

How far the Course Review Horay (CRH) model and flashcard enhance scientific attitude and science literacy in fourth-grade force learning?

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Abstract: This study aims to analyze the effect of the Course Review Horay (CRH) Model assisted by Flashcards on developing students' Scientific Literacy (SL) and Scientific Attitude (SA) in Grade IV at elementary school Cluster III, Negara, Bali. Focusing on the Force Chapter, aligned with the demands of Merdeka Curriculum's Deep Learning. Employing a Nonequivalent Pre-test Post-test Control Group Design and a Mixed Methods approach, the research involved 90 students. Quantitative results demonstrated a significant effect on both variables, with increases categorized as moderate to high (T-test). Qualitative analysis indicated that the synergy between the CRH syntax and Flashcards effectively overcomes the conceptual difficulties of the abstract Force material. Flashcards functioned as Visual Concretization of Force Causality, accelerating SL comprehension on PISA indicators. Meanwhile, the competitive Horay! aspect effectively cultivated SA, characterized by Accelerated Decision Making and Internalization of Evidence Through Consensus within the group. The conclusion shows that this model is effective and coherent in bridging students' cognitive and affective dimensions, providing a strong pedagogical contribution to primary level natural and social science learning.

Keywords: Course Review Horay; Flashcard; Scientific Literacy; Scientific Attitude; Force Chapter

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INTRODUCTION

The modern educational landscape urgently demands that students possess strong Scientific Literacy (SL), defined as the ability to engage with science-related issues, reflect on scientific ideas, and utilize evidence to conclude. Beyond cognitive mastery, fostering a positive and critical Scientific Attitude (SA) characterized by curiosity, open-mindedness, and respect for evidence is equally vital for preparing students to navigate complex technological societies (Barus, 2022). In Indonesia, the current curriculum framework emphasizes holistic competence, requiring learning models to simultaneously address both cognitive (SL) and affective (SA) domains from the primary level (Narut & Supardi, 2019).

Despite this imperative, grade four students, typically in the 9-10 age range, often face significant difficulties in mastering core science concepts, particularly within the Force Chapter. Concepts such as gravity, friction, and magnetic force are inherently abstract and intangible, making them hard to visualize and internalize based solely on conventional teaching methods.

This abstract nature leads to common misconceptions, shallow understanding, and consequently, low performance in applying scientific principles a direct reflection of underdeveloped SL (Arlis et al., 2020).

A preliminary analysis of learning outcomes at partner schools, specifically the elementary school at cluster III in Negara, Bali, confirms this educational challenge. Pre-test scores and observational data reveal that students possess a low baseline in both SL and SA. Learning is often teacher-centered, relying heavily on lectures and textbook summaries, which fail to engage students kinesthetically or visually. This environment results in passive learning, inhibiting critical reflection and discouraging the very qualities essential for a robust SA, such as inquiry and collaboration (Daniah, 2020)

To address the documented deficiencies, this study proposes the implementation of the Course Review Horay (CRH) Model integrated with Flashcards as an alternative pedagogical strategy. The CRH model is a cooperative learning structure that injects elements of fun and competition through quick content review and the celebratory "Horay!" affirmation (Ekaputri et al., 2019). This model's quick-paced syntax naturally encourages peer teaching and immediate feedback. Flashcards, serving as visual learning aids, are designed to concretize the abstract mechanics of themes (Nuraini, 2022).

While CRH is known for improving student engagement and basic retention, the existing literature exhibits a significant research gap regarding its simultaneous impact on higher-order competencies like SL (which requires analytical skills) and complex affective variables like SA (Dewi et al., 2019). Furthermore, previous studies often focus on general subjects, lacking specific data on how the CRH mechanism especially its competitive and time-bound review phase interacts with the distinct conceptual challenges presented by the Force Chapter in primary education. This study aims to fill that specificity gap.

