

Enhancing Student Learning Outcomes through a Station Rotation Model with Hypercontent Materials: A Research and Development Study

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ABSTRACT:

Learning in the Introduction to Education course at a private university in Banten, Indonesia, remains lecturer-centered and reliant on conventional teaching materials. Institutional records for 2021–2023 show that 17.32% of enrolled students failed or required remedial study, despite an 82% positive evaluation of the university's cloud-based learning management system (LMS). This study aimed to design, validate, and test the effectiveness of a Station Rotation-based learning model supported by Hypercontent teaching materials for this course. A Research and Development (R&D) design was employed, integrating the Dick, Carey and Carey instructional design model with the Rowntree model for developing hypercontent materials. Formative evaluation proceeded through four sequential stages: expert review by nine validators (three each in instructional design, content, and media), one-to-one trials with three students, a small-group trial with eight students, and a field trial with 28 first-semester Physical Education and Health students using a one-group pretest–posttest design. Data were analyzed using expert validation scoring, the normalized gain (N-Gain) index, and the paired-samples t-test ($\alpha = 0.05$). Expert validation produced very high feasibility scores on a 4.00-point scale: instructional design 3.73, content 3.85, and media 3.76, with an average practicality score of 3.76. In the field trial, mean scores rose from 66.11 (pretest) to 91.46 (posttest), yielding an average N-Gain of 0.799 (high category) and a paired t-test result of $t(27) = 13.512$, $p < .001$. The model integrates a station-rotation blended-learning structure with multimodal hypercontent materials specifically for a conceptually dense, first-semester foundation course, offering a validated and practical alternative to lecturer-centered instruction in university settings with adequate technological infrastructure.

Keywords: station rotation, hypercontent, blended learning, instructional design, learning outcomes.

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1. Introduction

Twenty-first-century competency frameworks place critical thinking, creativity, effective communication, and cross-disciplinary collaboration among the core competencies that

higher-education graduates must master (Rahayu et al., 2024), alongside digital literacy and the capacity to critically manage information in an increasingly data-saturated environment. Indonesia's National Qualification Framework

(KKNI) further requires undergraduate learning outcomes to simultaneously address professional attitude, theoretical knowledge, generic skills, and field-specific skills (Kementerian Pendidikan dan Kebudayaan, 2012), a requirement that implicitly demands a shift from passive, teacher-centered instruction toward active, technology-based, student-centered course designs.

Universitas Setia Budhi Rangkasbitung has adopted a cloud-based learning management system, SiakadCloud, as the primary platform for course materials, assignments, evaluation, and lecturer–student communication. A preliminary study using a learning-organization framework found that all seven organizational-learning dimensions were rated very high, ranging from 82.60% to 86.95% (Arini et al., 2024). This highly positive uptake of the LMS, however, did not translate into improved learning outcomes. Closer examination attributed the gap to three conditions: the LMS being used mainly as an upload–download repository rather than for its interactive features (discussion forums, adaptive quizzes, instructional video); the absence of a structured pedagogical model directing meaningful use of the platform; and course materials confined to static PDFs and slide decks without interactive multimedia elements. The problem, in other words, was not the availability of technology but the absence of a pedagogical model able to exploit it.

This diagnosis is corroborated by three years of course records. Between 2021 and 2023, of 329 students enrolled in the Introduction to Education course in the Physical Education and Health study program, 57 (17.32%) failed or required remedial study a persistently high rate for a first-semester foundational course. Interviews with the course lecturer and students identified four systemic root causes: (1) a teacher-centered model dominated by one-way lecturing with minimal active student involvement; (2) teaching materials confined to printed texts, PDFs, and slides without interactivity; (3) no accommodation of diverse learning styles (visual, auditory, kinesthetic); and (4) no structured scaffold supporting the transition from lecturer-guided to self-directed learning.

The Station Rotation model a form of blended learning in which learners rotate through a fixed sequence of stations combining face-to-face instruction, collaborative tasks, and independent digital learning (Aksak Kömür et al., 2023; Horn et al., 2017) directly addresses the first and fourth root causes by requiring active output at every station and by providing a graduated continuum from fully guided to self-directed learning within a single class session. Hypercontent materials digital teaching materials that combine text, images, video, and hyperlinks in a non-linear, multimodal structure (Johan et al., 2022; Siang et al., 2019) address the second and third causes by reducing cognitive load through multimodal presentation and by allowing students to access materials at their own pace through the existing LMS.

