms that generate these patterns (illumination geometry, rotational and orbital relations, axial tilt, and alignment conditions) are not directly observable; therefore, instruction must help students build models that

capture the underlying relational structure and link it to what is seen (Driver et al., 1994; Vosniadou & Brewer, 1992).

A critical distinction in instruction lies between observation (what do we see?) and inference or explanation (which mechanism produces this appearance?). When students treat appearance as cause, they rely on intuitively plausible explanatory schemas rather than scientific mechanisms. Many difficulties in Sun–Earth–Moon learning therefore stem not from incorrect facts, but from the topic's requirement that multiple cognitive processes be coordinated simultaneously (Driver et al., 1994; Vosniadou & Brewer, 1992).

Accordingly, the skills discussed below should not be understood as isolated sub-skills, but as simultaneous demands that collectively support the transition from description to explanation.

Simultaneous Cognitive Demands in Sun–Earth–Moon Instruction

What makes Sun–Earth–Moon instruction challenging is rarely a single concept; rather, it is the need to operate multiple forms of reasoning within a single explanation. Abstract reasoning requires linking visible phenomena to invisible mechanisms; scaling involves constructing meaningful comparisons among size, distance, and time; perspective coordination entails relating Earth-based observations to space-based configurations; and spatial–temporal reasoning demands organizing cyclical motions and simultaneous movements at the level of mechanism. When any of these demands remains underdeveloped, students may incorporate new information into existing intuitive schemas, producing explanations that sound scientific but remain relationally fragmented (Vosniadou & Brewer, 1992, 1994).

Abstract reasoning: from visible patterns to invisible mechanisms

In astronomy, students cannot directly experience most mechanisms; they must explain observations by coordinating representations. For example, lunar phases are visible changes in the Moon's appearance, but they are produced by changes in the portion of the Moon's sunlit half that is visible from Earth. Similarly, the Sun's apparent daily motion invites the idea that "the Sun moves," whereas the scientific account depends on Earth's rotation (Driver et al., 1994; Vosniadou & Brewer, 1992).

Thus, instructional models should not aim to depict the phenomenon's appearance, but to make the relational structure that produces that appearance explicit. A lunar phase model, for instance, is evaluated not by shape resemblance but by its capacity to represent the relations among light source, illuminated surface, and viewing angle.

Scaling: preventing numbers from becoming labels

In the Sun–Earth–Moon system, distances, sizes, and durations exceed everyday reference frames. Without meaningful comparison, numerical values become labels rather than explanatory tools. Students may rely on vague descriptors such as "very large" or "very far," which fail to support spatial organization. As a result, explanations of eclipses, phases, and seasons remain fragmented. Scaling should therefore emphasize relational comparison rather than numerical transmission. Explanatory power lies not in "how much," but in "how many times larger relative to what."

Numbers are not excluded from instruction; rather, their meaning emerges only within a comparative framework. Otherwise, numerical information may increase cognitive load and push students toward intuitive shortcuts. Accordingly, the next section treats scaled modeling not as the construction of accurate replicas, but as a design principle for establishing meaningful comparisons (Paivio, 1991).

Perspective coordination: navigating between two planes

Astronomical phenomena are experienced across two planes: the observer's perspective on Earth and the system perspective in space. To explain lunar phases, students must coordinate the changing appearance observed from Earth with the illumination geometry operating in space. Without support for this coordination, explanations remain appearance-based (Vosniadou & Brewer, 1992, 1994). The key factor is not the number of representations used, but whether translation between representations is required. Short dual-drawing tasks (e.g., depicting the same configuration from two observer positions and specifying what changes and what remains invariant) provide a rapid diagnostic of students' perspective coordination.

Spatial–temporal reasoning: organizing simultaneous cycles

The Sun–Earth–Moon system consists of interrelated cycles: Earth's rotation, Earth's revolution, the Moon's revolution, and synchronous motion. Students must understand these not as isolated durations, but as spatially organized motion systems. The persistence of the same lunar face, for example, requires coordinating rotation and revolution simultaneously (Vosniadou & Brewer, 1994). Brief spatial rotation tasks, inserted before or after embodied modeling activities, can help prevent experiential activities from remaining episodic and instead support representational abstraction. Understanding becomes durable not when students recognize cycles, but when they can explain which motions produce which appearances.

Common Alternative Explanations and Thematic Patterns

In the Sun–Earth–Moon context, students' alternative explanations tend to emerge not as isolated "errors," but as explanatory patterns organized around recurring themes. These patterns reveal which variables students select when explaining appearances, which variables they omit, and which representational levels (e.g., visual appearance, verbal description, two-dimensional diagrams) they rely on excessively. From an instructional perspective, the central concern is therefore not the error itself, but identifying where and how the explanatory logic becomes constrained (Driver et al., 1994; Duit & Treagust, 2003).

a. *Treating visible motion as cause (the Sun's rising and setting and its path across the sky)*

For many students, the expression "the Sun rises and sets" functions not only as a description but also as an explanation. When the visible pattern (the Sun's apparent movement) replaces mechanism, constructing Earth's rotation at the system level becomes difficult. This pattern reflects a common equation in astronomy learning: what is seen equals what happens. The difficulty lies in the inability to coordinate Earth-based appearance with space-based motion within a single explanation**.** Statements such as "If the North Star does not move, Earth cannot be rotating" similarly indicate difficulty in organizing reference points and perspectives within a model.

b. *Single-variable causality (explaining seasons solely by distance)*

Explaining seasons through Earth–Sun distance reflects a tendency to reduce causality to a single, intuitively powerful variable. Seasonal change, however, requires coordinating relational variables such as solar angle and duration of illumination. Everyday inferences like "farther means colder" become misleading shortcuts at the cosmic scale. Explanations such as "Earth's orbit is very elliptical, so seasons occur" illustrate how students may use scientific terminology while still constructing the model around an incorrect component. Although the explanation appears scientific, the underlying mechanism remains relationally incomplete.

c. *Substituting illumination with shadow (explaining lunar phases through Earth's shadow)*

Explaining lunar phases as Earth's shadow reflects an attempt to account for changing appearance through a single mechanism rather than constructing illumination geometry. Knowledge of cyclicity ("it happens every month") may support a shadow-based explanation, since appearance-level changes already suggest darkening. Once this schema is established, students struggle to recognize why the light source–illuminated surface–viewing angle relationship is

necessary; appearance-based explanations such as "something is covering it" may become integrated into hybrid models expressed in scientific language (Harrison & Treagust, 2000; Vosniadou & Brewer, 1994). At this point, illumination geometry can be made visible through simple ray diagrams, angle measurements, and line-of-sight sketches, helping students relate perceived shape to lighting direction and illuminated surface (Kontra et al., 2015). A similar appearance–mechanism shortcut appears when students interpret the Sun and Moon as having similar actual sizes because they appear similar in the sky. This can be addressed through a brief apparent-size task: students align a small disk held at arm's length with a larger disk placed farther away and then answer two prompts (Observation: What did I see? Inference: Which relationship produced this appearance—distance or size?). This makes explicit that appearance alone is not an explanation of mechanism.

d. Difficulty integrating simultaneous cycles (rotation–revolution–synchrony)

Statements such as "the Moon does not rotate; it always shows the same face" often reflect difficulty integrating rotation and revolution within a single spatial–temporal structure**.** The label "revolution" may be known, yet students cannot model how simultaneous rotation and revolution yield a constant appearance. Here, duration information is memorized while the mechanism producing the appearance remains unconstructed. This pattern reflects difficulty coordinating multiple motions within one explanatory chain and reliance on intuitive shortcuts.

e. Reducing eclipses to "darkening events" (confusing eclipses and phases)

Explaining eclipses through night, clouds, or generalized darkening—and conflating eclipse and phase mechanisms—indicates difficulty coordinating alignment conditions, shadow geometry, and scale relations. Eclipse conditions become explainable when alignment and shadow cones are represented geometrically. Scale plays a critical role: from the knowledge that full Moon occurs monthly, students may infer that eclipses should also occur monthly, since orbital inclination is often invisible in two-dimensional diagrams. This pattern foregrounds a central instructional question: *Which features does a model make visible, and which does it obscure?*

Across these thematic patterns, a common feature emerges: students rely on intuitively convincing schemas to explain appearance. Conceptual change begins not by labeling these schemas as wrong, but by making their underlying assumptions visible and testing them within evidence–model relations. For this reason, the following section examines why these patterns remain persistent at a more structural level.

Why Do These Difficulties Persist?

These alternative explanations may persist even after instruction because students' explanations function as coherent meaning structures that align with everyday experience. Moreover, the Sun–Earth–Moon system requires the simultaneous coordination of scale, perspective, and spatial–temporal reasoning; mastering a single component does not suffice to reconstruct the entire system at the level of mechanism. Students may use correct terminology, yet if the relations carried by these terms are not integrated, explanations remain appearance-based.

