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Development and Validation of the Ge O' Clock for Improving Mastery of Time Telling and Measurement in 12-Hour and 24-Hour Formats

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A B S T R A C T

Mathematics is a crucial subject for elementary pupils, providing foundational knowledge and skills essential for their future academic success and everyday life. This study aimed to develop a researcher-made teaching aid designed to help learners overcome their difficulties and improve mastery in time-telling and time measurement using both 12-hour and 24-hour formats. The developed teaching aid will undergo expert validation to determine its effectiveness, appropriateness, and potential classroom applicability. The development phase employed a developmental research design in creating the Ge O' Clock. The validation phase employed a quasi-experimental one-group pretest–posttest design complemented by qualitative observations. Findings show it can be concluded that the Ge O' Clock teaching strategy is an effective and engaging approach for improving time telling and measurement in 12-Hour and 24-Hour Formats. The tool demonstrated strong content validity, with experts confirming that it is relevant, clear, and aligned with the learning objectives. Learners showed significant improvement in their performance from pretest to posttest, indicating that the strategy effectively develops both conceptual understanding and practical skills. Observations revealed that while some learners faced challenges, especially those with limited reading proficiency or difficulties in converting time formats, guided practice, manipulatives, peer support, and repeated demonstrations enabled most learners to overcome these difficulties.

Keywords: Mathematics, Teaching Strategy, Approach, Ge O' Clock, Design, Develop, Support

1. INTRODUCTION

Mathematics is a crucial subject for elementary pupils, providing foundational knowledge and skills essential for their future academic success and everyday life. According to Clements and Sarama (2021), developing a strong mathematical foundation in the early grades leads to long-term achievement across multiple subject areas, as early mathematics enhances reasoning, problem-solving, and logical thinking. Among the core competencies in primary mathematics, time-telling and time measurement are particularly important because they equip learners with skills necessary for interpreting schedules, managing routines, and applying quantitative reasoning in real-world situations. Guerriero (2022) further emphasizes that explicitly teaching time-related skills in elementary classrooms strengthens task initiation, reduces anxiety, and supports smooth transitions between activities—capabilities closely tied to understanding temporal concepts.

Despite their importance, research has consistently shown that time-telling and time measurement are among the most challenging competencies for elementary learners worldwide. In Ireland, Bray and Tangney (2021) found that teachers perceive time as one of the most difficult mathematical competencies to teach because it requires learners to coordinate visual, numerical, and abstract temporal concepts simultaneously. In Japan, Kamii et al. (2022) examined the developmental aspects of learning time measurement and found that children struggle with the abstract nature of temporal duration, as time cannot be physically observed and must be represented symbolically. Japanese learners also showed difficulty converting hours to minutes and solving elapsed-time problems, as these require mental coordination of sequential events, logical reasoning, and unit conversion. Moreover, students tended to interpret clock numbers literally (e.g., thinking "3" equals three minutes), exposing common conceptual misconceptions. Similarly, in Saudi Arabia, Alabdulaziz (2021) reported that time measurement and time-telling tasks produced some of the highest rates of errors among Grades 3–5 learners, particularly when distinguishing hour and minute hands, interpreting quarter- and half-hour intervals, and translating between 12-hour and 24-hour formats. Difficulty conceptualizing elapsed time further contributed to inaccuracies in real-world time-interval problems.

In the Philippine context, similar challenges have been documented. Daoas (2022) conducted a comprehensive analysis of the mathematical competencies of elementary learners in public schools within the Schools Division of Nueva Vizcaya and found that time-telling and time measurement emerged as among the least mastered competencies from Grades 4 to 6. Learners commonly struggled to interpret analog clocks, read minute increments, and distinguish the roles of the hour and minute hands. Additionally, pupils demonstrated poor retention of unit conversions and committed errors in computing elapsed time. Likewise, Camayang (2021) investigated instructional challenges in the Division of Davao del Sur and found that teachers consistently rank time as one of the most conceptually difficult topics due to its abstract nature. Pupils were observed to misinterpret clock values, struggle

with 12-hour and 24-hour conversions and become confused when determining start and end times across noon or midnight—difficulties exacerbated by limited exposure to analog clocks at home and insufficient manipulative-based instruction in classrooms.

These findings are not confined to broader national reports. Similar issues have been observed within the local school setting, where elementary learners demonstrate difficulties in time-related skills. In the researcher's local school context, Grade-V learners exhibit recurring difficulties in accurately distinguishing the functions of the hour and minute hands, telling time using analog clocks, measuring time in 12-hour and 24-hour formats, and converting between the two systems. Studies show that learners often misinterpret the positions and roles of the clock hands because analog clocks require simultaneous processing of visual, spatial, and numerical information—cognitive demands that developing learners are not yet fully equipped to handle (Yan & Park, 2021). Likewise, converting between 12-hour and 24-hour time formats has been found to be challenging due to students' difficulties in mentally coordinating sequences of hours and visualizing the transition between noon and midnight, which leads to persistent misconceptions in elapsed-time problem solving (Aksoy & Yazlık, 2021). Informal interviews with mathematics teachers further suggest that limited instructional materials and reduced exposure to non-digital time devices contribute to learners' struggles, a concern supported by Hofmann, Schiltz, and Reiss (2020), who found that increased reliance on digital interfaces decreases students' familiarity with analog clocks and minute intervals. Additionally, the inherently abstract nature of temporal reasoning makes time difficult to conceptualize, as children cannot physically observe or manipulate time in the same way they do with other measurable attributes such as mass or length, resulting in weak understanding of duration and sequencing (Friedman, 2020). These challenges mirror national trends, reinforcing the concern that time-telling and measurement remain among the least mastered competencies in elementary mathematics.