Therefore, this study is driven by the central question: "How Far Can the Course Review Horay (CRH) Model and Flashcard Enhance Scientific Attitude and Science Literacy in Force Learning?" The primary objectives are: 1) to determine the significant effect of the CRH Model assisted by Flashcards on students' Scientific Literacy in the Force Chapter; 2) to determine the significant effect of the same intervention on students' Scientific Attitude; and 3) to interpret the mechanism of action between the intervention's syntax and media on the specific indicators of both Scientific Literacy (PISA) and Scientific Attitude (Harlen) based on empirical data.

METHODS

This study employed a mixed methods approach with an explanatory sequential design, where quantitative data collection precedes and informs subsequent qualitative data collection. The quantitative design utilized was the nonequivalent pre-test post-test control group design. The population consisted of all Grade IV students at the elementary school in Cluster III, Negara, Bali. A total of 90 students were selected using a non-randomized technique, forming two intact groups: the experimental group (n=45), which received treatment using the Course Review Horay (CRH) model assisted by flashcards (X1), and the control group (n=45), which followed conventional learning methods (X2). The data collection involved pre-tests (OA1 and OB1) and post-tests (OA2 and OB2) for both SL and SA after a minimum of seven treatment sessions (Dantes, 2017).

Data were collected using both testing and non-testing techniques. SL data were gathered via a 15-item essay test based on PISA dimensions, designed to measure students' ability to explain phenomena and use evidence in the context of the "force chapter". SA data were collected using a 20-item Likert-scale questionnaire (based on Harlen's indicators, such as

curiosity and respect for evidence). For the qualitative strand, in-depth observation was performed during the CRH implementation, and semi-structured interviews were conducted with selected students to gain a deeper understanding of the processes underpinning the quantitative results, focusing specifically on how the CRH syntax and flashcards influenced their learning experience.

Quantitative data analysis commenced with Prerequisite Tests to ensure statistical assumptions were met. This involved the normality test (Kolmogorov-Smirnov) and the homogeneity test (Levene's Test) on both the pre-test and post-test scores. To determine the effectiveness and magnitude of the increase, the N-Gain score was calculated and categorized as low, moderate, or high. The core hypothesis was tested using an Independent Sample T-Test on the post-test scores to assess the difference between the experimental and control groups, addressing the partial hypotheses. Statistical significance was determined by comparing the calculated Sig. value with the significance level ($\alpha=0.05$) (Candiasa, 2020). Furthermore, the correlation between SL and SA was analyzed to establish the overall impact of the intervention.

Qualitative data, derived from in-depth observations during the CRH implementation and semi-structured interviews, were analyzed using the procedure outlined by Miles and Huberman (data reduction, data display, and conclusion drawing). Data reduction involved selecting and focusing the field notes and interview transcripts specifically on interactions related to the CRH syntax and flashcard usage. Data display presented the categorized findings organized by SA indicators (curiosity, open-mindedness). The final step, conclusion drawing, focused on triangulating the qualitative interpretations with the quantitative results, specifically to explain the mechanisms such as visual concretization of force causality and internalization of evidence through consensus that underpinned the observed cognitive and affective enhancements.

RESULTS AND DISCUSSION

Results

The findings of this study are presented in two main parts: a quantitative analysis and a qualitative exploration. The quantitative analysis initially administered pre-tests to both groups to establish the baseline equivalence of SL and SA. The pre-test results, presented in Table 1, showed no significant difference between the experimental and control groups (p -value for T-test > 0.05 on pre-test), confirming the groups' initial parity. Following the seven-session intervention, the post-test results revealed a clear distinction: the experimental group, which received the CRH model and flashcards, achieved significantly higher mean scores in both SL and SA compared to the control group. This initial recapitulation suggests a substantial positive impact of the intervention.

Table 1. Recapitulation of Pre-test and Post-test Mean Scores

Research Group	Group	N	Mean Pre-test Score	Mean Post-test Score	Standard Deviation (Post-test)
SL	Experimental	45	58.21	85.34	7.91
	Control	45	57.98	71.12	8.87
SA	Experimental	45	60.15	88.05	6.55
	Control	45	60.01	75.20	7.64

Before proceeding to hypothesis testing, the prerequisite assumptions were checked. The Normality Test (Kolmogorov-Smirnov) performed on the post-test scores for both variables in both groups showed that the data were normally distributed (Sig.>0.05), thus justifying the use of parametric statistics. Furthermore, the Homogeneity Test (Levene's Test) indicated that the variances of the post-test scores for both SL and SA between the experimental and control groups were homogeneous (Sig.>0.05). These results validate the decision to utilize the Independent Sample T-Test and MANOVA for subsequent hypothesis testing (Dantes, 2017).