One factor sustaining persistence is the high simultaneity demanded by the explanatory structure. When constructing explanations, students must concurrently reason about large-scale quantities, coordinate Earth-based and space-based perspectives, integrate multiple cycles, and translate across representations. As these demands increase, students often select the most cognitively economical route: jumping directly from appearance to cause, memorizing symbolic diagrams, or using cyclicity as a substitute for mechanism. In such cases, explanation becomes automated response rather than model construction. Cognitive effort shifts toward rapid intuitive processing, while reflective control and contradiction checking recede. These concurrent demands place heavy pressure on proportional reasoning and hypothetical–deductive thinking, thereby magnifying individual differences within the same grade level, most notably in early middle school, where instructional support for simultaneity is often limited.

A second factor reinforcing persistence lies in everyday language. Expressions such as "the Moon darkened" or "the Sun rose" easily substitute descriptive language for explanatory language, reinforcing appearance-as-cause reasoning. Instructional goals are not to eliminate such expressions, but to surface the linguistic schemas shaping students' interpretations and to highlight what distinguishes scientific explanation: testing visible patterns through evidence–model–explanation relations (Driver et al., 1994; Duit & Treagust, 2003). Historically, appearance-based explanations of celestial motion were long sustained because they aligned with naked-eye observation. Brief historical contrasts can support students in reorganizing their explanations through evidence and models, while affective resources such as curiosity and wonder help sustain explanatory effort (Pintrich, 2003).

Mental Models: A Theoretical Lens for Enriched Sun–Earth–Moon Instruction

The Sun–Earth–Moon system appears closely aligned with students' everyday observational language, yet remains distant from scientific explanatory language. Students often organize what they observe into meaningful structures; however,

these structures may not coherently integrate key variables (e.g., the light source, illumination geometry, motion relations, perspective coordination, and scale) into a single explanation. Thus, the instructional challenge lies not only in identifying incorrect concepts, but in understanding the internal representational structures through which students explain phenomena.

In this chapter, mental models are treated less as a theoretical lens for making visible why students' explanations are often functional yet scientifically limited, and for examining how enriched learning environments can support transformation toward more relational and mechanism-based explanations (Harrison & Treagust, 2000; Johnson-Laird, 1983; Vosniadou & Brewer, 1992, 1994).

What is a mental model and why is it critical in astronomy?

A mental model is the relational structure of representations that individuals construct to explain and predict phenomena; it determines which variables are considered salient and how causal links are established among them. Students' responses to "why does this happen?" often reflect not observational data itself, but the explanatory schema used to interpret that data. Mental models therefore reveal not only what students know, but how they organize and deploy knowledge (Duit & Treagust, 2003; Vosniadou & Brewer, 1994).

In the Sun–Earth–Moon context, mental models are particularly consequential because explanations depend on representing unobservable mechanisms. When representations are insufficient or students fixate on a single representational form, explanations remain at the level of appearance. In astronomy, "knowing" often means naming what is seen; scientific understanding, however, lies in constructing the mechanism that produces what is seen. The mental model perspective thus frames the observation–inference distinction not merely as a skill, but as an epistemic orientation shaping explanation.

Mental model patterns in the Sun–Earth–Moon context: initial, hybrid, and near-scientific explanations

Students' explanations of Sun–Earth–Moon phenomena typically fall into three broad patterns: initial explanations, intermediate or hybrid explanations, and explanations approaching the scientific model (Harrison & Treagust, 2000; Vosniadou & Brewer, 1992, 1994).

- Initial explanations replace mechanism with appearance; system-level variables are absent or invoked superficially.

- Hybrid explanations incorporate scientific terminology without organizing it relationally; older schemas absorb new language,

producing explanations that sound scientific yet remain mechanistically incomplete.

- Near-scientific explanations connect observation to system-level mechanisms, seek representational coherence, and remain open to justification.

These categories are not labels, but analytic tools that help teachers identify students' explanatory positions and select appropriate interventions.

Model transformation in enriched learning environments

Mental models are often resistant because they align with everyday experience and function as workable explanations. When instruction merely adds information, students may generate richer-looking but still non-scientific hybrid explanations (Duit & Treagust, 2003; Vosniadou & Brewer, 1992, 1994). Enriched learning environments support transformation through three complementary mechanisms:

- ***Externalization (visibility):*** making students' thinking visible through drawings, models, enactments, discussion, and writing.

- ***Justification (evidence-model-explanation):*** Requiring students to separate what is observed from what is inferred, and to build mechanism-based explanations by grounding claims in evidence and models.

- ***Representational diversity (two planes):*** prompting students to move back and forth between Earth-based appearances and space-based configurations, so that perspective coordination becomes part of the explanation rather than an add-on.

Through these mechanisms, enrichment functions not as diversification, but as a pedagogical means of aligning students' mental models with scientific explanatory structures (Driver et al., 1994; Duit & Treagust, 2003; Gilbert & Justi, 2016).

Enriched Learning Environments: Components and Design Principles

In Sun–Earth–Moon instruction, enrichment is not an add-on of more activities but a design logic that determines which experiences address which conceptual difficulties through which mechanisms. In this view, enriched instruction should therefore be understood as a coherent design structure that targets students' recurrent alternative explanatory patterns and guides them toward more consistent reasoning by connecting evidence, models, and explanations**.** The effectiveness of this structure depends less on the presence of individual components than on how these components are sequenced and

mutually referenced, compelling students to think about the same phenomenon across different representational planes (Driver et al., 1994; Duit & Treagust, 2003; Gilbert & Justi, 2016). In the following subsections, each component is accompanied by classroom-applicable "micro-tasks" that can be implemented within 5–10 minutes (e.g., scale comparisons, dual-perspective drawings, spatial rotation stations), making the underlying design principles operational for teachers. The aim of this section is to make this design logic visible in classroom-ready terms.

First component: Observation experiences that transform observation into evidence

The first component consists of observation experiences that foreground the distinction between the phenomenon itself and its appearance. Direct sky observation (or instrument-supported observation under safe conditions) provides an initial context for challenging students' automated intuitive schemas. However, transformation occurs only when observation is structured as data. When observations are systematically recorded in terms of time, direction, and appearance, classroom discussion shifts from "what did we see?" to "which data support which explanation?" Observation thus becomes not merely motivational, but a source of evidence that sustains explanation building. Accordingly, observation tasks should be designed not as passive viewing, but as brief recording and comparison activities.

Second component: Scaled modeling experiences that establish scale as ratio

The second component involves scaled modeling experiences that support ratio-based rather than intuition-based reasoning about scale and geometry. In the Sun–Earth–Moon system, when size–distance relations are not meaningfully established, explanations of phases, eclipses, and seasons easily become fragmented. Scaled models should therefore be viewed not as secondary visualization tools, but as thinking instruments that externalize ratios and make them discussable. Explanatory language is carried less by numbers themselves than by comparisons. Stating the Earth–Moon distance as 384,400 km provides information, but recognizing that this distance corresponds to roughly 30 Earth diameters disrupts the intuition that the Moon is "very close" and enables reasoning about alignment and illumination geometry.

Practical classroom implementation may involve everyday objects to construct scaled analogies. For example, representing Earth with a 65 cm exercise ball and the Moon with a peppercorn (approximately 0.6 cm) establishes a crude but functional ratio that recalibrates proximity intuitions. Objects such as tennis balls, soccer balls, and basketballs can similarly function as a "comparison

ladder" that helps students differentiate close values. The goal is not producing an accurate model, but supporting an explanatory ratio language.

The instructional value of scaled modeling depends not on realism, but on which feature the model is designed to explain. For instance, maintaining both size and distance scales simultaneously is often impossible when modeling eclipses. If model limitations are not made explicit, students may attribute distortions to reality rather than to the model. Accordingly, scaled modeling should routinely foreground the question, "What does this model show, and what does it not show?", not to perfect the model, but to help students compare explanations and evaluate model limits.

The same principle applies to large quantities and similar durations. The astronomical unit (AU), for example, becomes meaningful only when used comparatively rather than as isolated information. Likewise, the difference between the Moon's sidereal period (~27.3 days) and synodic period (~29.5 days) illustrates how small numerical differences can be collapsed into "the same thing" without relational reasoning. Thus, instruction should emphasize what quantities are referenced to and which appearances they generate. At the fifth-grade level, such discussions can be conducted through simple "comparison–justification" pairs (prediction plus one-sentence explanation).

Third component: Embodied modeling and enactment of simultaneity

The third component involves embodied modeling and enactment activities that allow students to experience simultaneous motion and perspective coordination rather than merely hear about them. These activities enable students to organize spatial–temporal patterns through bodily engagement, while subsequent justification tasks make their reasoning visible. The critical design decision is not to leave enactment at the level of play, but to connect it to externalization (drawing, brief explanation, comparison), thereby transforming experience into conceptual expression.

Fourth component: Multiple representations that require representational translation

The fourth component emphasizes multiple representations that require students to actively translate between representational levels. Drawings, physical models, animations, and three-dimensional visuals are insufficient in isolation; what matters is whether students are required to answer questions such as "What changed?", "What remained the same?", and "Which feature does this representation make visible?" Enrichment thus involves designing short tasks that press students to rebuild an explanation as the representation changes. For example, in lunar phase instruction, students may first infer phases from an animation, then draw the corresponding Sun–Earth–Moon configuration, and

finally justify the phase in two sentences. This sequence quickly reveals whether appearance has been connected to mechanism.