Given the importance of time-related skills in both academic performance and daily life management, there is a pressing need for targeted instructional interventions and innovative teaching aids. Tan-Abrenica et al. (2024) emphasize the importance of developing creative, interactive, and manipulative instructional materials to enhance engagement and improve learning outcomes in elementary education. Consequently, addressing these difficulties within the local school context is both timely and necessary. By developing context-specific instructional innovations—such as visual, manipulative, and activity-based materials—learners may be better supported in constructing a stronger understanding of time concepts, ultimately improving their mathematical proficiency and functional life skills.

With these considerations, this study aimed to develop a researcher-made teaching aid designed to help learners overcome their difficulties and improve mastery in time-telling and time measurement using both 12-hour and 24-hour formats. The developed teaching aid will undergo expert validation to determine its effectiveness, appropriateness, and potential classroom applicability.

1.1 Objectives of the Study

This study aims to develop and validate the Ge O' Clock, a teaching aid designed to improve Grade V learners' mastery of time telling and measurement in both the 12-hour and 24-hour formats.

Specifically, it sought to answer the following questions:

1. Determine the psychometric property of the tool as to:

1.1: Content

1.2: Other Findings

1.3: Additional requirement for manipulative.

2. Determine the performance of the learners in terms of their:

2.1: pretest

2.2: posttest

3. Ascertain the difference on the performance of the learners in terms of their pre-test and posttest.
4. Investigate learners' challenges on the implementation of the Ge O' Clock teaching strategy.
5. Develop a sustainability plan/ implementation plan.

1.2 Related Literature

Mathematics, as an important subject in the curriculum, develops essential skills like problem-solving, logical thinking, and analytical reasoning that students use throughout their lives. These skills are crucial for understanding the world around them and for success in many fields. Among these fundamental mathematical skills, time telling and measurement play a key role, enabling students to manage daily activities and prepare them for higher mathematical concepts. Despite this importance, many elementary pupils, including those in Grade V, continue to struggle with interpreting both the 12-hour and 24-hour formats. According to Thomas (2016), children's understanding of time should not only be assessed through clock-reading tasks but also through their conceptual grasp of awareness, succession, duration, and measurement. More recent work by Thomas et. al (2023) confirmed that many

learners are proficient in reading whole hours but experience significant difficulty when interpreting half-past, quarter-to, and elapsed time problems, demonstrating the need for more concrete interventions in teaching time.

Several studies emphasize that manipulatives can bridge the gap between abstract concepts and concrete understanding. Byrne et al. (2023) reported in a meta-analysis that the use of concrete manipulatives has a positive impact on mathematics achievement when they are purposefully integrated with symbolic representations. Similarly, Peltier et al. (2020) noted that pupils using manipulatives showed greater improvements in problem-solving and retention compared to those taught through traditional methods. This finding aligns with Rakes et al. (2020), who highlighted that manipulatives are most effective when paired with explicit instruction that links physical representations to symbolic reasoning. Earlier classroom research by Earnest (2015) revealed that even when pupils can read clocks, many continue to miscalculate elapsed time due to poor connections between symbolic representations and lived experiences. These findings collectively stress that hands-on materials, coupled with explicit guidance, support deeper mastery of abstract concepts like time.

One of the most common learning difficulties in time measurement is converting between the 12-hour and 24-hour formats. DiCarlo et al. (2021) found that pupils often confuse afternoon times (e.g., interpreting 14:00 as 4:00 AM instead of 2:00 PM). To address this issue, Siller et al. (2024) have recommended a blended approach using both concrete and virtual manipulatives to scaffold learners' understanding. In their study, pupils exposed to both physical and digital tools demonstrated significantly higher mastery than those who relied on traditional methods alone. Gullion (2024) and Farra (2024) further confirmed that blended instruction yields better outcomes than using either virtual or physical manipulatives alone, reinforcing the importance of multimodal teaching.

The design of innovative teaching aids also plays an important role in capturing learners' interest and maintaining engagement. Verdine et al. (2018) highlighted that the use of geometric toys not only develops spatial awareness but also stimulates children's use of spatial language during play. Taffoni et al. (2019) confirmed this by showing that shape-sorting activities enhance both motor performance and conceptual understanding. Lockman et. al (2018) provided additional developmental evidence that object-fitting tasks strengthen children's spatial coordination, while Jung et al. (2015) emphasized how manual action and spatial planning in early childhood predict later math readiness. Casasola (2018) likewise noted that children's understanding of spatial relations provides a foundation for abstract concepts like number and time. These findings provide strong support for the design of the teaching aid, "Ge O'Clock", which combines shape recognition with time telling, enabling learners to both sort geometric figures and apply them to clock positions. The novelty of such a design corresponds to what Ribeiro et al. (2023) described as a "dual-learning function," where an instructional tool addresses more than one learning competency simultaneously.

