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THE EFFECTIVENESS OF USING VISUAL REPRESENTATIONS IN ORGANIZING ACTIVITIES TEACHING THE CONCEPT OF TIME TO 5-6-YEAR-OLD PRESCHOOLERS: A QUASI-EXPERIMENTAL STUDY

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Abstract

This quasi-experimental study evaluates the effectiveness of using visual representations supporting 5-6-year-old preschool children familiar with the concept of time. Two groups of children (40 each) were compared: the experimental group participated in activities using visual tools (e.g., pictorial calendars, weekly wheels, seasonal charts), while the control group followed traditional instruction. Statistical analysis revealed a significant difference between the two groups after the intervention ($p < 0.05$), with the experimental group showing greater improvement in time-related understanding. The study highlights the positive impact of visual representations in helping young children acquire the abstract concept of time in a more concrete, logical, and engaging way, and recommends broader application in early childhood education.

Keywords: *Concept of time, early childhood, quasi-experimental, strategy, visual representation.*

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HIỆU QUẢ CỦA SỬ DỤNG MÔ HÌNH TRỰC QUAN TRONG TỔ CHỨC HOẠT ĐỘNG CHO TRẺ MẪU GIÁO 5-6 TUỔI LÀM QUEN VỚI KHÁI NIỆM THỜI GIAN: MỘT NGHIÊN CỨU BÁN THỰC NGHIỆM

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Tóm tắt

Nghiên cứu bán thực nghiệm này đánh giá hiệu quả của việc sử dụng mô hình trực quan trong dạy trẻ mẫu giáo 5-6 tuổi làm quen với khái niệm thời gian. Hai nhóm trẻ (mỗi nhóm 40 trẻ) được so sánh: nhóm thực nghiệm tham gia các hoạt động sử dụng mô hình trực quan (lịch, mô hình các ngày trong tuần, các mùa trong năm...), nhóm đối chứng học theo phương pháp truyền thống. Kết quả phân tích cho thấy có sự khác biệt có ý nghĩa thống kê giữa hai nhóm sau can thiệp ($p < 0,05$), với nhóm thực nghiệm đạt tiến bộ vượt trội trong nhận thức về thời gian so với nhóm đối chứng. Nghiên cứu khẳng định vai trò tích cực của mô hình trực quan trong việc giúp trẻ tiếp cận khái niệm thời gian một cách trực quan, logic và hứng thú hơn, đồng thời đề xuất áp dụng rộng rãi trong giáo dục mầm non.

Từ khóa: *Bán thực nghiệm, biện pháp, mô hình trực quan, khái niệm thời gian, trẻ mầm non.*

1. Introduction

The concept of Time plays a crucial role in children's cognitive development, influencing how they understand sequences, anticipate events, and organize their daily routines. For preschoolers aged 5-6, becoming familiar with time-related concepts, such as before and after, duration, and daily schedules, is foundational for later academic success, personal autonomy, and social adaptation. Despite its importance, Time is an abstract and intangible construct, which makes it difficult for young learners to grasp without appropriate instructional support.

Visual representations have been widely acknowledged as practical tools in early childhood education, especially in facilitating the learning of abstract concepts. When properly designed and implemented, visual models can transform complex or invisible phenomena, such as time, into concrete, relatable, and engaging forms for young children. However, in many preschool settings, especially in contexts with limited pedagogical training or resources, the use of visual representations for teaching time concepts remains underutilized or improperly applied. Teachers may lack the skills or strategies to integrate these tools effectively, resulting in fragmented instruction and reduced learning outcomes.

In Vietnam, the organization of mathematics learning activities in preschool education, particularly those related to familiarizing children with the concept of time, still faces several challenges. Many preschool teachers focus on rote learning or simple factual recall rather than providing rich, meaningful, interactive learning experiences. Instructional practices often lack the use of visual, manipulative, or experiential learning tools, which are essential in helping young children understand abstract mathematical concepts. As a result, young learners may struggle to grasp foundational ideas such as time, quantity, or spatial orientation—concepts vital for later academic achievement.

Furthermore, there is a growing need for empirical studies examining how specific teaching strategies, such as visual representations, impact preschoolers' time perceptions. While some international literature has explored this intersection, research in the context of Vietnamese early childhood education, or similar cultural and developmental contexts, is still limited. This gap underscores the need for a systematic and evidence-based investigation. Therefore, this quasi-experimental study is designed to evaluate the effectiveness of visual representations in helping 5–6-year-old children become familiar with the concept of Time. The findings are expected to provide practical implications for early childhood educators, contribute to curriculum development, and inform policymakers on integrating visual learning tools in foundational mathematics and cognitive development programs.