Fifth component: Classroom discourse that shifts from correctness to justification

The final component sustaining this design is classroom discourse that evaluates explanations based on warrants rather than correctness. Brief argumentation tasks, counterexample questions, and requests for justification (e.g., "Why does an eclipse not occur at every full Moon?") move explanations toward the level of mechanism and provide teachers with diagnostic insight into conceptual links (Mercer, 2000; Vygotsky, 1978). Curiosity and wonder function here as affective resources that sustain explanatory effort (Pintrich, 2003). The teacher's role shifts from confirming correct answers to organizing discourse that continuously interrogates evidence–explanation alignment.

The impact of these components emerges only when teachers explicitly articulate which conceptual rupture an activity targets and which type of evidence students are expected to produce. Accordingly, the following guiding questions can serve as the backbone of instructional decision-making:

1. What data does the student generate in this activity, and which explanation will that data test?

2. Which variables does this model preserve, which does it intentionally distort, and are these limits discussed?

3. Is embodied experience always linked to a product that shifts from "what happened?" to "why did it happen?"

4. Are students merely observing representations, or are they required to reconstruct explanations as representations change?

5. Is classroom discourse organized around "who is correct?" or around "which explanation aligns with which evidence?"

Assessment, therefore, should not only track conceptual accuracy, but also make visible how students use evidence, articulate model limitations, and justify explanations. Enrichment in Sun–Earth–Moon instruction thus constitutes not a collection of activities, but a coherent design that transforms observation into evidence, establishes scale through ratio, supports perspective coordination through experience, and compels representational translation. The following section structures this design logic through explicit mappings between explanatory patterns and instructional interventions.

Mapping Conceptual Difficulties, Explanatory Patterns, and Enriched Interventions

In Sun–Earth–Moon instruction, conceptual difficulties arise less from isolated incorrect facts than from the explanatory structures students construct when interpreting appearances. Explaining lunar phases through shadow, reducing seasons to distance, or conflating eclipses with phases reveal which variables students prioritize, which they omit, and which representational levels they over-rely on (Baxter, 1989; Sadler, 1998; Trundle et al., 2002; Vosniadou & Brewer, 1992, 1994). The mapping approach adopted here therefore treats error not as an outcome, but as an expression of explanatory logic.

Rather than focusing on what students do not know, this approach foregrounds the cognitive–epistemic demands that must be coordinated simultaneously. Explanations in the Sun–Earth–Moon system require reasoning about scale, spatial relations, simultaneous motion, and representational translation. When these demands remain implicit, students tend to collapse explanations into single-variable shortcuts. Enrichment thus functions not by expanding content, but by managing explanatory load through design.

Instruction targets the assumptions underlying students' explanations, tests those assumptions against evidence, and supports reconstruction through representational translation**.** The same apparent error may arise from different sources: scale reasoning, perspective coordination, or difficulty integrating simultaneous cycles. Instructional decisions must therefore be responsive to where explanatory breakdowns occur (Driver et al., 1994; Duit & Treagust, 2003). Research on learning progressions in astronomy further indicates that perspective coordination develops gradually, particularly in spatially grounded explanations (Plummer, 2009; Plummer & Maynard, 2014).

Accordingly, enriched interventions serve three complementary functions: strengthening evidence generation, enforcing representational translation, and centering justification and contradiction. Regular observation records and brief comparison tasks stabilize appearance as data; translation tasks reveal which information is preserved across representations; and contradiction prompts shift discourse from correctness to explanatory warrant (Mercer, 2000; Ainsworth, 2006; Schnotz & Bannert, 2003).

The instructional value of this mapping lies in reorganizing planning around explanatory patterns rather than topic sequence. Although phases, eclipses, and seasons may be taught separately, design becomes more productive when each topic repeatedly engages the same core questions: Which mechanism is being used? Which variables are coordinated? Which representational level constrains explanation? Which evidence can test it? Table 1 illustrates this logic by mapping

frequent fifth-grade explanatory patterns to micro-interventions that generate evidence, support modeling, require translation, and demand justification. The purpose of the table is not to prescribe activities, but to make the underlying decision logic visible for teachers.

Table 1

Mapping Explanatory Patterns and Enriched Interventions in Grade 5 Sun–Earth–Moon Instruction

Common explanatory pattern (student statement)	Underlying difficulty / "breakdown"	Evidence-generation task (observation–record–compare)	Model/representation task (build–show)	Translation task (product transformation)	Justification / conflict question
"The Sun moves; it rises and sets."	Treating appearance as cause; mixing observation and inference	Where did you see the Sun today? (one-line record: time–direction–position)	Simple Earth-rotation demonstration (student = Earth; flashlight = Sun)	Write two sentences: (1) What did I observe? (2) What mechanism makes it look that way?	If Earth did not rotate, would the Sun's position change during the day? Why?
"The Moon's phases are Earth's shadow."	Illumination geometry not constructed; overgeneralized "shadow" schema	Which side is lit? mini-task (ball + light; 30-second observation)	Physical model emphasizing "half of the ball is always illuminated" (light–Moon)	Draw the Sun–Moon–observer configuration and mark the lit half.	If phases were Earth's shadow, why wouldn't we have an eclipse every month? (one reason)
"If there is a full Moon, there should be an eclipse." / "Eclipse = darkening."	Alignment condition invisible; no conditional reasoning about orbital tilt	Do we get an eclipse at every full Moon? (compare two lunar-calendar months)	Simple alignment model (string/straight-line drawing for 'alignment')	Complete the sentence: "For an eclipse to occur, … must happen."	Why isn't there an eclipse at every full Moon? (one condition + one reason)

"The Moon does not rotate; it always shows the same face."	Failure to coordinate simultaneous cycles (rotation + revolution)	Role-play record: in Earth–Moon roles, "Which face do I see?"	Simultaneous rotation–revolution enactment (one turn–one orbit)	After the enactment, sketch arrows for rotation and revolution on a simple diagram.	If the Moon did not rotate, would we still see the same face? Why?
"The Sun is very close." / "The Moon looks huge."	Scale/ratio not constructed; apparent size treated as real size	Near-small vs far-large comparison (apparent-size activity with two objects)	Scale prompt set: "If Earth = 1 cm, how many mm is the Moon?"	Explain in 1–2 sentences why two objects can look similar in size.	Why do the Sun and Moon look similar in size? (observation + mechanism)
"I'm only describing what I see from Earth." (single-perspective fixation)	Cannot coordinate observer plane (appearance) with system plane (space-based relations)	Describe the same event from two locations (Earth-based / space-based; 2 short sentences)	Dual-representation cards: "Earth observer / space observer"	Make two quick drawings (Earth view and space view) and list: what changed / what stayed the same.	Which account is appearance and which is mechanism? What evidence supports your claim?

Note. -asks listed under "evidence generation" may involve observation records, brief comparisons, or mini experiments. The goal is not to collect notes, but to generate small pieces of evidence that make students' explanations visible. (rows = explanatory patterns; columns = instructional decisions)

Table 1 is not intended to provide teachers with a ready-made list of activities. Rather, it illustrates how to select from a repertoire of short tasks that make the *same explanatory pattern* visible through different products. Each row represents not a single activity suggestion, but a set of small evidence-generation tasks that teachers can activate depending on where students' explanations break down.

For example, instruction may begin with a brief task that surfaces the explanatory pattern, followed by a model or representation that carries the explanation, then a translation of that representation into another product (drawing, diagram, short text), and finally a single contradiction question that elicits justification. This sequence supports teachers in making reasoned decisions about subsequent instructional moves: what evidence to collect, which representational transition to require, and which counter-question to pose.

The following section demonstrates how this repertoire can be organized into a recurring classroom cycle, showing how the steps diagnose, test, reconstruct, and justify can be sequenced within an example instructional routine. The aim is not to treat Table 1 as a scattered task list, but to operationalize it as a short, repeatable classroom routine embedded within everyday lessons.

Translating Enriched Sun–Earth–Moon Instruction into Classroom Practice: Implementation and Assessment

When assessment is embedded within instructional design, the logic of enrichment is fully realized. Systems based on small, frequent student productions enable teachers to monitor students' explanatory reasoning in real time and to adapt instruction responsively (Black & Wiliam, 1998; Heritage, 2010). In astronomy, where learning hinges on connecting visible phenomena with invisible mechanisms, assessment must do more than classify responses as correct or incorrect. It should make visible the evidence on which explanations rest, the representations through which they are constructed, and students' awareness of model limitations (Ruiz-Primo & Shavelson, 1996). Accordingly, assessment tasks are positioned not as end-of-unit checks, but as continuous sources of instructional guidance.