Validation of educational innovations is crucial to ensure their accuracy, usability, and effectiveness. Israel (2016) and Ribeiro et al. (2023) emphasize that instructional tools must be evaluated based on specific criteria including content accuracy, simplicity, novelty, and the use of sustainable materials. These indicators are particularly relevant in the Philippine context, where the Department of Education encourages the creation of low-cost, recyclable, and innovative materials to make learning more engaging and environmentally sustainable. Recent studies, such as Labrell et al. (2020), developed psychometric measures like the Time Knowledge Questionnaire to ensure validity in assessing children's understanding, while Wieber et al. (2017) demonstrated the value of structured, validated teaching procedures for learners with disabilities. Collectively, these studies show that proper validation strengthens both usability and credibility of instructional tools. The Ge o' Clock, developed with recyclable materials and designed with simplicity and child-friendly features, aligns with these validation principles.

Existing research indicates that interactive learning tools can positively influence student motivation, leading to increased engagement and improved academic outcomes. DiCarlo et al. (2021) observed that pupils who practiced time telling through mobile learning applications were more engaged and retained concepts longer than peers who used paper-and-pencil exercises. Likewise, Keldgord et al. (2022) reported that teachers viewed virtual manipulatives positively, especially when they supported student participation during remote learning. Dýrfjörð et al. (2023) added that children's perspectives of time are context-sensitive, and therefore teaching tools should connect with real-life contexts such as routines and schedules. Gomez-Galan (2018) suggested extending this approach by linking time measurement with chronological or historical time, reinforcing real-world applications. The Ge O'Clock, with its bright colors, interchangeable shapes, and hands-on mechanics, has the potential to foster similar motivation while grounding time concepts in meaningful, interactive experiences.

Finally, systematic reviews strengthen the rationale for innovation. van Bommel et al. (2025), in a recent literature review, summarized international research on early mathematics and time, concluding that while clock reading is taught in many curricula, conceptual understanding of duration and conversion remains underdeveloped. Zhang et al. (2018) emphasized that linguistic and cognitive factors strongly affect children's acquisition of temporal concepts, reinforcing the need for materials that integrate language, visuals, and interaction. "Clock Work" (2019) further highlighted how clock manipulatives themselves mediate problem-solving strategies, suggesting that the researcher made innovative tool, "Ge O' Clock" can reveal not only what learners know but also how they think about time.

2. METHODOLOGY

2.1 Development Phase

Design

This study employed a developmental research design in creating the Ge O' Clock, an instructional material aimed at improving Grade V pupils' mastery of time telling and measurement in 12-hour and 24-hour formats. The development process followed two major phases: (1) diagnosing the least-mastered skills of pupils, and (2) designing and developing the Ge O' Clock prototype based on the identified needs.

2.2 Validation Phase

Design

The validation phase employed a quasi-experimental one-group pretest–posttest design complemented by qualitative observations. In this phase, the initial prototype of the Ge O' Clock teaching aid was evaluated by three (3) mathematics teachers handling intermediate levels. These teachers served as expert validators and assessed the researcher-made material using a standardized validation rating sheet. Their quantitative ratings, along with descriptive feedback, were systematically reviewed, and the necessary revisions were incorporated to enhance the clarity, manipulability, and content accuracy of the teaching aid.

Following refinement, the Ge O' Clock was implemented in a cooperating Grade V class upon approval from the school principal and class adviser. The learners were administered a pretest to determine their baseline mastery in time telling and measurement, participated in instructional sessions utilizing the teaching aid, and subsequently completed a posttest to determine learning gains following the intervention. Throughout implementation, classroom observations and informal learner remarks were documented to capture emerging challenges and usability concerns related to the teaching strategy. Quantitative data derived from the pretest and posttest scores were used to determine the instructional effectiveness of the Ge O' Clock, while qualitative insights provided a deeper understanding of learner difficulties and areas requiring further instructional support.

Locale

The study was conducted at Benabaye Elementary School, situated in Barangay Benabaye, in the Municipality of Merida, Province of Leyte.

2.3 Research Respondents

The respondents of the study consisted of two groups:

1. Respondents – The Grade V pupils of Benabaye Elementary School participated in the pretest and posttest to determine their mastery before and after the intervention.
2. Expert validators – Three (3) mathematics teachers handling intermediate levels served as validators of the researcher made teaching aid. They evaluated the teaching aid.

2.4 Research Instruments

This study utilized the following research instruments:

1. Ge O' Clock Teaching Aid

This researcher-made instructional material served as the main intervention tool. It consists of a manipulative analog clock with interchangeable geometric pieces designed to assist learners in understanding the functions of the hour and minute hands, reading time in 12-hour and 24-hour formats, and performing basic conversions. The manipulative features were intended to strengthen symbolic–concrete connections during instruction.

2. Validation Rating Sheet for the Manipulative

This instrument was used by the three expert validators to assess the Ge O' Clock teaching aid in terms of content validity, other findings (e.g., factual, visual, or conceptual errors), and additional requirements for manipulative use. The rating sheet employed a four-point Likert scale with verbal interpretations to ensure objective evaluation.