2. Literature review

2.1. Visual representations in early childhood education

Visual representations, often called visual models, are a critical pedagogical tool in early childhood education, especially when supporting young learners in understanding abstract or complex concepts. According to English and Watters (2002), visual models should begin in early learning environments rather than be reserved for later education stages. They argue that children possess foundational representational abilities to engage with mathematical modeling and problem-solving if supported with developmentally appropriate tools.

Research by Lehrer and Schauble (2002) further demonstrates that engaging young children with visual representations—such as charts, pictograms, and manipulatives—enhances mathematical reasoning and promotes social interaction, collaboration, and metacognitive reflection. These visual tools provide scaffolding for thinking, allowing

children to externalize and manipulate ideas that might otherwise remain intangible or too complex for their developmental stage. Zawojewski et al. (2003) emphasize that such representations can take multiple forms, including schematic diagrams, story-based timelines, or concrete manipulatives, all of which foster different approaches to problem-solving. Moreover, children are more likely to engage with and internalize the targeted concepts when these models are embedded in rich, meaningful contexts.

2.2. The abstract nature of Time and challenges in early instruction

Time is a uniquely challenging concept for preschool-aged children due to its inherently abstract, invisible, continuous, and irreversible nature. Unlike tangible objects or spatial relationships, time cannot be directly perceived through the senses; its presence is inferred only through indirect cues such as the progression of daily routines, the change from day to night, or seasonal transitions. As Mioni et al. (2017) and Güne and Şahin (2020) highlight, young children construct their understanding of the world primarily through concrete sensory experiences. Because time lacks a concrete and manipulable form, it presents a significant obstacle to conceptualization in early childhood.

In Vietnam's early childhood education context, this difficulty is further compounded by curricular and instructional practices prioritizing numerical literacy over temporal understanding, such as counting and number recognition. As Nguyen (2024) observed, teaching time to children aged 5–6 often involves rote memorization of sequential terms (e.g., days of the week, morning, afternoon, evening) with minimal integration of experiential or visual tools that could support deeper conceptual engagement. As a result, children may be able to recite temporal labels without genuinely grasping the relationships between them, leading to superficial learning and limited ability to apply temporal knowledge in real-life contexts.

2.3. The role of visual representations in teaching the concept of Time

Visual representations—such as calendars, clocks, pictorial schedules, seasonal wheels, or timeline charts—offer a powerful means to bridge the gap between abstract time concepts and children's lived experiences. These models provide perceptual anchors that help children visualize patterns of change, sequence, and recurrence.

Lomako (2017) showed that children aged 5-6 possess strong symbolic thinking capacities, making them developmentally ready to engage with visual symbols and models representing time. In his study, using visual tools to teach temporal concepts significantly improved children's ability to name and sequence the days of the week, distinguish between "yesterday," "today," and "tomorrow," and relate these terms to personal experience. In the Vietnamese context, Do (2015) used visual models such as symbolic time cards and object-based time indicators in preschool classrooms. Her findings demonstrated that visual representations helped children internalize the structure of time, both in sequence and duration, and promoted schematic thinking.

The literature highlights several cognitive and pedagogical benefits of integrating visual models into early math and time instruction: Concrete experience with abstract ideas: Visual representations turn abstract ideas, like time intervals, into visible and manipulable objects (Rudolph & Wright, 2015). Encouragement of active learning: Visual tools foster children's agency as learners. Instead of passively receiving information, children explore, match, sort, and construct meaning (English & Watters, 2004). Development of logical and sequential thinking: Visual timelines and cyclical models (e.g., the four seasons) help children organize events temporally, reinforcing logical sequencing and prediction. Support for diverse learning styles: Children with varying developmental profiles can benefit from visual and kinesthetic

interaction with models, improving inclusion and engagement in mixed-ability classrooms. Cultural relevance and familiarity: Models built around culturally familiar routines—such as school timetables, holidays, or traditional calendars—make learning more meaningful and accessible for young children (Rudolph & Wright, 2015).