Within this approach, assessment unfolds through a recurring instructional cycle applied across topics: students first produce a brief diagnostic artifact; their ideas are then tested against evidence; explanations are revised through representational translation; and claims are finally defended with warrants. The diagnostic phase uses brief tasks to probe whether students can distinguish descriptive statements from explanatory claims. For instance, asking whether "the Sun is setting" represents an observation or an inference (and why) reveals whether students separate what is seen from the mechanism that produces the appearance. Similarly, the prompt "Why do the Sun and the Moon appear to be

similar in size?" surfaces whether students differentiate apparent size from the distance–size relationship through which this appearance is generated. These tasks prioritize the structure of explanation over answer correctness.

The second phase, testing through evidence, is designed to surface breakdowns in scale- and ratio-based reasoning. At the fifth-grade level, scale is more productively assessed through comparative reasoning than through extended calculations. Tasks therefore elicit a prediction, require a minimal operation, and conclude with a justification. For example, "If one sheet represents the Earth–Moon distance, approximately how many sheets would represent the Earth–Sun distance?" assesses proportional reasoning rather than recall. Likewise, in multiple-choice tasks (such as selecting an appropriate measuring container to represent the Sun's volume relative to Earth students) are required to justify their selections, shifting assessment from recognition to explanation.

The reconstruction phase prevents students from becoming fixed at a single representational level by requiring translation between representations. Tasks such as "Draw the Sun–Earth–Moon positions for a given lunar phase and explain why this phase is observed" assess whether students can construct illumination geometry rather than merely label phases. Perspective coordination is similarly assessed through paired representations (for example, asking how the Moon appears to an observer on Earth and how Earth appears to an observer on the Moon) followed by a brief comparison. These tasks make students' ability to move coherently between observer and system perspectives immediately visible.

In the justification phase, explanations must be defended at the level of mechanism. Contradiction prompts such as "Why does an eclipse not occur at every full Moon?" compel students to integrate alignment conditions and orbital inclination rather than rely on appearance-based reasoning. For some students, explanatory breakdowns originate not in astronomy content but in spatial operations such as perspective shifting or mental rotation. Accordingly, brief spatial tasks (e.g., interpreting different observers' views of a cube) may be used diagnostically to probe representational prerequisites. In all cases, students are asked to justify their responses, ensuring that underlying reasoning is made explicit.

Structured in this way, assessment functions not as a separate testing component but as an integral part of instruction that continually surfaces students' explanatory reasoning in terms of evidence, models, representations, and warrants. Alternative explanations are treated not as errors to be eliminated, but as productive forms of reasoning to be transformed toward more scientific explanatory structures (White & Gunstone, 1992). Assessment thus becomes a continuous learning component that supports and documents change in students' explanatory frameworks.

Conclusion

Difficulties in learning the Sun–Earth–Moon system cannot be adequately explained by incorrect knowledge alone. The framework developed in this chapter shows that many challenges arise from the need to coordinate multiple cognitive and epistemic demands simultaneously: distinguishing observation from inference, reasoning about scale, coordinating perspectives, and integrating spatial–temporal relationships. In this sense, difficulty stems less from not knowing and more from being unable to coherently integrate multiple relations within a single explanatory structure and to carry these relations consistently across representations.

The approach proposed here reconceptualizes Sun–Earth–Moon instruction as neither content transmission nor activity accumulation. Instead, it advances a design logic centered on students' explanatory structures—making these structures visible, testing them against evidence, and supporting their transformation toward more scientific forms of explanation. Mental models are positioned as an analytic lens for understanding students' reasoning and for justifying instructional decisions. This lens enables teachers to address the question "Where is the student struggling?" at the level of underlying mechanisms rather than at the level of surface responses.

A central conclusion of this chapter is that enriched learning environments become transformative only when guided by explicit design principles. Accordingly, the chapter advances a three-plane conceptualization of Sun–Earth–Moon instruction. At the conceptual plane, phenomena such as lunar phases, eclipses, and seasons must be explained through coherent scientific mechanisms. At the cognitive–epistemic plane, students must operate the observation–inference distinction, coordinate scale and perspective, and construct evidence-based justifications. At the pedagogical–design plane, instruction is organized around students' explanatory patterns rather than topic sequences. Addressing these planes together moves instruction beyond fragmented practices toward a coherent instructional architecture grounded in evidence generation, representation translation, and justification.

From a practitioner perspective, this chapter intentionally avoids offering a fixed set of activities. Instead, it provides a design repertoire and decision-making logic that teachers can adapt to their contexts, enabling differentiation based on students' explanatory breakdowns. For researchers, the framework supports investigations of enriched learning environments that focus not only on achievement outcomes but also on changes in explanatory structure across representations.

In sum, teaching the Sun–Earth–Moon system should be understood as an effort to bridge the gap between visible phenomena and invisible mechanisms by centering students' ways of constructing explanations and by designing enriched learning environments accordingly. The core claim advanced here is that effective instruction in cognitively demanding domains depends less on teaching correct answers than on building the reasoning structures required to construct correct explanations. When these structures are in place, both the durability of conceptual understanding and the development of scientific ways of thinking are placed on firmer ground.

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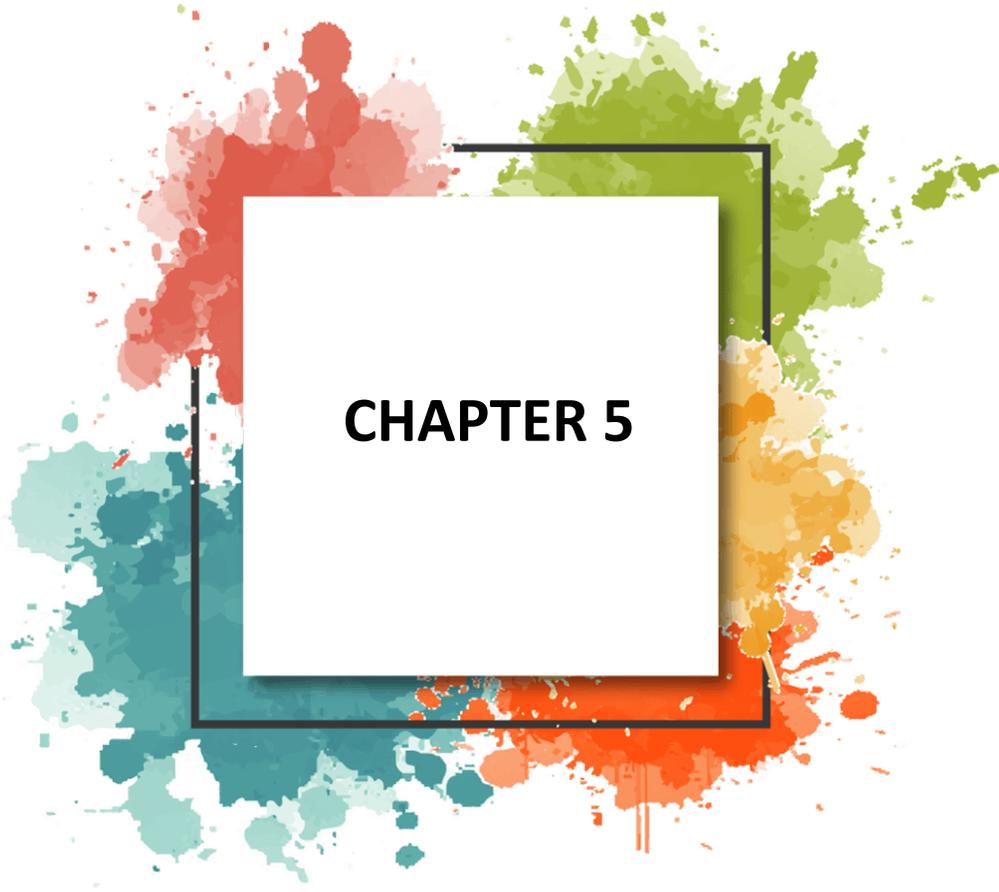
CHAPTER 5

Middle School Students' Perspectives on Historical Consciousness in Social Studies Education

Birol Petek[1]

INTRODUCTION

Societies maintain their continuity through the nature of the relationship they establish with the past. The past is not merely a collection of events; it also represents a field of meaning that shapes individuals' identities, values, and perceptions of the future. The conscious understanding of this field is explained through the concept of historical consciousness. Historical consciousness enables individuals to interpret past experiences, make sense of the present, and develop orientations toward the future (Rüsen, 2004; Ahonen, 2005; Thorp, 2014).

In the modern understanding of history education, the aim is not only to transmit historical knowledge but also to develop students' historical thinking skills. Within this approach, students are expected to evaluate historical events based on evidence, analyze cause–effect relationships, and understand different historical perspectives (Wineburg, 2001; Seixas & Peck, 2004; Thorp & Persson, 2020).

Historical consciousness is also closely related to the processes through which individuals construct meaning from past experiences and relate these meanings to their present lives. In this sense, historical consciousness should not be considered merely as knowledge about the past but as a form of awareness that enables individuals to interpret historical processes critically (Bulut, 2011; Popa, 2023).