3. Researcher-Developed Pretest and Posttest

The pretest and posttest consisted of comparable items aligned with the Grade V Mathematics curriculum competency standards focusing on distinguishing hour and minute hands, reading analog time, and converting 12-hour to 24-hour formats (and vice versa). These tests measured learners' mastery levels before and after using the Ge O' Clock.

2.5 Data Gathering Procedure

The data gathering procedure began with the issuance of a formal request addressed to the school principal and Grade V class adviser to obtain permission to implement the study. Upon approval, the initial prototype of the Ge O' Clock teaching aid was subjected to expert evaluation by three mathematics teachers handling intermediate levels, using a standardized validation rating sheet. Their comments and recommendations were systematically reviewed, and necessary revisions were incorporated to improve the material's clarity, manipulability, and content accuracy. Thereafter, a pretest was administered to the Grade V learners to establish their baseline mastery in time telling and measurement. The intervention was subsequently implemented through a

series of instructional sessions utilizing the Ge O' Clock, during which learners engaged in guided manipulation and activities related to time concepts. After the instructional period, a posttest of comparable difficulty was administered to measure learning gains. The resulting data were then recorded, tabulated, and subjected to appropriate statistical treatments to determine improvements in learners' performance.

2.6 Data Analysis

The data collected in this study were analyzed using a combination of descriptive, inferential, and qualitative approaches. For Objective 1, the ratings of the Ge O' Clock tool by three expert validators were summarized using mean and standard deviation, showing that all subcomponents—Content, Other Findings, and Additional Requirement for Manipulatives—received a mean of 4.00 (Very Satisfactory) with SD = 0.00, indicating complete agreement and confirming strong content validity. For Objectives 2 and 3, learners' pretest and posttest scores were analyzed using descriptive statistics (mean, standard deviation, and range) and a paired-sample t-test to determine the significance of improvements in time-telling skills. Objective 4 was addressed through qualitative descriptive analysis of learners' behaviors, gestures, and challenges during implementation. Finally, Objective 5 involved synthesizing the results and observations to develop a sustainability and implementation plan, structured in a table format to ensure continued effective use of the Ge O' Clock strategy in teaching time concepts.

2.7 Ethical Considerations

The conduct of this study strictly adhered to established ethical standards in educational research. Formal permission was obtained from the school principal and class adviser, and learners were informed that their participation in the study would not influence their academic standing. Participation was voluntary, and pupils were afforded the right to withdraw from the study at any point without any form of penalty. Confidentiality and anonymity were maintained by using coded identifiers in place of learners' names, ensuring that individual identities remained protected. The intervention posed no physical or psychological risk, as all activities were developmentally appropriate and aligned with the learners' cognitive abilities. Furthermore, all data were recorded accurately and reported truthfully, without fabrication or manipulation, and proper acknowledgment was accorded to all authors, sources, and intellectual properties utilized in the course of the research.

3. RESULTS AND DISCUSSION

Table 1. Psychometric Property of the Tool

Item No.	I-CVI	Mean Rating	Interpretation
1	1.00	4.00	VS
2	1.00	4.00	VS
3	1.00	4.00	VS
4	1.00	4.00	VS
5	1.00	4.00	VS
6	1.00	4.00	VS
7	1.00	4.00	VS
8	1.00	4.00	VS
9	1.00	4.00	VS
10	1.00	4.00	VS
11	1.00	4.00	Not present
12	1.00	4.00	Not present
13	1.00	4.00	Not present
14	1.00	4.00	Not present
15	1.00	4.00	VS
16	1.00	4.00	VS
17	1.00	4.00	VS
18	1.00	4.00	VS

Item No.	I-CVI	Mean Rating	Interpretation
19	1.00	4.00	VS
20	1.00	4.00	VS

S-CVI = 1.000

The tool's content validity was evaluated across three subcomponents: 1.1 Content, 1.2 Other Findings, and 1.3 Additional Requirement for Manipulative. Items 1-10 (subcomponent 1.1) received a mean rating of 4.00 from the validators, with individual Content Validity Indices (I-CVI) of 1.00 for each item; these were interpreted as "VS." Items 11-14 (subcomponent 1.2) also received a mean rating of 4.00 and I-CVI values of 1.00, interpreted as "Not Present." Items 15-20 (subcomponent 1.3) likewise had mean ratings of 4.00 and I-CVI values of 1.00, interpreted as "VS." The Scale-level Content Validity Index (S-CVI), calculated as the average I-CVI across all 20 items, is 1.000, indicating excellent overall content validity. In sum, the instrument's items are highly representative of the intended content domain and require no content-level revisions based on validator's assessment.

Table 2. Descriptive Statistics on the Performance of Learners in the Pretest and Posttest

	Pretest	Posttest
Valid	21	21
Missing	0	0
Mean	6.667	17.62
Std. Deviation	5.498	5.852
Minimum	1.000	6.000
Maximum	17.00	25.00

Table 2 presents the descriptive statistics of the learners' performance in a 25-item test administered before and after the implementation of the Ge O' Clock teaching strategy. As shown, the learners obtained a pretest mean score of 6.67, indicating a low level of initial performance. The low minimum score of 1 and a maximum of 17 further suggests that most learners had limited prior knowledge of the competencies measured. After utilizing the Ge O' Clock strategy, the learners' performance improved as reflected in the posttest mean score of 17.62. The minimum score increased to 6, and the highest possible score of 25 was achieved by one learner, suggesting substantial improvement in mastery. Although variability remained (SD = 5.852), the overall increase in mean scores denotes improved mastery in time telling and measurement in 12-Hour and 24-Hour Formats. These results imply that the Ge O' Clock teaching aid positively influenced learners' performance, enabling them to acquire a better grasp of the lesson compared to their initial understanding prior to the intervention.