To quantify the effectiveness and magnitude of improvement, the normalized gain (N-Gain) score was calculated. The N-Gain analysis was performed to measure the effectiveness and magnitude of improvement achieved by each group. The experimental group demonstrated a strong level of learning effectiveness in both variables, categorizing the gain as "Moderate to High". This Table 2 finding confirms that the combined use of the CRH model and flashcards was successful in promoting both cognitive and affective development in the Force learning chapter. Conversely, the control group only achieved a "Low" category gain.

Table 2. Summary of Normalized Gain (N-Gain) Analysis

Variable	Group	Mean N-Gain Score	N-Gain Category	Group
SL	Experimental	0.63	Moderate to High	Experimental
	Control	0.31	Low	Control
SA	Experimental	0.66	Moderate to High	Experimental
	Control	0.28	Low	Control

For hypothesis testing, the Independent Sample T-Test was utilized to test the partial hypotheses, assessing whether the intervention produced a statistically significant difference in each dependent variable independently. The test was conducted using the post-test scores, controlling for pre-test variations. As presented in Table 3, the significance values (Sig. (2-tailed)) for both SL and SA were less than the established significance level ($\alpha=0.05$). This result leads to the definitive rejection of the null hypotheses (H_0), confirming that the CRH model and flashcards had a statistically significant effect on both SL and SA.

Table 3. Independent Sample T-Test Results (Post-test Scores)

Variable	F-Value (Levene's)	Sig. (Levene's)	t-value	Sig. (2-tailed)	Decision
SL	1.15	0.285	8.92	0.000	H_0 Rejected
SA	0.98	0.323	9.75	0.000	H_0 Rejected

To test the simultaneous effect of the CRH model and flashcards on both variables combined, a MANOVA was performed. The results from the MANOVA test, as summarized in Table 4, indicated that the intervention had a statistically significant combined effect on the set of dependent variables (SL and SA). The low Wilks' Lambda value and the corresponding p-value less than 0.05 confirm the rejection of the overall null hypothesis, thus achieving the primary objective of the research: establishing that the CRH model assisted by flashcards is effective in enhancing both SL and SA simultaneously.

Table 4. Multivariate Test (MANOVA) Results

Test	Value	F-Value	Hypothesis df	Error df	Sig.
Wilks' Lambda	0.158	45.72	2	87	0.000

The CRH model, when combined with flashcard media, proved to have a significant influence ($p < 0.05$) and a strong increase (N-Gain SL=0.63; SA=0.66) on student competencies. This substantial contribution is comprehensively explained through the procedural impact of each syntax step on specific indicators of SL and SA. The model's structured approach ensured that every learning phase directly addressed either a cognitive challenge posed by the abstract Force material or an affective requirement for forming a robust scientific disposition (Mudana, 2023).

Table 5. Procedural Impact of CRH Syntax on Variables

Model Syntax	Affected Indicator	Empirical and Qualitative Contribution
Material Presentation & Flashcard Distribution	Scientific Literacy (Explaining Phenomena & Content Comprehension)	SL: Flashcards provided Visual Concretization of Force Causality. This directly addresses the abstract nature of the Force Chapter in primary school. Qualitative findings show students formulated explanations more easily after seeing the visual content on the cards.
Students Working in Groups & Answering Questions	Scientific Attitude (Open-mindedness & Respect for Evidence)	SA: This group work process triggered Internalization of Evidence Through Consensus. Students were compelled to discuss and utilize evidence (concepts on the flashcards) collectively, which significantly boosted Scientific Attitude scores in the Respect for Evidence indicator.
Review and Verification of Answers (Exchanging Answers)	Scientific Attitude (Curiosity)	SA: This stage initiated Stimulated Curiosity based on Discrepancy. When other groups had different answers, students' curiosity (qualitatively noted as the highest increase) was competitively motivated to compare and validate their own answers.
Celebration (Horay!)	Scientific Literacy (Using Scientific Evidence) & Scientific Attitude (Critical Reflection)	SL: The "Horay!" shout was only permitted after confirmation of correctness by the teacher, leading students to perform rapid Accelerated Decision Making to prove their answers. This positive reinforcement emotionally solidified concept memory.
Repetition	Scientific Literacy (Problem Solving) & Scientific Attitude (Environmental Sensitivity)	SL/SA: Repetition proved to significantly increase the N-Gain score. This recurring exposure allowed Force concepts to be internalized to the level of simple Problem Solving and Environmental Sensitivity through repeated contextualization (concept retention and transfer).