The development of historical consciousness among young individuals is closely associated with effective history education. Skills such as historical empathy, evidence-based reasoning, and the evaluation of multiple perspectives enable students to interpret historical events more critically and contribute to the development of historical consciousness (Levstik & Barton, 2005; Safran & Şimşek, 2006; Sezginsoy, 2011).

In Türkiye, the development of students' historical consciousness is among the key objectives of educational curricula. The Social Studies curriculum aims to help students establish connections between the past, present, and future,

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interpret historical events, and draw conclusions about the future based on past experiences (Ministry of National Education [MoNE], 2024).

Although numerous theoretical and empirical studies have examined historical consciousness in the international literature, studies focusing on middle school students' perceptions of historical consciousness within the context of recent educational reforms remain limited. Therefore, determining students' perceptions of historical consciousness is important for evaluating the effectiveness of educational curricula and understanding the goals of recent educational reforms.

Accordingly, the present study aims to examine middle school students' perceptions of historical consciousness, their views on democracy, the importance they attribute to learning Turkish history, and their preferences regarding the presentation of historical topics. The findings are expected to contribute to a better understanding of students' historical consciousness and provide insights for improving history education practices.

LITERATURE REVIEW

In the literature, most studies on historical consciousness focus on teachers' opinions and the examination of educational curricula. However, studies that reveal students' perceptions of historical consciousness through quantitative data appear to be limited. This situation highlights the need to re-evaluate students' levels of historical consciousness within the framework of contemporary teaching approaches.

The Concept of Historical Consciousness

The concept of historical consciousness is largely explained through the typology proposed by Rüsen. According to Rüsen (2004), historical consciousness can take four different forms—traditional, exemplary, critical, and genetic—depending on how individuals interpret the past and relate it to the present and the future.

Historical consciousness refers to individuals' ability to establish meaningful connections between the past, present, and future and to interpret historical processes through cause–effect relationships (Demircioğlu, 2016). In this respect, it is closely related to historical thinking skills, which involve evaluating historical evidence and interpreting past events from multiple perspectives (Wineburg, 2001; VanSledright, 2004).

Historical consciousness also includes the development of historical empathy, the understanding of change and continuity, and the evaluation of historical events from multiple perspectives (Bulut, 2011). Individuals who critically

evaluate historical processes are more likely to contribute to social development in a conscious and responsible manner (Bıçak, 1996).

The development of historical consciousness is not a spontaneous process. Although family, media, and the social environment influence this process, formal education plays a decisive role in shaping students' historical awareness and transmitting cultural heritage to younger generations (Sezginsoy, 2011; Akdemir, 2014).

Some studies also indicate that teachers' levels of historical consciousness play an important role in combating historical distortions (Briones, 2025).

Social Studies Education and Historical Consciousness

History teaching plays an important role in the development of historical consciousness. Social Studies courses aim to enable students to participate in social life as conscious individuals by integrating disciplines such as history, geography, and citizenship education (Demircioğlu, 2016).

In this context, history education supports individuals in recognizing their cultural heritage and in making conscious plans for the future (Yumak, 2014).

The teaching of historical topics in Social Studies courses is closely related to the instructional methods used by teachers. However, teachers may encounter various challenges, such as the abstract nature of historical topics, limited instructional time, and overcrowded classrooms (Ayaydın & Aktaş, 2020).

Studies on Historical Consciousness

Previous studies on historical consciousness have largely focused on teachers' views and curricula. These studies indicate that instructional methods and the development of skills such as historical empathy and cause–effect reasoning play an important role in fostering historical consciousness (Sezginsoy, 2011; Ayaydın & Aktaş, 2020).

Student-focused studies emphasize that historical consciousness is not limited to knowledge but also involves the ability to connect past events with present-day contexts (Bulut, 2011). However, historical consciousness may not develop sufficiently when history teaching relies heavily on rote learning approaches (Akdemir, 2014).

In addition, both students and teachers may encounter difficulties when analyzing historical documents (Cowgill & Waring, 2017).

Research also indicates that both school-related and out-of-school factors influence the development of students' historical consciousness. For example,

teachers, textbooks, and the school environment play an important role in shaping students' historical consciousness (Sarıbaş, 2024).

Therefore, historical consciousness is considered not only an individual achievement but also an important element of social sustainability (Bulut, 2011; Bıçak, 1996).

Research Gap and Purpose of the Study

Previous studies on historical consciousness have largely focused on teachers' views, curricula, and approaches to history teaching. However, studies examining students' perceptions of historical consciousness remain limited, particularly within the context of recent educational reforms.

Accordingly, the present study aims to examine middle school students' perceptions of historical consciousness and to provide a student-centered perspective that goes beyond the predominantly teacher-focused studies in the literature.

The findings of this study are expected to contribute to a better understanding of students' levels of historical consciousness and to provide insights into improving history teaching practices.

METHOD

Research Design

This study is based on the survey model and aims to determine middle school students' perceptions of historical consciousness and the adequacy of the Social Studies curriculum in fostering historical consciousness. The survey model is one of the research approaches that aims to describe a situation as it existed in the past or as it currently exists. In this model, the researcher attempts to reveal the existing situation without intervening in the events or phenomena under investigation (Karasar, 2015).

The primary aim of the survey model is to reveal the current situation regarding a particular issue through data obtained from large samples. In line with this purpose, students' perceptions of historical consciousness were evaluated within several dimensions, including the meaning of history, the concept of democracy, the way history lessons are conducted, and historical factors influencing human life. Through the scale used in the study, students' views were identified, and a general assessment was made regarding the adequacy of the Social Studies curriculum in fostering historical consciousness.

Participants (Population and Sample)

In scientific research, the population refers to the entire group of individuals or objects to which the research findings are intended to be generalized (Kıncal, 2015). In other words, the population represents the overall group that includes all units that may fall within the scope of the research. However, since it is often not possible to reach the entire population in research studies, investigations are conducted on smaller groups that are assumed to represent the population. This group, consisting of individuals or objects selected from the population through specific methods and assumed to represent the population, is referred to as the sample (Tan, 2016, p. 8).

The population of the study consists of 7th-grade students enrolled at Hilalkent 125th Year Secondary School in the Yakutiye district of Erzurum during the 2021–2022 academic year. A total of 240 students were studying at this grade level at the school.

The sample of the study consists of 81 students from the 7-A and 7-D classes of Hilalkent 125th Year Secondary School. As a result of the survey administered during the data collection process, valid data were obtained from 70 students. In this study, purposive sampling was employed because the selected classes were considered suitable for examining students' perceptions of historical consciousness. Purposive sampling is a method based on selecting cases that are appropriate for the purpose of the research and rich in information (Büyüköztürk et al., 2012). In this context, classes that displayed heterogeneous characteristics in terms of academic achievement were preferred. The research data were collected through a questionnaire administered during class hours. The students were informed about the purpose of the study and were given sufficient time to respond to the survey questions. The questionnaire used in this study has also been employed in previous research examining students' perceptions of history and historical consciousness (Örten, 2019), which supports the applicability of the instrument.

Table 1. Distribution of 7th-Grade Students by Gender

Gender	Frequency (f)	Percentage (%)
Female	37	52.9
Male	33	47.1
Total	**70**	**100**

As presented in Table 1, among the 70 students who participated in the study, 37 (52.9%) are female and 33 (47.1%) are male.

Data Collection Instruments

In developing the theoretical framework of the study, the relevant literature was reviewed and both national and international studies related to the subject were examined. As the data collection instrument, the Historical Consciousness Scale developed by Tekeli (1998) within the scope of the "Comparative European Project on Young People's Historical Consciousness" was utilized. The scale consists of items designed to determine students' perceptions of history, the purpose of learning history, their views on democracy, their attitudes toward Turkish history, the factors influencing historical change, and their opinions regarding the presentation of historical topics. The scale items were organized in a five-point Likert-type format and were designed to evaluate students' historical perceptions and their attitudes toward historical consciousness across different dimensions.

The scale developed within the scope of this project includes a total of 280 items. Through these variables, the levels of historical consciousness among young people in different countries were examined through a comparative approach. The scale includes questions aimed at measuring different dimensions of historical consciousness, such as the interpretation of the past, the perception of the present, and expectations regarding the future.

The questionnaire used in the study consists of 48 international items prepared within the scope of the project. In the implementations conducted in Türkiye, an additional 12 groups of questions were included. These questions aim to determine students' views on history teaching in Türkiye. The items address topics such as the necessity of learning Turkish history, students' interests in different historical periods, perceptions of Ottoman history, the significance of the Tanzimat and reform movements, the societal impact of Atatürk's reforms, and evaluations of the democratization process in Türkiye.

The items included in the scale were evaluated for their suitability for the cognitive level of 7th-grade students. In this process, the opinions of three faculty members in Social Studies education, one curriculum development specialist, and one faculty member in guidance and psychological counseling were obtained. Based on expert feedback, some items considered unsuitable for the students' level were removed and the scale was revised. The validity and reliability of the instrument were examined, and the questionnaire was finalized for use in the study.