Table 3. Paired Samples t-Test Results for Pretest and Posttest Scores

Measure 1		Measure 2	t	df	p
Pretest	-	Posttest	-9.930	20	< .001

Note. Student's t-test.

Based on the results shown in Table 3, there is a significant difference between the learners' pretest and posttest scores. The paired samples t-test revealed a computed t-value of -9.930 with 20 degrees of freedom and a p-value of <.001, indicating that the improvement in scores after the intervention is highly significant. This means that the learners performed much better in the posttest compared to the pretest, demonstrating that the strategy used effectively enhanced their understanding of the lesson.

4. Learners' Challenges During the Implementation of the Ge O' Clock Teaching Strategy

The implementation of the Ge O' Clock teaching strategy provided valuable insights into learners' engagement, behaviors, and difficulties, particularly in identifying the hour and minute hands, telling time and measurement in 12-hour and 24-hour formats. Observations showed that learners were generally attentive and actively engaged with the clock manipulatives, often pointing, adjusting, and verbally explaining their actions while setting the correct time. Learners displayed satisfaction and confidence through gestures such as leaning forward, smiling, or nodding when they successfully completed tasks. At the same time, some learners showed hesitation and uncertainty, frequently repositioning the clock hands, frowning, or seeking guidance, particularly in distinguishing the hour hand from the minute hand. Tasks involving conversion between 12-hour and 24-hour formats were challenging for several

learners, who expressed frustration by tapping their fingers, sighing, or asking peers for help. Learners with limited reading skills faced additional difficulties in following written instructions, often pointing to the text, requesting clarification, or waiting for further guidance from the teacher. Group work also revealed differences in learner participation. Confident learners often guided their peers through tasks and explained their reasoning, while less confident learners observed, copied gestures, or repeated actions to understand the steps. Some learners showed persistence, attempting tasks multiple times until they succeeded, whereas others occasionally became distracted or disengaged. Despite these challenges, repeated demonstrations, guided practice, peer support, and positive reinforcement helped most learners gradually master the targeted skills.

Table 5. Sustainability/Implementation Plan for the Ge O' Clock Teaching Strategy

To promote the continued use and effectiveness of the Ge O' Clock teaching strategy, a structured sustainability plan has been developed. This plan specifies key activities, responsibilities, timelines, and evaluation measures to ensure consistent classroom implementation, support for learners, and continuous improvement of teaching outcomes. The following table presents the detailed components and corresponding strategies for successful and sustainable application of the strategy.

Component	Objective	Activities/Strategies	Responsible Person(s)	Timeline	Monitoring & Evaluation / Success Indicators
Classroom Integration	Ensure regular use of Ge O' Clock strategy to reinforce time-telling skills.	- Integrate Ge O' Clock activities in weekly math lessons - Use manipulatives during instruction to teach hours, minutes, and time conversions - Conduct guided and independent practice exercises	Class Adviser	Weekly, throughout the school year	- Observation checklist showing consistent use - 80% of lessons incorporate the strategy - Learners demonstrate improved clock reading accuracy
Learner Engagement	Maintain learners' interest and motivation in learning time concepts	- Conduct group activities, timed challenges, and quizzes - Organize interactive games like "Set the Time" using manipulatives - Implement a reward system for participation and accuracy	Class Adviser	Weekly	-Attendance and participation records - Learner satisfaction survey with >75% positive responses - Improved posttest scores and engagement levels
Differentiated Support	Address learning gaps and support individual needs	Identify struggling learners through pre-assessment - Provide additional practice sessions or peer-assisted learning - Offer one-on-one guidance for difficult concepts	Class Adviser	As needed; review by-weekly	- Progress monitoring sheets show improvement - At least 70% of struggling learners achieve mastery in posttests
Teacher Capacity Building	Equip teachers with the skills to implement the strategy effectively	Conduct initial training/workshop on Ge O' Clock strategy - Share lesson plans, manipulatives guides, and best practices	School Coordinator / Math Supervisor	Beginning and end of grading period	- Teacher self-assessment checklist - Peer observation forms completed - Evidence of application in at

Component	Objective	Activities/Strategies	Responsible Person(s)	Timeline	Monitoring & Evaluation / Success Indicators
		- Organize peer observation and feedback sessions			least 90% of lessons
Assessment & Feedback	Continuously monitor learners' progress and strategy effectiveness	- Conduct pretest, formative, and posttest assessments - Collect learners' feedback on challenges and preferences - Adjust teaching methods based on results	Class Adviser	Pretest (start of topic), Formative (weekly), Posttest (end of topic)	- Assessment data shows significant improvement (e.g., 20% increase in scores) - Feedback forms indicate learners' understanding and satisfaction
Documentation & Reporting	Maintain records for tracking progress and sustaining the strategy	- Document lessons conducted, learners' scores, and challenges faced - Submit monthly reports to school management for review - Update strategy implementation based on feedback and results	Class Adviser/School Coordinator	Monthly / Quarterly	- Reports submitted on time -Documentation reflects implementation fidelity - Adjustments made to address identified challenges