No prior model in this institutional context had integrated these two solutions into a single, coherent design for a conceptually dense, first-semester foundation course. This study therefore aimed to (1) develop a Station Rotation-based learning model supported by Hypercontent materials for the Introduction to Education course, (2) examine the model's feasibility through expert and user evaluation, and (3) assess its effectiveness in improving student learning outcomes.

2. Literature Review

Instructional-model development commonly draws on established systematic design frameworks such as the Dick, Carey and Carey model, ASSURE, Kemp's model, Borg and Gall's R&D model, ADDIE, and Rowntree's materials-development model (Dick et al., 2022; Gall et al., 2007; Rowntree, 1994). A complete instructional model comprises five components: syntax, social system, principles of reaction, support system, and instructional and nurturant effects (Joyce et al., 2015). The present study integrates the Dick, Carey and Carey model as the primary framework for developing the instructional system, with Rowntree's model serving as the framework for developing hypercontent materials, reflecting the complementary fit between a systematic

instructional-design sequence and a dedicated materials-development sequence.

Station Rotation is one of several blended-learning models alongside Flex, A La Carte, and Enriched Virtual models in which students physically rotate, on a fixed schedule, through learning stations combining teacher-led instruction, collaborative work, and online or independent activities (Aksak Kömür et al., 2023; Horn et al., 2017). Evidence across educational levels and subjects indicates that Station Rotation improves academic achievement (Ayob et al., 2020; Govindaraj & Silverajah, 2017), motivation and engagement (Mahalli et al., 2019; Truitt & Ku, 2018), and higher-order thinking and collaboration (Oledan, 2025). A recent meta-analysis reported medium-to-high effect sizes on academic achievement across studies (Ramadan et al., 2025), while a systematic review reported consistent gains in engagement, motivation, and learning satisfaction (Anagnostopoulou & Casillas-Martín, 2025), and further work reported improved interest, collaboration, and learner autonomy (Yılmaz & Açıkgül Fırat, 2026). Yukhymenko (2024) emphasizes that Station Rotation's effectiveness in higher education depends on achieving an optimal balance between face-to-face and online instruction.

Hypercontent refers to digital teaching material that integrates text, images, video, QR/barcode links, and hyperlinks into a non-linear structure that allows multiple access paths rather than a single fixed sequence (Johan et al., 2022; Siang et al., 2019; Simbolon et al., 2021). Because it presents information through multiple simultaneous channels, hypercontent aligns closely with Mayer's (2021) Multimedia Learning Theory, which holds that combining verbal and visual channels enhances comprehension and retention more than single-channel presentation. Prior applications of hypercontent modules in information-behavior and secondary-education contexts report improved comprehension and positive learner response (Johan et al., 2022; Turmudi et al., 2022).

The model's anticipated effectiveness rests on three complementary theories. Constructivist

theory (Piaget; Vygotsky) holds that knowledge is built through active engagement with the learning environment rather than passive reception; each station in the model requires students to discuss, explore hypercontent, or solve problems rather than simply listen. Blended Learning Theory (Horn et al., 2017) argues that a structured combination of face-to-face and digital modes increases flexibility and learner control, a proposition embodied directly in the multi-station rotation design. Multimedia Learning Theory (Mayer, 2021) provides the rationale for the hypercontent materials themselves. Together, these three frameworks constitute the theoretical basis on which the model's syntax, materials, and expected outcomes were designed, and are later used to interpret its empirical effectiveness.

2. Methodology

This study used a Research and Development (R&D) design, defined as a systematic study to design, develop, and evaluate instructional processes and products on an empirical basis (Richey & Klein, 2007). R&D was selected because the study aimed not merely to theorize a learning model but to empirically test its validity, practicality, and effectiveness. Quantitative data (expert validation scores on a 1–4 Likert scale, pretest–posttest scores, N-Gain, and paired t-test results) were analyzed alongside qualitative data (interviews, observation notes, and expert/student feedback collected during formative evaluation) to provide a comprehensive assessment of the model from both theoretical and empirical perspectives (Sugiyono, 2023).