Despite international recognition of the effectiveness of visual representations, research and practice in Vietnam regarding their use in teaching time remain underdeveloped. Nguyen (2024) found that while teachers are aware of the value of visual models, many lack training in their practical implementation. As a result, instructional practices remain largely verbal and theoretical, with limited child-centered exploration. Moreover, studies in Vietnam have primarily focused on visual tools for counting, shape recognition, or spatial orientation, rather than time-related concepts. The lack of systematic, evidence-based strategies for using visual models to support temporal understanding represents a significant gap. This calls for more in-depth, context-specific research—especially using experimental or quasi-experimental designs—to assess the impact of visual representations on preschoolers' time concept development. It also highlights the need for professional development programs that equip early childhood educators with the skills to effectively design, adapt, and integrate visual tools into their teaching.

Visual representations are essential pedagogical tools in helping young children understand abstract temporal concepts. They support perceptual development, logical reasoning, and engagement in learning. While international research affirms the value of these tools, their use in Vietnamese early childhood education, particularly in teaching the concept of time, requires further investigation and structured implementation. A quasi-experimental study, such as the one conducted by Nguyen (2024), offers a promising direction for validating the effectiveness of these tools in real preschool settings and contributing to a more enriched, meaningful, and developmentally appropriate approach to early mathematical education.

3. Research method

This study employed a quasi-experimental design with a pre–test–post–test non-equivalent group structure, aiming to evaluate the effectiveness of using visual representations in developing time-related understanding in preschoolers aged 5 to 6. The design included two parallel groups: an experimental group, which received instruction involving structured visual representation interventions, and a control group, which continued learning under the standard early childhood curriculum without such intervention.

Participants: 80 children aged 5–6 years participated in the study. They were selected from two preschool classes within the same institution located in an urban district of Hanoi. The sample was divided into two groups of equal size using random assignment, ensuring comparability in terms of age, gender, prior knowledge, classroom environment, and teacher experience: Experimental group: 40 children participated in structured activities designed around visual representation strategies. Control group: 40 children continued their regular curriculum-based instruction without the inclusion of visual models.

Intervention: The experimental group engaged in a structured intervention program consisting of five pedagogical strategies that integrated developmentally appropriate visual models to support understanding time-related concepts.

Strategy 1: Selection and design of age-appropriate visual representations: Teachers selected or created engaging visual tools that aligned with the cognitive and perceptual abilities of 5-6-year-old children. These included: Circular weekly calendars showing seven days, with rotating arrows and attachable activity cards; Seasonal boards depicting four seasons with corresponding weather, clothing, and activity visuals; Daily routine timelines using sequential

images to illustrate morning, noon, afternoon, and evening events; Picture-based mini-calendars showing sequences of "yesterday - today - tomorrow" using actual or illustrative photos of children's daily life. Visual materials were designed to be colorful, safe, reusable, and manipulable, enhancing interaction and engagement (see Appendix).

Strategy 2: Facilitating active child–model interaction, instructional activities were designed to promote direct child interaction with the visual models. Examples included: Hands-on manipulation (e.g., rotating a day wheel, matching an event card to the correct part of the day); Open-ended questioning to elicit children's reasoning (e.g., "What do you do in the afternoon?" "What do you wear in winter?"); Encouraging verbal expression and reflection based on children's real-life experiences; Establishing connections between the model, vocabulary, and daily experience to support symbolic understanding and temporal reasoning.

Strategy 3: Game-based learning with time-oriented activities, games were incorporated to reinforce learning through playful engagement with time-related concepts. These included: Sequencing events of a day using visual cards (e.g., "My Day" game); Matching seasons with activities and attire; Time-guessing games (e.g., identifying whether an event happened yesterday, today, or tomorrow based on clues); "Magic Box" game: children pick a card and state the associated time; Make your calendar: children mark specific events or days on large calendar models. These games were conducted individually, in small groups, or during learning centers, fostering both conceptual acquisition and social skills.

Strategy 4: Encouraging creative construction of Time models: Children were encouraged to create their visual representations of time using age-appropriate materials such as colored paper, picture cards, and blocks. Specific activities included: Designing personal daily timelines through drawing or arranging cards; Making a personal calendar, marking important dates (e.g., birthdays, field trips); Group construction and storytelling: working together to build and present a time-based model; Comparing different children's models to consolidate correct understanding of time sequences and seasonal features—this intervention aimed to foster symbolic thinking, creativity, presentation skills, and collaborative learning.