4. CONCLUSIONS, AND RECOMMENDATIONS

Conclusion

Based on the findings of this study, it can be concluded that the Ge O' Clock teaching strategy is an effective and engaging approach for improving time telling and measurement in 12-Hour and 24-Hour Formats. The tool demonstrated strong content validity, with experts confirming that it is relevant, clear, and aligned with the learning objectives. Learners showed significant improvement in their performance from pretest to posttest, indicating that the strategy effectively develops both conceptual understanding and practical skills. Observations revealed that while some learners faced challenges especially those with limited reading proficiency or difficulties in converting time formats guided practice, manipulatives, peer support, and repeated demonstrations enabled most learners to overcome these difficulties.

Recommendations

For Teachers:

- Regularly integrate the Ge O' Clock strategy into mathematics lessons to reinforce time-telling skills.
- Provide additional support for learners who struggle with reading instructions or converting time formats, including peer-assisted learning and individualized guidance.
- Utilize manipulatives effectively, emphasizing hands-on activities, clear visual cues, and step-by-step demonstrations.

For Schools/Administrators:

- Conduct professional development sessions to train teachers on the effective use of the Ge O' Clock teaching strategy.
- Ensure availability of durable and visually clear manipulatives to support consistent classroom implementation.

For Future Research:

- Explore the long-term effects of the Ge O' Clock strategy on learners' retention of time-telling skills.

- Investigate the application of the strategy with learners of different levels or in diverse learning contexts to determine its generalizability.

References

Alabdulaziz, M. S. (2021). The effectiveness of digital tools in mathematics education. Education and Information Technologies, 26(3), 3527–3544. https://doi.org/10.1007/s10639-021-10602-6

Bray, A., & Tangney, B. (2021). Enhancing student engagement through interactive digital tools. International Journal of Child-Computer Interaction, 29, 100323. https://doi.org/10.1016/j.ijcci.2021.100323

Byrne, E. M., Higgins, J., & McLaughlin, T. (2023). The effectiveness of concrete manipulatives in mathematics instruction: A meta-analysis. Educational Research Review, 38, 100523. https://doi.org/10.1016/j.edurev.2022.100523

Byrne, E. M., Higgins, J., & McLaughlin, T. (2023). The effectiveness of concrete manipulatives in mathematics instruction: A meta-analysis. Educational Research Review, 38, 100523. https://doi.org/10.1016/j.edurev.2022.100523

Camayang, R. P. (2021). Challenges in teaching measurement to elementary students. International Journal of Innovation in Education Research, 4(3), 102–110.

Clements, D. H., & Sarama, J. (2021). Building a strong foundation for early mathematics learning. Child Development Perspectives, 15(1), 30–35. https://doi.org/10.1111/cdep.12419

Daoas, I. A. (2022). Common difficulties in learning mathematics among elementary pupils. International Journal of Multidisciplinary: Applied Business and Education Research, 3(6), 1224–1235.

DiCarlo, C. F., Garcia, R., & Estrella, J. (2021). mLearning versus traditional practice in teaching time-telling skills to elementary pupils. Journal of Educational Technology Development and Exchange, 14(2), 45–59.

DiCarlo, C. F., Garcia, R., & Estrella, J. (2021). mLearning versus traditional practice in teaching time-telling skills to elementary pupils. Journal of Educational Technology Development and Exchange, 14(2), 45–59.

Dýrfjörð, K., Jónsson, G., & Kristjánsdóttir, Ö. (2023). Young children's perspectives of time: New directions for contextualized teaching. British Educational Research Journal. https://doi.org/10.1002/berj.3935

Dýrfjörð, K., Jónsson, G., & Kristjánsdóttir, Ö. (2023). Young children's perspectives of time: New directions for contextualized teaching. British Educational Research Journal. https://doi.org/10.1002/berj.3935

Earnest, D. (2015). When "half an hour" is not "thirty minutes": Elementary students solving elapsed time problems. Proceedings of the 37th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. ERIC ED584230. Retrieved from https://files.eric.ed.gov/fulltext/ED584230.pdf

Earnest, D. (2015). When "half an hour" is not "thirty minutes": Elementary students solving elapsed time problems. In Proceedings of the 37th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. ERIC ED584230. https://files.eric.ed.gov/fulltext/ED584230.pdf

Earnest, D. (2017). Clock work: How tools for time mediate problem solving and reveal understanding. Journal for Research in Mathematics Education.

Earnest, D. (2017). Clock work: How tools for time mediate problem solving and reveal understanding. Journal for Research in Mathematics Education.