The qualitative data highlighted that the CRH-flashcard integration was particularly effective in overcoming two major hurdles in primary science: understanding causation and applying evidence (Magfira et al., 2025). The visual cue of the flashcards provided the necessary input for students to successfully Explain Phenomena Scientifically, allowing them to articulate the "why" behind concepts like inertia or magnetic attraction, which often remained elusive under traditional instruction (Table 6). Furthermore, the competitive nature of the "Horay!" phase compelled students to quickly justify their answers with scientific evidence, directly enhancing the Using Scientific Evidence indicator far beyond mere factual recall (OECD, 2023).

Table 6. Qualitative Interpretation of Scientific Literacy Improvement

Scientific Literacy Indicator (PISA)	Qualitative Observation Focus	Interpretation of High N-Gain
Explaining Phenomena Scientifically	Students' articulation of Force Causality after reviewing Flashcards.	High success in articulating "why" Force acts, moving beyond surface description due to Visual Scaffolding of concepts.
Using Scientific Evidence	Speed and accuracy in justifying answers during the "Horay!" phase.	Evidence used quickly and accurately, reflecting Accelerated Cognitive Decision Making under competitive pressure.
Interpreting Data and Scientific Problem Solving	Student ability to handle simplified resultan gaya (resultant force) problems.	Repeated, context-rich review provided by CRH builds confidence in transferring concepts to problem-solving scenarios.

The affective domain exhibited strong growth primarily through the social and emotional elements of the CRH model. The need for group consensus during the Review Phase was the primary driver for improving both Respect for Evidence and Open-mindedness, as students were forced to justify their claims using the flashcard's factual data before shouting the final answer. The competitive aspect served as an external motivator for Curiosity, ensuring active engagement with the material. This proves the CRH model's strength in cultivating a classroom environment that values collaborative inquiry a key component of scientific methodology (Harlen, 2000).

Table 7. Qualitative Interpretation of Scientific Attitude Improvement


Scientific Attitude Indicator (Harlen)	Qualitative Observation Focus	Interpretation of High N-Gain
Curiosity / Interest	Level of student inquiry and enthusiasm during the "Horay!" phase.	High level of engagement and intrinsic motivation triggered by the model's Fun and Competitive Structure.
Respect for Evidence	Student behavior in validating answers against the Flashcard facts.	Achieved Internalization of Evidence Through Consensus; evidence is valued as a prerequisite for group success.
Open-mindedness	Student willingness to accept peers' corrections or alternative data during discussion.	Increased acceptance of differing views, confirming the successful function of the Cooperative Learning aspect of CRH.

The successful enhancement in both SL and SA, confirmed by the quantitative data, is fundamentally rooted in how the CRH model and flashcards were specifically designed to counteract the unique pedagogical challenges of the Force Chapter for Grade IV students. This material is inherently abstract concepts like magnetism and gravity are invisible yet the curriculum demands concrete application through everyday activities (pushing, friction). The efficacy of the intervention is justified by its ability to resolve this dichotomy: the flashcards provided the necessary Visual Concretization to bridge the conceptual gap, allowing students to visualize causality and apply scientific evidence, thereby fulfilling the stringent demands of the SL instrument. As shown in Table 8, the test items deliberately target the higher cognitive levels of PISA (C4-C5), demanding analytical skills that could only be met through the deep conceptual understanding facilitated by the CRH syntax and the visual aid of the Flashcard model (Table 9) during active, experimental learning.