Strategy 5: Integrating visual models into classroom learning centers visual representations were integrated into various learning centers beyond whole-group instruction: In the math center, children engaged with number–event matching games and compared time durations; In the science or discovery corner, children interacted with hourglasses, weather charts, and thermometers; In the reading area, books were selected to highlight time sequences and supported with guiding questions linked to visual models. This integration ensured repeated exposure and opportunities for reinforcement in diverse learning contexts, enhancing retention and transfer.

The experimental process followed three stages:

Stage 1 - Pre-test: Both groups were assessed using a time-understanding survey tool.

Stage 2 - Intervention (5 weeks): The experimental group participated in structured activities incorporating the five visual representation strategies. The control group continued standard instruction without the use of visual aids.

Stage 3 - Post-test: The same assessment tool was used to evaluate both groups' progress, enabling a comparison of changes and intervention effects.

Children's ability to become familiar with Time was measured across three main dimensions:

i) Understanding of daily divisions (morning, noon, afternoon, evening): correctly identifying and sequencing parts of the day;

ii) Understanding of weekdays and simple chronology: naming days of the week, distinguishing "Yesterday – today – tomorrow";

iii) Understanding of seasonal patterns: identifying names and characteristics of the four seasons (weather, clothing, typical activities).

The assessment consisted of age-appropriate exercises and structured prompts, scored on a 10-point scale and categorized into four levels: Excellent (8–10 points): completed tasks accurately and independently; Good (6 to <8 points): generally correct, with some prompts; Average (4 to <6 points): partial success with substantial assistance; Poor (<4 points): significant difficulties or non-performance.

4. Results and discussion

Pre-intervention assessment results before the intervention: The experimental and control groups were assessed using the same evaluation tool designed to measure preschoolers' familiarity with time-related concepts. The descriptive statistical parameters, such as Mean Score (X) and Standard Deviation (SD) of the two groups before the intervention, are detailed in Table 1. The T-test result was $T = 0.02 < T_a = 2.04$ ($\alpha = 0.05$), indicating that the difference in pre-test scores was not statistically significant. Therefore, it can be concluded that the two groups had equivalent baseline levels of time-related understanding, ensuring the objectivity and reliability of the subsequent intervention phase. The results revealed no significant difference between the two groups, with nearly identical mean scores and standard deviations.

Table 1. Pre-intervention statistics and T-test results for the two groups

Pre-test	X	SD	T	Tα (α=0.05)
Control group	5.34	1.94	0.02	2.04
Experimental group	5.33	1.93		

Note. N = 80 (Experimental group: n = 40; Control group: n = 40).

Post-intervention assessment results: After five weeks of applying the five intervention strategies involving visual representations in the experimental group, both groups were reassessed using the same instrument. The results show a clear distinction in performance between the two groups:

The descriptive statistical parameters, such as Mean Score (X) and Standard Deviation (SD) of the two groups after the intervention, are detailed in Table 2. The T-test result was $T = 2.14 > T_a = 2.04$ ($\alpha = 0.05$), indicating that the difference in post-test scores is statistically significant. This confirms that the intervention using visual representations had a positive and measurable impact on children's understanding of time concepts .

Table 2. Post-intervention statistics and T-test results for the two groups

Post-test	X	SD	T	Tα (α=0.05)
Control group	6.21	1.80	2.14	2.04
Experimental group	7.10	1.57		

Note. N = 80 (Experimental group: n = 40; Control group: n = 40).

Independent Samples T-Test Results

Based on Levene's Test for Equality of Variances, the significance value is 0.906 > 0.05 (Table 3), indicating that the assumption of homogeneity of variances is met. The results of the independent samples t-test show t(78) = 0.020, p = 0.984 > 0.05. This suggests there is no statistically significant difference between the control and experimental groups in their pre-test scores, confirming that both groups had similar initial levels of understanding regarding the concept of time.

Table 3. Independent Samples Test (Pre-test)

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Pre-test (Equal variances assumed)	0.014	0.906	0.020	78	0.984	0.01	0.50	-0.99	1.01

Note. N = 80 (Experimental group: n = 40; Control group: n = 40).

Levene's Test yields a significance value of 0.789 > 0.05 (Table 4), confirming that the assumption of equal variances holds. The independent samples t-test reveals a statistically significant difference between the two groups (t(78) = 2.770, p = 0.007 < 0.05). Children in the experimental group demonstrated significantly higher post-test scores compared to those in the control group. This result indicates that the use of visual representation-based strategies had a positive impact on children's understanding of time.