During the research process, students participated voluntarily, their identities were kept confidential, and the collected data were used solely for scientific purposes. The questionnaire items were coded with letters to represent different

dimensions, allowing systematic classification during the data analysis process and enabling students' views to be evaluated across different dimensions.

Table 2. Item–Total Correlation and Cronbach's Alpha Values

Item	Cronbach's Alpha	Item	Cronbach's Alpha	Item	Cronbach's Alpha
1A	0.832	3G	0.825	5H	0.821
1B	0.811	3H	0.816	5I	0.822
1C	0.836	3I	0.807	5J	0.816
1D	0.832	4A	0.799	5K	0.821
1E	0.816	4B	0.817	5L	0.809
1F	0.819	4C	0.806	5M	0.825
1G	0.808	4D	0.816	6A	0.828
1H	0.813	4E	0.809	6B	0.823
2A	0.814	4F	0.815	6C	0.818
2B	0.829	4G	0.808	6D	0.808
2C	0.818	5A	0.812	6E	0.822
3A	0.834	5B	0.838	6F	0.819
3B	0.802	5C	0.829	6G	0.801
3C	0.825	5D	0.812	6H	0.833
3D	0.812	5E	0.805		
3E	0.818	5F	0.823		
3F	0.828	5G	0.814		
Overall Cronbach's Alpha = 0.818					

As shown in Table 2, the Cronbach's Alpha reliability coefficient for the questionnaire items used in the study was calculated as 0.818. A Cronbach's Alpha coefficient of 0.70 or higher indicates that the measurement instrument is reliable (Büyüköztürk et al., 2012). Accordingly, the obtained value of 0.818 indicates that the scale used in the study has a high level of reliability.

Accordingly, the scale used in the study can be considered a valid and reliable measurement instrument based on both expert evaluations and the results of the reliability analysis. Therefore, the use of this scale within the scope of the research was deemed appropriate.

Data Analysis

The data obtained in the study were analyzed using the SPSS 20.0 statistical software package. The data collected through the scale designed to determine the adequacy of the Social Studies curriculum in fostering historical consciousness among students were analyzed using descriptive statistical methods. In this process, frequency, percentage, mean, and standard deviation values were utilized. Descriptive statistical techniques were preferred because the study aimed to describe students' perceptions rather than to test causal relationships.

The items included in the scale used in the study were prepared in a five-point Likert-type format. The level of agreement for each item in the scale was scored on a scale from 1 to 5.

Accordingly, the response options were evaluated as follows: "Strongly Disagree" (1), "Disagree" (2), "Neutral" (3), "Agree" (4), and "Strongly Agree" (5).

In five-point Likert-type scales, the formula $(5–1)/5 = 0.80$ was used to determine the interval width. Accordingly, the following ranges were used to interpret the mean scores obtained from the scale.

Table 3. Frequency and Adequacy Level Distribution of the Five-Point Likert Scale

Frequency level	Score range	Adequacy level
Strongly Disagree	1.00 – 1.80	Very Inadequate
Disagree	1.81 – 2.60	Inadequate
Neutral	2.61 – 3.40	Partially Adequate
Agree	3.41 – 4.20	Adequate
Strongly Agree	4.21 – 5.00	Very Adequate

In the tables, N refers to the number of participants, M represents the mean score, and SD indicates the standard deviation.

Based on these intervals, the mean scores obtained from the scale items were interpreted to determine the adequacy level of the Social Studies curriculum in fostering historical consciousness among students. The data obtained in the study were used solely for scientific purposes, participants' identities were kept confidential, and the analysis was conducted in accordance with the principles of research ethics.

Validity and Reliability of the Scale

In order to ensure the content validity of the scale titled "Comparative European Project on Young People's Historical Consciousness", the scale items were reviewed by academic experts in Social Studies education. Based on expert feedback, items that were considered unsuitable for the cognitive level of the students were removed, and minor revisions were made to improve the clarity and comprehensibility of the scale. In addition, the opinion of an expert in Turkish education was obtained to ensure that the items were clear and appropriate for the students' age level. Thus, the scale was finalized for use in the study.

To determine the reliability of the measurement instrument, the Cronbach's Alpha coefficient was calculated. The analysis revealed that the reliability coefficient of the scale was 0.818. A Cronbach's Alpha value of 0.70 or higher indicates that the measurement instrument is reliable (Büyüköztürk et al., 2012).

Accordingly, the obtained value of 0.818 indicates that the scale used in the study has a high level of reliability.

RESULTS

This section presents the findings obtained from the analysis of the questionnaire data. The findings reveal students' perceptions of the concept of history, their evaluations of the aims of history teaching, and their views on how historical topics are presented. Accordingly, the data are presented in tables and interpreted for each item.

Determining students' perceptions of the concept of history is important for understanding the effects of history teaching. Identifying the meanings that students associate with history provides important insights into their views on history teaching and helps evaluate the quality of history education. In particular, examining whether students perceive history merely as a collection of past events or as a field of knowledge that helps them understand the present offers valuable information about their historical understanding.

The distribution of 7th-grade students' responses to the question "What does history mean to you?" is presented in Table 4.

Table 4. Students' Responses to the Question "What Does History Mean to You?"

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	M	SD
a) Just a school subject, nothing more								
f	36	12	10	7	5	70	2.04	1.31
%	51.4	17.1	14.3	10.0	7.1			
b) A source of adventure and excitement that influences me and stimulates my imagination								
f	5	8	17	21	19	70	3.59	1.21
%	7.1	11.4	24.3	30.0	27.1			
c) An opportunity for me to learn from the successes and failures of others								
f	5	12	14	19	20	70	3.53	1.27
%	7.1	17.1	20.0	27.1	28.6			
d) Something that happened in the past and has no relation to my present life								
f	36	12	7	8	7	70	2.11	1.41
%	51.4	17.1	10.0	11.4	10.0			
e) Many instructive examples showing what is good or bad and what is right or wrong								
f	4	3	9	19	35	70	4.11	1.15
%	5.7	4.3	12.9	27.1	50.0			
f) A body of knowledge that illuminates the past and explains current problems								
f	3	3	14	17	33	70	4.06	1.12
%	4.3	4.3	20.0	24.3	47.1			
g) A chain of oppression and disasters								
f	38	11	10	4	7	70	2.01	1.36
%	54.3	15.7	14.3	5.7	10.0			
h) A means of controlling my life as a part of historical change								
f	2	11	16	22	19	70	3.64	1.13
%	2.9	15.7	22.9	31.4	27.1			
Overall Mean = 3.13								

As shown in Table 4, the overall mean score of the items was calculated as (M = 3.13). This finding indicates that students' perceptions of the concept of history are generally at a moderate level.

When the items are examined individually, the statements receiving the highest levels of agreement are "Many instructive examples showing what is good or bad and what is right or wrong" (M = 4.11) and "A body of knowledge that illuminates the past and explains current problems." (M = 4.06). These findings suggest that students perceive history as a field of knowledge that allows them to draw lessons from the past and better understand the present.

In contrast, students showed low levels of agreement with the statements "Just a school subject, nothing more" (M = 2.04) and "A chain of oppression and disasters" (M = 2.01). This finding suggests that students do not perceive history merely as a school subject and do not regard history as a process composed only of negative events.

Furthermore, students showed moderate to high levels of agreement with the statements "A source of adventure and excitement that influences me and stimulates my imagination" (M = 3.59) and "A means of influencing my life as part of historical change" (M = 3.64). These findings suggest that students perceive history not merely as knowledge about the past but also as a process that contributes to understanding both individual and social life.

In addition, students' moderate level of agreement with the statement "An opportunity for me to learn from the successes and failures of others" (M = 3.53) suggests that they view historical knowledge as a means of drawing lessons from past experiences. Moreover, the low level of agreement with the statement "Something that happened in the past and has no relation to my present life" (M = 2.11) indicates that students do not perceive history as a field detached from present-day life. This finding suggests that students tend to interpret history not merely as information about the past but as a meaningful field that contributes to understanding contemporary life and social realities.

Table 5. Students' Views on the Objectives of History Teaching

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	M	SD
a) To gain knowledge about the past								
f	0	4	6	22	38	70	4.34	0.87
%	0	5.7	8.6	31.4	54.3			
b) To understand the present								
f	4	3	23	21	19	70	3.69	1.10
%	5.7	4.3	32.9	30.0	27.1			
c) To prepare for the future								
f	3	5	12	17	33	70	4.03	1.15
%	4.3	7.1	17.1	24.3	47.1			
Overall Mean = 4.02								

As presented in Table 5, the overall mean score of students' views regarding the objectives of history teaching was calculated as (M = 4.02). This finding indicates that students hold highly positive views regarding the objectives of history teaching.

When the items were examined individually, the statement that received the highest level of agreement from students was "To gain knowledge about the past" (M = 4.34). This finding indicates that students primarily perceive history lessons as a means of acquiring knowledge about past events.

In addition, students showed a high level of agreement with the statement "To prepare for the future" (M = 4.03). This finding indicates that students perceive history teaching not only as a means of acquiring knowledge about the past but also as a guide for future-oriented thinking.