Table 8. Summary of Scientific Literacy Test Items and Cognitive Alignment

Item No.	PISA Competency Dimension	Cognitive Level	Focus of the Question on Force Chapter
1, 5	Explaining Phenomena Scientifically	C4 (Analyzing)	Analyzing various types of forces (e.g., gravity, friction, magnet) in daily scenarios.
2, 11	Using Scientific Evidence	C4 (Analyzing)	Analyzing the relationship between the magnitude of applied force and its effect on an object.
3, 6, 9	Interpreting Data and Scientific Problem Solving	C5 (Evaluating)	Interpreting simulated data results (e.g., speed change) to conclude which type of force is dominant.
4, 12, 13	Using Scientific Evidence	C6 (Creating)	Designing or proposing an object modification based on an understanding of force principles.

Table 9. Core Design of Flashcard Model Supporting Experimental Learning

Flashcard Component	Function in Force Learning	Experimental/Learning Support
Visual Illustration 	Concretization of Abstract Forces (e.g., showing a magnet attracting metal filings).	Provides a visual schema for phenomena difficult to observe directly during experiments.
Key Terminology/Formula (Back)	Quick access to operational concepts (e.g., $F_{gesek} = \mu N$).	Acts as a fast review tool during the CRH Review Phase for evidence application.
Real-World Context Example	Linking theory to practical life (e.g., showing friction on a sliding box).	Facilitates retention and transfer of knowledge when students perform physical pushing/pulling simulations.
Cause-Effect Diagram	Showing how force magnitude changes an	Directly supports analytical tasks required for PISA competency (C4/C5) in the test instrument.

Flashcard Component	Function in Force Learning	Experimental/Learning Support
	object's state (speed/shape).	
Flashcard Component	Function in Force Learning	Experimental/Learning Support

Discussion

The primary finding, confirmed by MANOVA, establishes that the integration of the CRH Model and flashcards yields a statistically significant simultaneous effect on the enhancement of both SL and SA. This result is strongly supported by the subsequent Independent Sample T-Tests, which led to the definitive rejection of all partial null hypotheses (Sig.<0.05). Furthermore, the N-Gain analysis validated the magnitude of the change, categorizing the increase for both SL (0.63) and SA (0.66) as Moderate to High. This quantitative evidence underscores the model's robustness as a dual-domain pedagogical intervention, effectively addressing the holistic competence requirements of the contemporary curriculum, unlike conventional methods observed in the control group.

The significant increase in Scientific Literacy is primarily attributed to the unique synergistic function of the Flashcard media in tackling the conceptual challenges of the abstract Force Chapter. Qualitative findings confirmed that the Flashcards facilitated Visual Concretization of Force Causality, providing Grade IV students with tangible visual anchors for concepts such as gravity and friction that are otherwise elusive. This scaffolding mechanism directly addressed the core PISA competency of Explaining Phenomena Scientifically. When students could visualize the cause-and-effect relationship, their ability to articulate scientific concepts improved, reflected in the high N-Gain observed in SL. This finding demonstrates the pedagogical necessity of using targeted media to bridge the cognitive gap between concrete operational thinking (Grade IV) and abstract scientific concepts.

Beyond mere visualization, the CRH syntax amplified the cognitive engagement necessary for high SL scores. The competitive nature of the "Review and Horay!" phase compelled students to engage in Accelerated Cognitive Decision Making while verifying their answers (Sari & Pambudi, 2022). Qualitative data revealed that the students were forced to quickly access and apply scientific evidence (the formulas and concepts detailed on the flashcards) to justify their group's response before the time limit expired. This high-pressure, rapid-recall environment transformed the passive act of "Using Scientific Evidence" into a dynamic, performance-driven task, making the knowledge highly retrievable and applicable, thereby directly boosting SL performance on higher-order thinking items.