Table 4. Independent Samples Test (Post-test)

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Post-test (Equal variances assumed)	0.072	0.789	2.770	78	0.007	1.57	0.567	0.436	2.704

Note. N = 80 (Experimental group: n = 40; Control group: n = 40).

The findings prove that visual representation-based instruction significantly enhances preschoolers' ability to understand time. The five instructional strategies employed in the intervention helped make abstract time concepts more concrete, engaging, and accessible. They also supported the development of logical reasoning, verbal expression, and self-regulation skills related to temporal awareness. The apparent disparity in post-test scores between the two groups underscores the effectiveness and educational value of incorporating visual models into early childhood mathematics and cognitive development.

The findings of this study demonstrate that the use of visual representations has a statistically significant and pedagogically meaningful impact on the development of time-related understanding in preschool-aged children. While the experimental and control groups showed improvements in post-test scores, the magnitude and quality of change were notably higher in the experimental group. This section discusses the possible reasons behind this

outcome, grounded in cognitive development theory, empirical literature, and the observed classroom dynamics.

Visual representations as cognitive scaffolds: One of the key insights from the study is the effectiveness of visual representations as cognitive scaffolds for abstract thinking in early childhood. As argued by English and Watters (2004), young learners benefit from the early and consistent use of visual models that help externalize and concretize complex ideas. In this study, the five intervention strategies provided children with structured, engaging, and manipulable tools that helped them visualize temporal sequences, daily routines, and seasonal cycles.

The significant gain in mean scores—from 5.33 to 7.10 in the experimental group—supports the view that visual representations bridge the gap between sensory experience and abstract reasoning, which is essential for understanding the concept of time (Güneş & Şahin, 2020; Mioni et al., 2014). These tools served not only as a medium of instruction but also as a means for children to explore, express, and reflect on their temporal understanding through concrete interaction.

Active engagement and child-centered learning: The intervention also strongly emphasized child-centered pedagogy, encouraging active manipulation of materials, peer interaction, and self-expression. This aligns with Vygotsky's sociocultural theory (1978), which posits that symbolic concepts such as time are constructed through guided social interaction and culturally mediated tools. The use of rotating calendars, illustrated timelines, and collaborative model-building activities created opportunities for dialogue, comparison, and meaning-making, all essential for internalizing abstract concepts. By contrast, although the control group showed some improvement (mean score rising from 5.34 to 6.21), it had fewer opportunities for exploratory learning, leading to slower progress and greater individual variability. This is reflected in the persistently higher standard deviation and lower proportion of children reaching the "Excellent" level.

Developmental readiness and symbolic thinking: Children aged 5-6 are at a critical stage in developing symbolic reasoning and representational competence. According to Lomako (2017), this age group is particularly responsive to visual-symbolic representations, as they move from purely perceptual cognition toward mental abstraction. The results of this study affirm that visual representations—when tailored to the learner's developmental stage—can significantly enhance temporal awareness by offering repeated, meaningful encounters with symbolic formats (e.g., pictorial calendars, seasonal cycles).

Moreover, the observed decline in standard deviation in the experimental group suggests that visual strategies improve average performance and reduce learning disparities within the group. This equity-promoting effect is particularly valuable in early childhood education, where developmental variability is high. The findings underscore the practical value of integrating visual models into early childhood mathematics and cognitive instruction, particularly about temporal concepts. In many preschool classrooms—especially in the Vietnamese context, as highlighted by Nguyen (2024)—instruction on time remains verbal, repetitive, and fragmented. This study offers a replicable, low-cost, and developmentally appropriate model for enhancing temporal learning through structured visual interaction. Given the growing emphasis on competency-based education and 21st-century skills, developing temporal reasoning, sequencing ability, and planning skills from an early age can contribute to mathematical proficiency and broader domains of executive function and social-emotional development.

In conclusion, this study contributes to a growing body of evidence supporting the use of visual representations in early childhood education. The intervention strategies implemented here were statistically effective and pedagogically transformative. By making time visible, tangible, and interactive, visual models empowered children to construct, refine, and apply temporal concepts in meaningful ways. Future research may build on this foundation by exploring longitudinal effects and integration with digital tools, but the present study already affirms the pedagogical power of well-designed visual interventions.