The study was conducted in the Physical Education and Health study program, Faculty of Teacher Training and Education, Universitas Setia Budhi Rangkasbitung, from September 2024 to December 2025. Needs analysis involved three subject groups: students who had previously taken the course, academic officials, and the course lecturer (Yaumi, 2013). Participants in the formative-evaluation stages comprised nine content, design, and media experts (one-to-one expert evaluation), three first-semester students representing high,

moderate, and low ability levels (one-to-one learner evaluation), eight students (small-group evaluation), and 28 first-semester students (field trial).

Development integrated ten steps derived from the Dick, Carey and Carey model with Rowntree's materials-development steps, organized into three phases: Analysis; Design and Development; and Implementation/Evaluation. The main steps comprised: (a) preliminary research and needs analysis, comparing actual and ideal learning conditions through document review of syllabi, grade records, and curriculum, classroom observation, and interviews; (b) identification of the general instructional goal, covering cognitive, affective, and psychomotor domains; (c) instructional analysis, sequencing twelve core topics including the nature and development of the human person, the foundations and principles of education, the national education system, and education and character-building from simple to complex; (d) analysis of learner characteristics and context, including prior knowledge, learning styles, and available facilities; (e) formulation of specific performance objectives using the ABCD format; (f) development of criterion-referenced assessment instruments; (g) development of the instructional strategy, operationalized as four learning stations; (h) development and selection of instructional materials following Rowntree's (1994) four-step sequence; (i) formative evaluation, conducted in four sequential stages with revision after each; and (j) implementation and final revision, producing a field-tested prototype ready for classroom use.

The instructional strategy was operationalized as four learning stations, each allotted 15–20 minutes within a structured session that also included an opening and a closing segment: Station 1 (Lecturer Instruction), in which the lecturer delivered core concepts and answered questions; Station 2 (Group Discussion), in which students analyzed cases or solved problems collaboratively; Station 3 (Hypercontent), in which students independently explored digital materials video, images, and interactive links via the LMS; and Station 4

(Practice and Evaluation), in which students completed online quizzes and reflected on the material with lecturer feedback. Groups of two to three students rotated through the four stations in a fixed sequence during each class meeting, as formalized in the semester learning plan (RPS).

Formative evaluation proceeded through four sequential stages, following an established formative-evaluation sequence (Dick et al., 2022): (1) One-to-One Expert Evaluation, in which nine validators three instructional-design experts, three content experts, and three media experts rated the model and materials using a structured 1–4 Likert questionnaire assessing goals, instructions, content, and language; (2) One-to-One Learner Evaluation with three students representing high, moderate, and low ability, assessing readability, comprehensibility, and usability; (3) Small-Group Evaluation with eight students, including a pretest–posttest to gauge the effect of revisions; and (4) Field Trial with 28 students under authentic classroom conditions, using a pretest–posttest design to evaluate overall effectiveness. Revisions were carried out cumulatively across four cycles following peer review, expert evaluation, one-to-one learner evaluation, and small-group evaluation before the field-trial prototype was finalized. A summative evaluation was not conducted, owing to time and resource constraints.

Data-collection instruments comprised semi-structured interview guides for the needs analysis; Likert-scale questionnaires for expert validation of the model and materials and for student perception of practicality and readability; a pretest–posttest achievement test, separately validated by an instrumentation expert with subsequent revisions to the operational definitions and test blueprint; and structured classroom-observation sheets for implementation fidelity and student engagement at each station.

Content validity of the model and instruments was established through expert judgment, following a standard categorization of validity scores (Seels & Richey, 1994), in which a mean validation score above 0.80 is classified as very

valid and scores between 0.60 and 0.80 as valid. Implementation of fidelity and lecturer instructional-management ability were each scored on a four-tier quality scale (very good, good, fair, poor). Model effectiveness was assessed using pretest–posttest scores analyzed with the normalized gain (N-Gain) index, categorized as high ($g > 0.70$), medium ($0.30 \leq g \leq 0.70$), or low ($g < 0.30$), and with the paired-samples t-test at $\alpha = 0.05$ to determine the statistical significance of the pretest–posttest difference.