Although the mean score of students' responses to the statement "To understand the present" (M = 3.69) was relatively lower than those of the other items, it was still at an adequate level. This finding indicates that students believe history teaching contributes to a better understanding of contemporary life.

Table 6. Students' Responses to Statements about the Concept of Democracy

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	M	SD
a) It is the government of the people, by the people, for the people.								
f	3	1	18	20	28	70	3.99	1.06
%	4.3	1.4	25.7	28.6	40.0			
b) It is the most valuable heritage from Ancient Greece.								
f	10	8	26	15	11	70	3.13	1.24
%	14.3	11.4	37.1	21.4	15.7			
c) It is the result of a long process of trial and error throughout history.								
f	15	12	16	19	8	70	2.90	1.31
%	21.4	17.1	22.9	27.1	11.4			
d) It is nothing more than the approval of some party leaders in elections.								
f	27	17	7	14	5	70	2.33	1.36
%	38.6	24.3	10.0	20.0	7.1			
e) It is the dominance of law and justice and the protection of minorities.								
f	6	4	9	25	26	70	3.87	1.23
%	8.6	5.7	12.9	35.7	37.1			
f) It should be associated with a developed state								
f	10	9	17	14	20	70	3.30	1.39
%	14.3	12.9	24.3	20.0	28.6			
g) It is a weak system of government that is not suitable for times of crisis.								
f	33	12	14	7	4	70	2.10	1.26
%	47.1	17.1	20.0	10.0	5.7			
h) It is an excuse that hides the reality that the rich and powerful have always won in history.								
f	35	9	16	7	3	70	2.06	1.24
%	50.0	12.9	22.9	10.0	4.3			
i) It cannot be considered realized until women and men have equal rights in all circumstances.								
f	13	7	12	8	30	70	3.50	1.57
%	18.6	10.0	17.1	11.4	42.9			
Overall Mean = 3.02								

As presented in Table 6, the overall mean score of students' views on the concept of democracy was (M = 3.02). This finding indicates that students' perceptions of the concept of democracy are at a moderate level.

When the items were examined individually, the statement receiving the highest level of agreement from students was "It is the government of the people, by the people, for the people," with a mean score of (M = 3.99). This finding indicates that students largely perceive the concept of democracy in line with its classical definition.

Furthermore, students showed a high level of agreement with the statement "It is the dominance of law and justice and the protection of minorities" (M = 3.87). This finding indicates that students associate democracy with the rule of law and the protection of fundamental rights.

Students also showed a relatively high level of agreement with the statement "It cannot be considered realized until women and men have equal rights in all circumstances" (M = 3.50). This finding indicates that students perceive democracy in relation to social equality and the protection of rights.

In contrast, students showed low levels of agreement with the statements "It is nothing more than the approval of some party leaders in elections" (M = 2.33), "It is a weak system of government that is not suitable for times of crisis" (M = 2.10), and "It is an excuse that hides the reality that the rich and powerful have always won in history" (M = 2.06). These findings indicate that students generally do not support negative interpretations of democracy and tend to hold positive perceptions of democracy.

Furthermore, students' responses to the statements "It is the most valuable heritage from Ancient Greece" (M = 3.13), "It is the result of a long process of trial and error throughout history" (M = 2.90), and "It should be associated with a developed state" (M = 3.30) were at a moderate level.

These results indicate that students generally perceive democracy as a positive value and that their awareness of democratic governance is gradually developing.

These evaluations regarding the concept of democracy indicate that students understand democratic values and governance to a certain extent. Identifying students' views on democracy is important for understanding the role of Social Studies education in fostering democratic citizenship. In this context, examining students' views on learning Turkish history is also important for revealing how they interpret the purposes of history teaching.

Table 7. Students' Responses to the Question "Why Is It Necessary to Learn Turkish History?"

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	M	SD
a) To learn about the heroism and victories in Turkish history								
f	5	6	13	15	31	70	3.87	1.27
%	7.1	8.6	18.6	21.4	44.3			
b) To be successful in the LGS entrance examination								
f	13	6	14	21	16	70	3.30	1.41
%	18.6	8.6	20.0	30.0	22.9			
c) To build my own identity								
f	11	10	20	12	17	70	3.20	1.38
%	15.7	14.3	28.6	17.1	24.3			
d) To learn about our traditions, past, and religion								
f	1	4	14	16	35	70	4.14	1.03
%	1.4	5.7	20.0	22.9	50.0			
e) To understand the development and change of humans and society								
f	4	1	12	19	34	70	4.11	1.11
%	5.7	1.4	17.1	27.1	48.6			
f) To understand the past and present and prepare consciously for the future								
f	5	2	12	19	32	70	4.01	1.19
%	7.1	2.9	17.1	27.1	45.7			
g) To determine Türkiye's place in the world								
f	5	21	17	9	18	70	3.20	1.31
%	7.1	30.0	24.3	12.9	25.7			
Overall Mean = 3.69								

As presented in Table 7, the overall mean score of students' views on the necessity of learning Turkish history was found to be (M = 3.69). This finding indicates that students generally hold positive views regarding the necessity of learning Turkish history.

When the items were evaluated individually, the statement that received the highest level of agreement from students was "To learn about our traditions, past, and religion" (M = 4.14). This finding indicates that students consider learning Turkish history important for understanding cultural values and social heritage.

Students also showed a relatively high level of agreement with the statement "To learn about the heroism and victories in Turkish history" (M = 3.87). This finding indicates that students consider history education important for understanding national values and historical heritage.

On the other hand, the mean scores for the statements "To be successful in the LGS entrance examination" (M = 3.30) and "To determine Türkiye's place in the world" (M = 3.20) were lower than those of the other items. This finding indicates that students do not perceive learning history solely as a means of achieving success in examinations.

In addition, students showed high levels of agreement with the statements "To understand the development and change of human beings and society" (M = 4.11) and the statement "To understand the past and present and consciously prepare

for the future" (M = 4.01). These findings indicate that students perceive learning history as an important means of understanding processes of social change and developing awareness for the future.

Furthermore, students' views regarding the statement "To build my own identity" (M = 3.20) were at a moderate level. This finding indicates that students associate learning history with the development of individual identity to a certain extent. In this context, students consider historical knowledge as a factor that contributes, to some degree, to the formation of personal identity and a sense of belonging; however, the strength of this relationship remains at a moderate level.

The findings indicate that students consider learning Turkish history important for understanding cultural heritage, comprehending social development, and establishing connections between the past and the future. Moreover, students perceive learning history not only as a requirement for academic achievement but also as an important means of developing historical consciousness and understanding social values.

Furthermore, identifying students' views on the factors that influence human life throughout history is important for understanding historical consciousness. Historical change does not emerge solely from political events; it is also shaped by various factors such as scientific, technological, social, and economic developments. Therefore, examining which factors students perceive as more influential provides important insights into how they interpret historical change.

Table 8. Students' Views on Factors Influencing Human Life Throughout History

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	M	SD
a) Technological inventions and machines								
f	10	4	6	12	38	70	3.91	1.47
%	14.3	5.7	8.6	17.1	54.3			
b) Social movements and social conflicts								
f	9	14	13	17	17	70	3.27	1.37
%	12.9	20.0	18.6	24.3	24.3			
c) Prominent political leaders (kings, sultans, presidents, etc.)								
f	6	12	17	11	24	70	3.50	1.35
%	8.6	17.1	24.3	15.7	34.3			
d) Political reforms (e.g., the First and Second Constitutional Monarchy)								
f	6	9	18	17	20	70	3.51	1.27
%	8.6	12.9	25.7	24.3	28.6			
e) Founders of religions and religious leaders								
f	8	13	22	10	17	70	3.21	1.32
%	11.4	18.6	31.4	14.3	24.3			
f) Development of science and knowledge								
f	3	9	12	13	33	70	3.91	1.25
%	4.3	12.9	17.1	18.6	47.1			
g) Wars and armed conflicts								
f	16	18	8	13	16	70	2.90	1.50
%	22.9	25.7	11.4	18.6	22.9			
h) Economic interests and competition								

f	15	8	15	12	20	70	3.20	1.51
%	21.4	11.4	21.4	17.1	28.6			
i)	Philosophers, thinkers, and scholars							
f	8	10	16	17	19	70	3.41	1.34
%	11.4	14.3	22.9	24.3	27.1			
j)	Political revolutions (e.g., the French Revolution, Industrial Revolution)							
f	9	11	13	10	27	70	3.50	1.46
%	12.9	15.7	18.6	14.3	38.6			
k)	Rapid population growth							
f	2	11	20	17	20	70	3.60	1.15
%	2.9	15.7	28.6	24.3	28.6			
l)	Natural disasters							
f	12	8	20	14	16	70	3.20	1.38
%	17.1	11.4	28.6	20.0	22.9			
m)	Mass migrations (e.g., the Migration Period)							
f	10	11	15	14	20	70	3.33	1.41
%	14.3	15.7	21.4	20.0	28.6			
Overall Mean = 3.41								

As presented in Table 8, the overall mean score of students' views on the factors influencing human life throughout history was (M = 3.41). This finding indicates that students' perceptions of the factors affecting human life in the historical process are generally at a moderate to moderately high level.