Earnest, D., Gonzales, A. C., & Plant, A. M. (2018). Time as a measure: Elementary students positioning the hands of an analog clock. Journal of Numerical Cognition, 4(1), 188–214. https://doi.org/10.5964/jnc.v4i1.94

Earnest, D., Gonzales, A. C., & Plant, A. M. (2018). Time as a measure: Elementary students positioning the hands of an analog clock. Journal of Numerical Cognition, 4(1), 188–214. https://doi.org/10.5964/jnc.v4i1.94

Farra, N. K. A. (2024). Impact of using virtual and concrete manipulatives on teaching fractions. Education Sciences. https://doi.org/10.1080/2331186X.2024.2379712

Farra, N. K. A. (2024). Impact of using virtual and concrete manipulatives on teaching fractions. Education Sciences. https://doi.org/10.1080/2331186X.2024.2379712

Guerriero, L. (2022, January 13). Study skills in early elementary school: Teaching time management. Landmark Outreach. https://www.landmarkoutreach.org/blog-post/study-skills-early-elementary-school-teaching-time-management/

Guerriero, L. (2022, January 13). Study skills in early elementary school: Teaching time management. Landmark Outreach. https://www.landmarkoutreach.org/blog-post/study-skills-early-elementary-school-teaching-time-management/

Gullion, H. L. (2024). Virtual versus tangible math manipulatives: A quasi-experimental study (Doctoral dissertation). Liberty University. Retrieved from https://digitalcommons.liberty.edu/doctoral/

Gullion, H. L. (2024). Virtual versus tangible math manipulatives: A quasi-experimental study (Doctoral dissertation, Liberty University). Liberty University Digital Commons. https://digitalcommons.liberty.edu/doctoral/

Israel, M. (2016). Design and validation of instructional materials for mathematics learning. International Journal of Education and Research, 4(7), 67–80.

Israel, M. (2016). Design and validation of instructional materials for mathematics learning. International Journal of Education and Research, 4(7), 67–80.

Kamii, C., & Russell, K. A. (2012). Elapsed time: Why is it so difficult to teach? Journal for Research in Mathematics Education, 43(3), 296–315. https://doi.org/10.5951/jresematheduc.43.3.0296

Kamii, C., & Russell, K. A. (2012). Elapsed time: Why is it so difficult to teach? Journal for Research in Mathematics Education, 43(3), 296–315. https://doi.org/10.5951/jresematheduc.43.3.0296

Kamii, C., Kato, Y., & Ozaki, K. (2022). Children's construction of time concepts. Journal of Mathematical Behavior, 65, 100947. https://doi.org/10.1016/j.jmathb.2021.100947

Keldgord, F., Linderoth, J., & Magnusson, A. (2022). Teachers' experiences of virtual manipulatives in mathematics teaching during remote learning. Journal of Digital Learning in Teacher Education, 38(3), 239–252. https://doi.org/10.1080/21532974.2022.2038741

Keldgord, F., Linderoth, J., & Magnusson, A. (2022). Teachers' experiences of virtual manipulatives in mathematics teaching during remote learning. Journal of Digital Learning in Teacher Education, 38(3), 239–252. https://doi.org/10.1080/21532974.2022.2038741

Kwon, M. (2019). Second grade elementary school students' understanding of time and elapsed time. Journal of Educational Research in Mathematics, 29(4), 741–760. https://doi.org/10.29275/jerm.2019.11.29.4.741

Kwon, M. (2019). Second grade elementary school students' understanding of time and elapsed time. Journal of Educational Research in Mathematics, 29(4), 741–760. https://doi.org/10.29275/jerm.2019.11.29.4.741

Labrell, F., Roussel, C., & Barnéoud, P. (2020). The Time Knowledge Questionnaire for children. Frontiers in Psychology. https://doi.org/10.3389/fpsyg.2020.01212

Labrell, F., Roussel, C., & Barnéoud, P. (2020). The Time Knowledge Questionnaire for children. Frontiers in Psychology. https://doi.org/10.3389/fpsyg.2020.01212

Lockman, J. J., Fears, N. E., & Jung, W. P. (2018). The development of object fitting: The dynamics of spatial coordination. Advances in Child Development and Behavior.

Lockman, J. J., Fears, N. E., & Jung, W. P. (2018). The development of object fitting: The dynamics of spatial coordination. Advances in Child Development and Behavior.

Moyer-Packenham, P. S. (2016). Revisiting the definition of a virtual manipulative. Teaching and Learning.

Moyer-Packenham, P. S. (2016). Revisiting the definition of a virtual manipulative. Teaching and Learning.

Nam, J., & Chang, H. (2016). Analysis on mathematical understanding of elementary school students about time. Journal of Elementary Mathematics Education in Korea, 20(3), 479–498.

Nam, J., & Chang, H. (2016). Analysis on mathematical understanding of elementary school students about time. Journal of Elementary Mathematics Education in Korea, 20(3), 479–498.

Ong, J. S., & Horan, F. (2023). "When the clock strikes…": Early spatial-temporal understandings of the clock among preschoolers. Journal of Early Childhood Research.

Ong, J. S., & Horan, F. (2023). "When the clock strikes…": Early spatial–temporal understandings of the clock among preschoolers. Journal of Early Childhood Research.