The efficacy of the model is critically anchored in the function of the flashcard media as a visual concretization bridge. The flashcards were specifically designed to display the interaction and resulting effects of forces for instance, illustrating the concept of friction by showing a marble rolling on different surfaces (smooth vs. rough) or depicting how force alters an object's shape (impact on clay). These visual stimuli allowed students to "observe" interactions that are intrinsically difficult to capture or analyze in a basic classroom setting. This visual scaffolding provided the necessary concrete input for students to successfully perform higher-order tasks, effectively supporting the cognitive shift required to move from simply observing an action to analyzing the underlying scientific mechanism (Habib et al., 2023; Sehartiani & Adriyani, 2023).

The findings provide specific empirical support for the demands of skills beyond basic recall. The instrument required students to perform complex tasks, such as analyzing various types of forces in daily activities (Items 1, 5) and analyzing the relationship between the magnitude of

forces applied (Items 2, 11). The significant post-test gain, particularly on items targeting C4 (Analyzing) and C5 (Evaluating) cognitive levels, demonstrates that the Flashcard integration was successful in providing the prerequisite visualized data and causality relationships needed to achieve these levels. Thus, the model's success is not just a reflection of effective teaching, but a validation that the CRH-flashcard combination precisely targets and fulfills the high-level cognitive demands embedded within the Scientific Literacy test items (Ayshari & Clara, 2017; Fitriyani & Sari, 2024).

The substantial improvement in SA is a testament to the model's success in cultivating a positive affective environment. The Group Review/Discussion step of the CRH syntax was instrumental in fostering Respect for Evidence and Open-mindedness by triggering Internalization of Evidence Through Consensus. Students were required to collectively agree on the answer based on the facts provided by the flashcards (Febriyanto & Yanto, 2019; Wiyoko et al., 2020). This process inherently promoted critical discussion and required individuals to prioritize group success over personal bias, thereby internalizing the scientific value of objective evidence, as measured by the Harlen SA indicators.

The "Horay!" Phase served as the key mechanism for improving Curiosity (Astuti et al., 2019). Qualitative observation revealed that when groups shouted different answers, it created a situation of Stimulated Curiosity based on Answer Discrepancy. The competitive tension motivated students to actively re-examine their sources and seek the correct scientific justification with genuine enthusiasm (Andini & Miaz, 2022). This active inquiry, triggered by external competitive rewards (the chance to shout "Horay!"), effectively transformed the abstract concept of curiosity into a visible, measurable learning behavior, underscoring the power of the model's fun and rapid-fire review structure in the affective domain.

The simultaneous enhancement confirmed by MANOVA indicates that SL and SA are mutually reinforcing within this model. The CRH model and flashcards serve as a coherent system that facilitates Deep Learning moving beyond superficial content coverage to holistic competence (Rahman & Fuad, 2023). The model successfully harnesses the emotional and collaborative energy (SA) to drive rigorous cognitive performance (SL). The novelty of this research lies in identifying and empirically justifying the specific procedural mechanisms namely, Visual Concretization of Force Causality and Internalization of Evidence Through Consensus as the crucial elements that bridge the gap between abstract physics concepts and tangible primary-level mastery, thereby offering a valuable contribution to primary science pedagogy.

CONCLUSION

This research conclusively demonstrates that the Course Review Horay (CRH) Model integrated with Flashcards is a highly effective and coherent instructional system, simultaneously enhancing both Scientific Literacy (SL) and Scientific Attitude (SA) among Grade IV students. The effectiveness, confirmed by the MANOVA and high N-Gain categories, stems from two empirically validated mechanisms that constitute the study's novelty. Cognitively, the Flashcards provided the Visual Concretization of Force Causality, successfully bridging the gap between abstract physics concepts and tangible primary-level understanding, thereby boosting students' ability to use scientific evidence. Affectively, the cooperative and competitive CRH syntax cultivated Scientific Attitude through the Internalization of Evidence Through Consensus during group review. This model successfully leveraged the students' social and emotional energy (SA) to drive rigorous cognitive performance (SL). Consequently, the CRH-Flashcard combination is validated as an indispensable pedagogical tool for

facilitating Deep Learning and meeting the holistic competence demands of modern science education.

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