When the items were evaluated individually, the factors receiving the highest level of agreement from students were "Technological inventions and machines" (M = 3.91) and "The development of science and knowledge" (M = 3.91). This finding indicates that students perceive scientific and technological developments as key factors shaping human life throughout history.

Students' responses to the statement "Founders of religions and religious leaders" (M = 3.21) were at a moderate level. This finding indicates that while students recognize the influence of religious leaders on historical processes, they do not attribute historical change exclusively to religious factors.

Students' responses to the statement "Economic interests and competition" (M = 3.20) were also at a moderate level. This finding indicates that students are aware of the role of economic factors in shaping historical processes to some extent.

Similarly, students' responses to the statement "Natural disasters" (M = 3.20) were at a moderate level. This result indicates that students perceive natural disasters as one of the factors influencing societies throughout history.

In addition, the mean scores for the statements "Rapid population growth" (M = 3.60), "Political reforms" (M = 3.51), and "Political revolutions" (M = 3.50) were relatively high. This finding indicates that students perceive social and political developments as important factors shaping historical change.

Students' responses to the statements "Philosophers, thinkers, and scholars" (M = 3.41) and "Prominent political leaders" (M = 3.50) were at moderate to

moderately high levels. This finding indicates that students perceive both individuals and intellectual developments as influential factors in historical change.

In contrast, the mean score for the statement "Wars and armed conflicts" (M = 2.90) was lower than that of the other items. This finding indicates that although students recognize wars as factors influencing historical change, they attribute comparatively less importance to them than to scientific and technological developments. Moreover, this result suggests that students tend to interpret historical change not solely through conflict and warfare but also through scientific and social developments. These findings demonstrate that students are able to interpret historical processes from a more multidimensional perspective.

The findings indicate that students perceive historical change as a multidimensional process shaped not only by political events but also by scientific, technological, social, and demographic developments. In this context, identifying the ways students prefer to learn historical topics is important for evaluating the effectiveness of history education.

Table 9. Students' Preferred Formats for Learning Historical Topics

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N	M	SD
a) Textbooks								
f	16	7	17	14	16	70	3.10	1.47
%	22.9	10.0	24.3	20.0	22.9			
b) Historical documents and sources								
f	9	14	9	17	21	70	3.39	1.43
%	12.9	20.0	12.9	24.3	30.0			
c) Historical novels								
f	6	9	8	20	27	70	3.76	1.32
%	8.6	12.9	11.4	28.6	38.6			
d) Historical films								
f	2	5	8	22	33	70	4.13	1.06
%	2.9	7.1	11.4	31.4	47.1			
e) TV documentaries								
f	10	9	8	18	25	70	3.56	1.45
%	14.3	12.9	11.4	25.7	35.7			
f) Teachers' explanations								
f	5	3	12	19	31	70	3.97	1.20
%	7.1	4.3	17.1	27.1	44.3			
g) Explanations by other adults (parents, grandparents, etc.)								
f	7	4	18	14	27	70	3.71	1.31
%	10.0	5.7	25.7	20.0	38.6			
h) Museums and historical sites								
f	3	3	13	11	40	70	4.17	1.14
%	4.3	4.3	18.6	15.7	57.1			
Overall Mean = 3.72								

As shown in Table 9, the overall mean score of students' views regarding the presentation formats of historical topics was (M = 3.72). This finding indicates that students generally have positive views toward different ways of presenting historical topics.

When the items were examined individually, the highest level of agreement was observed for "Museums and historical sites" (M = 4.17). This finding indicates that students attach importance to visual and experiential learning environments in the process of learning historical topics.

Similarly, the mean score for "Historical films" (M = 4.13) was relatively high. This finding indicates that students view the use of visual materials in history education positively.

Students also showed high levels of agreement with the statements "Teachers' explanations" (M = 3.97) and "Historical novels" (M = 3.76). This finding indicates that students value both teacher-guided instruction and narrative-based learning materials when learning history.

On the other hand, the mean score for the "Textbooks" item (M = 3.10) was lower than that of the other items. This finding indicates that students consider textbooks less engaging than other instructional tools for learning historical topics.

In addition, students' responses to the statements "TV documentaries" (M = 3.56), "Historical documents and sources" (M = 3.39), and "Explanations by other adults" (M = 3.71) were at moderate to relatively high levels.

The findings indicate that students perceive visual, experiential, and narrative-based learning environments as more engaging in history education and show more positive attitudes toward interactive learning approaches than toward traditional textbook-based instruction.

DISCUSSION

This study examined middle school students' views on historical consciousness and history education. The findings reveal students' perspectives regarding the purposes of history teaching, the concept of democracy, the importance of learning Turkish history, and the ways in which historical topics are presented.

The results indicate that students perceive learning about the past as one of the main purposes of history teaching. Students also consider historical knowledge an important guide for understanding the future. This suggests that history education helps students establish connections between the past, present, and future. This finding is consistent with previous studies emphasizing that history education contributes to the development of historical thinking skills and historical consciousness (Sezginsoy, 2011; Demircioğlu, 2016).

Another finding shows that students generally perceive democracy as the principle of people governing themselves and associate it with concepts such as

the rule of law and social justice. Social Studies education aims to develop democratic values, citizenship awareness, and social responsibility among students (Ministry of National Education [MoNE], 2018). Accordingly, the findings suggest that students possess a basic level of awareness regarding democratic values.

The results also show that students consider learning Turkish history important for understanding cultural values and social identity. Students associate history with traditions, cultural heritage, and social values. This finding supports previous studies indicating that history education contributes to the development of national identity and a sense of belonging (Bulut, 2011).

Another result indicates that students view scientific and technological developments as important factors in explaining historical change. This suggests that students interpret historical processes not only through political developments but also through broader social and technological transformations.

In addition, students expressed positive views regarding the ways in which historical topics are presented. Visual and experiential learning environments, such as museums, historical sites, and historical films, were perceived as more engaging. This finding suggests that the use of visual materials and experience-based learning environments may enhance students' interest in history.

Overall, the findings suggest that Social Studies education contributes to the development of historical consciousness among students. The use of diverse instructional strategies and experience-based learning environments may further support students' interest in history and strengthen the development of historical consciousness.

From an educational perspective, these findings highlight the importance of designing history education in ways that promote active and student-centered learning. The integration of visual materials, historical narratives, museums, and experiential learning environments can enhance students' engagement and deepen their historical understanding. Furthermore, instructional practices that encourage students to analyze historical events from multiple perspectives and establish connections between the past and the present may significantly contribute to the development of both historical consciousness and critical historical thinking skills.

Similar conclusions have also been reported in studies examining the role of Social Studies education in developing historical awareness among students.

CONCLUSION AND RECOMMENDATIONS

This study examined middle school students' perceptions of historical consciousness, their understanding of democracy, and their views on history

education. The findings indicate that students generally hold positive attitudes toward history education and perceive it not only as learning about past events but also as a means of understanding the present and developing future-oriented thinking skills. These results suggest that Social Studies education plays an important role in the development of students' historical thinking and historical consciousness.

The findings also show that students generally associate democracy with concepts such as self-governance, the rule of law, and social justice. This indicates that Social Studies education contributes to the development of democratic values and citizenship awareness among students. However, incorporating more classroom practices that emphasize democratic participation may help students develop a deeper understanding of democratic principles.

Another important finding is that students perceive learning history as significant for understanding cultural values and social identity. This suggests that history education contributes to the development of a sense of belonging and cultural awareness among students.

In addition, students expressed greater interest in historical topics when visual and experiential learning environments such as museums, historical sites, and visual materials were used.

These findings highlight the importance of designing history education in ways that support students' active engagement with historical knowledge and encourage critical historical thinking.

Based on the findings of the study, several recommendations can be proposed. First, Social Studies education should incorporate a greater use of visual materials such as documentaries, historical films, and other multimedia resources in the teaching of historical topics. Second, experiential learning environments, including museum visits, excursions to historical sites, and place-based learning activities, should be expanded in order to enhance students' understanding of historical events. Third, Social Studies courses should include more participatory activities that encourage students' active engagement in the learning process and promote democratic awareness. Finally, instructional approaches that help students establish meaningful connections between the past, present, and future should be emphasized in history education. In addition, the use of historical documents, source analysis activities, and research-based learning practices may further support the development of students' historical thinking skills.

This study is limited to middle school students studying in the province of Erzurum. Future studies may examine historical consciousness among students in different regions and educational contexts. Furthermore, research employing

qualitative methods may provide a more in-depth understanding of students' views on historical consciousness and history education.

Recent educational reforms in Türkiye, particularly those introduced within the framework of the Century of Türkiye Education Model, emphasize the development of historical thinking skills, the transmission of cultural values, and interdisciplinary learning approaches. Therefore, future studies examining the impact of these reforms on students' historical consciousness and democratic awareness may contribute significantly to the literature.

Acknowledgements

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