Although this study provides clear empirical evidence regarding the effectiveness of visual representation-based instructional strategies in supporting 5-6-year-old preschool children's understanding of time concepts, several limitations should be acknowledged. First, the research sample was relatively small and limited to a single educational setting, which may affect the generalizability of the findings. Second, the duration of the intervention was relatively short, making it difficult to assess the long-term sustainability of the cognitive improvements observed. Additionally, the study primarily relied on pre- and post-test measures and did not explore in depth other influential factors such as children's learning styles, teacher competence, or the extent of parental involvement.

5. Conclusion

This study aimed to evaluate the effectiveness of visual representation-based instructional strategies in helping 5-6-year-old preschool children become familiar with the concept of time. Grounded in a quasi-experimental design with pre- and post-testing, the research compared outcomes between an experimental group that received targeted interventions and a control group that followed conventional instruction.

The findings reveal that developmentally appropriate visual models, such as pictorial calendars, seasonal diagrams, and daily routine charts, significantly enhanced children's understanding of abstract temporal concepts. Children in the experimental group demonstrated greater gains in their ability to recognize, sequence, and apply time-related ideas in real-world contexts. Moreover, the intervention strategies promoted active learning, symbolic thinking, and verbal expression, aligning with established theories of cognitive development (Vygotsky, Bruner, Piaget).

In contrast, the control group showed only moderate improvement, underscoring the limitations of traditional, verbally-driven instruction in teaching abstract concepts like time. The positive outcomes observed in the experimental group highlight the value of visual scaffolding and interactive learning environments in early childhood education.

The study provides empirical evidence and pedagogical direction for integrating visual representations into early mathematics and cognitive development curricula. By making time "visible" and accessible, these strategies improve conceptual understanding and support broader competencies such as planning, sequencing, and reasoning. The research affirms that intentional and well-structured visual interventions can play a transformative role in helping young children bridge the gap between everyday experience and abstract thought.

Although this study provides compelling evidence for the effectiveness of visual models in supporting preschool children's understanding of time concepts, several promising directions for future research remain. Subsequent studies could expand the scope to include a broader range of age groups within early childhood to determine developmental differences in responsiveness to visual representations. It is also important to examine the long-term sustainability of the intervention's effects and its applicability across diverse educational contexts, such as rural, mountainous, or inclusive classrooms. Furthermore, integrating digital technologies, such as interactive applications or smart boards, into visual instruction may offer

more flexible and engaging learning modalities for young children. Finally, exploring the relationship between temporal understanding and key cognitive skills such as memory, attention, and basic planning could further elucidate the role of time education in fostering young children's thinking and self-regulation.

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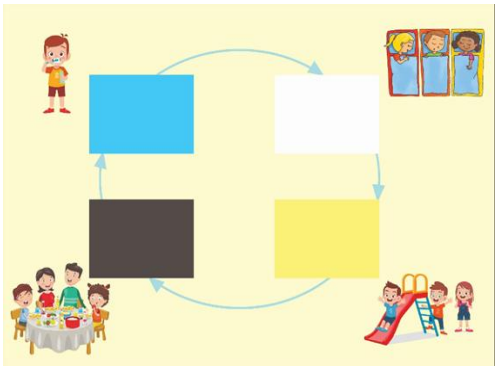
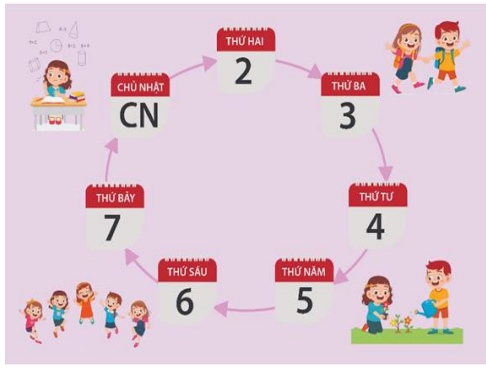
APPENDIX

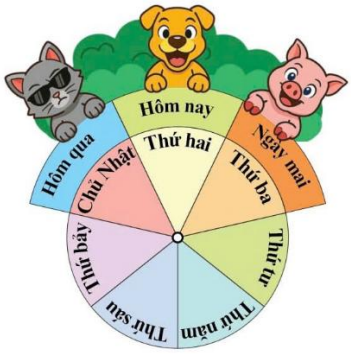
VISUAL REPRESENTATIONS



Representation of daily time segments



Visual representation of the days of the week



Visual representation of the concepts of yesterday, today, and tomorrow

Representation of weekday, date, month, and year

Visual representation of the months of the year