Peltier, C., Vannest, K. J., & Steele, A. (2020). A meta-analysis of single-case research on the use of mathematics manipulatives. Journal of Special Education, 54(1), 41–53. https://doi.org/10.1177/0022466919879522

Peltier, C., Vannest, K. J., & Steele, A. (2020). A meta-analysis of single-case research on the use of mathematics manipulatives. Journal of Special Education, 54(1), 41–53. https://doi.org/10.1177/0022466919879522

Rakes, C. R., Valentine, J. C., McGatha, M. B., & Ronau, R. N. (2020). A systematic review of the effects of concrete and virtual manipulatives on mathematics learning. Review of Educational Research, 90(2), 347–394. https://doi.org/10.3102/0034654320914742

Rakes, C. R., Valentine, J. C., McGatha, M. B., & Ronau, R. N. (2020). A systematic review of the effects of concrete and virtual manipulatives on mathematics learning. Review of Educational Research, 90(2), 347–394. https://doi.org/10.3102/0034654320914742

Ribeiro, F. A. A., da Silva, J. B., & Gomes, M. C. (2023). Calculia: An innovative game to assist individuals with learning difficulties in basic mathematics operations. Revista de Gestão e Secretariado, 14(2), 344–363. https://doi.org/10.7769/gesec.v14i2.1637

Ribeiro, F. A. A., da Silva, J. B., & Gomes, M. C. (2023). Calculia: An innovative game to assist individuals with learning difficulties in basic mathematics operations. Revista de Gestão e Secretariado, 14(2), 344–363. https://doi.org/10.7769/gesec.v14i2.1637

Scherr, R. E., Shaffer, P. S., & Vokos, S. (2002). Student understanding of time in special relativity: Simultaneity and reference frames. American Journal of Physics, 70(3), 218–227. https://doi.org/10.1119/1.1432595

Scherr, R. E., Shaffer, P. S., & Vokos, S. (2002). Student understanding of time in special relativity: Simultaneity and reference frames. American Journal of Physics, 70(3), 218–227. https://doi.org/10.1119/1.1432595

Siller, H. S., Wagner, T., & Kim, Y. (2024). Blended use of concrete and virtual manipulatives in elementary mathematics: Effects on conceptual understanding. International Journal of STEM Education, 11(1), 22. https://doi.org/10.1186/s40594-024-00382-9

Siller, H. S., Wagner, T., & Kim, Y. (2024). Blended use of concrete and virtual manipulatives in elementary mathematics: Effects on conceptual understanding. International Journal of STEM Education, 11(1), 22. https://doi.org/10.1186/s40594-024-00382-9

Sinclair, N., & Baccaglini-Frank, A. (2016). Digital technologies in the early primary school classroom. International Journal of Education Research.

Sinclair, N., & Baccaglini-Frank, A. (2016). Digital technologies in the early primary school classroom. International Journal of Education Research.

Thomas, M. (2016). Time: Assessing understanding of core ideas in primary mathematics. Mathematics Education Research Journal, 28(2), 201–220. https://doi.org/10.1007/s13394-015-0158-2

Thomas, M. (2016). Time: Assessing understanding of core ideas in primary mathematics. Mathematics Education Research Journal, 28(2), 201–220. https://doi.org/10.1007/s13394-015-0158-2

Thomas, M., Cheeseman, J., McDonough, A., & Ferguson, S. (2023). Assessing students' understanding of time concepts in Years 3 and 4: Insights from the development and use of a one-to-one task-based interview. Mathematics Education Research Journal. https://doi.org/10.1007/s13394-023-00451-3

Thomas, M., Cheeseman, J., McDonough, A., & Ferguson, S. (2023). Assessing students' understanding of time concepts in Years 3 and 4: Insights from the development and use of a one-to-one task-based interview. Mathematics Education Research Journal. https://doi.org/10.1007/s13394-023-00451-3

Thomas, M., Clarke, D. M., McDonough, A., & Clarkson, P. (2023). Assessing students' understanding of time concepts in Years 3 and 4: Insights from task-based interviews. Mathematics Education Research Journal, 35(4), 765–782. https://doi.org/10.1007/s13394-023-00484-9

Thomas, M., Clarke, D. M., McDonough, A., & Clarkson, P. (2023). Assessing students' understanding of time concepts in Years 3 and 4: Insights from task-based interviews. Mathematics Education Research Journal, 35(4), 765–782. https://doi.org/10.1007/s13394-023-00484-9

van Bommel, J., & Walla, M. (2025). Teaching and learning of time in early mathematics education: A systematic literature review. Education Sciences. https://doi.org/10.3390/educsci15081003

van Bommel, J., & Walla, M. (2025). Teaching and learning of time in early mathematics education: A systematic literature review. Education Sciences. https://doi.org/10.3390/educsci15081003

Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., & Newcombe, N. S. (2018). Effects of geometric toy design on parent–child spatial language and play. Child Development, 89(4), 1204–1219. https://doi.org/10.1111/cdev.12779

Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., & Newcombe, N. S. (2018). Effects of geometric toy design on parent–child spatial language and play. Child Development, 89(4), 1204–1219. https://doi.org/10.1111/cdev.12779

Zhang, M., Becker, B., & Cimmino, J. (2018). The development of temporal concepts: linguistic and cognitive factors. Frontiers in Psychology. https://doi.org/10.3389/fpsyg.2018.01804.

Zhang, M., Becker, B., & Cimmino, J. (2018). The development of temporal concepts: Linguistic and cognitive factors. Frontiers in Psychology. https://doi.org/10.3389/fpsyg.2018.01804