3. Results and Discussion

Course records for 2021–2023 confirmed that 57 of 329 enrolled students (17.32%) failed or required remedial study, despite the LMS's 82% positive utilization rating. Pretest data collected prior to the model's implementation indicated that most students scored in the 50–65 range, reflecting low-to-moderate prior competence attributable to limited independent-learning experience, limited prior exposure to interactive media, and conventional prior instruction. Interviews confirmed that learning had been monotonous and dominated by lecturing, that abstract conceptual material was difficult to grasp

through verbal explanation alone, and that materials were limited to PowerPoint slides and PDFs, while students expressed clear interest in more interactive, technology-based instruction.

Applying the Dick, Carey and Carey framework together with Rowntree's materials-development sequence, the study produced: (a) a conceptual model integrating systematic instructional design with the four-station rotation structure and hypercontent materials; (b) a procedural model detailing seven sequential development stages, from needs identification to summative evaluation; and (c) physical products comprising an ISBN-registered model handbook, a semester learning plan, a course contract, hypercontent teaching materials covering eleven core topics with progressive simple-to-complex sequencing, and an assessment-instrument package. The hypercontent module integrated text, images, instructional video, QR/barcode links, and hyperlinks to current articles, delivered through the existing LMS, together with per-subtopic summaries and practice items with feedback. Table 1 summarizes expert validation across the three domains assessed.

Table 1. Expert validation scores

Domain	Mean Score (scale 1–4)	Category
Instructional design	3.73	Very feasible
Content/materials	3.85	Very feasible
Media	3.76	Very feasible
Average practicality	3.76	Very practical

All three domains fell within the very feasible/very valid category. Feedback from the instructional-design experts led to refinement of the objective-formulation format and stronger inter-component alignment; content experts requested clarification of terminology and a stronger link between topics and national curriculum standards; and media experts recommended adding instructional videos and animated illustrations to the hypercontent barcodes, simplifying navigation, and standardizing font, color, and layout across the

module. Following revision, all three expert panels confirmed the model and materials as fit for use.

Three students representing high, moderate, and low ability evaluated the hypercontent materials for accessibility, readability, and engagement. All three reported that the materials were easily accessible via smartphone or laptop, with clear typography, understandable vocabulary (a small number of unfamiliar terms were noted by one student), an attractive layout, and helpful chapter

summaries; minor connectivity delays were reported by one participant. The small-group trial ($n = 8$) confirmed the practicality of the revised model and surfaced further minor usability issues that were addressed before the field trial.

In the field trial ($n = 28$), the mean score rose from 66.11 (pretest) to 91.46 (posttest), a mean

difference of 25.36 points. Individual gains ranged from -7 to $+40$ points; most students achieved gains of 20–35 points, while one student showed a -7 -point decline, attributed to individual factors such as prior preparation and participation. N-Gain and paired t -test results are presented in Tables 2 and 3.

Table 2. N-Gain descriptive statistics

Statistic	N	Min–Max	Mean	SD
N-Gain (score)	28	–0.10 to 1.00	0.799	0.0799
N-Gain (%)	28	–10 to 100.00	79.9	7.99

Table 3. Paired-samples t -test results

Parameter	Value
n	28
Mean difference	25.357
SD of difference	9.930
df	27
t (observed)	13.512
t (critical, $\alpha = .05$, two-tailed)	2.052
Sig. (2-tailed)	$< .001$

Because t observed (13.512) exceeded t critical (2.052) with $p < .05$, the pretest–posttest difference was statistically significant, and the average N-Gain of 0.799 fell within the high-effectiveness category ($g > 0.70$). Practicality, evaluated across the one-to-one, small-group, and field-trial stages, averaged 3.76 on the 4-point scale, indicating that the model required only readily available resources a smartphone and internet access for implementation.

The findings indicate that the developed model met all three quality criteria targeted in the study: theoretical validity, practical implementability, and empirical effectiveness. The very high expert-validation scores across the instructional design, content, and media domains confirm that the model's syntax, sequencing, and materials cohere with the alignment principle central to the Dick,

Carey and Carey framework, in which objectives, content, strategy, and assessment must be internally consistent (Dick et al., 2022). Practicality was corroborated by the model's minimal resource requirement of a smartphone and internet connection already available to all participating students echoing prior findings that Station Rotation implementations succeed most readily where basic digital infrastructure is already in place (Yukhymenko, 2024).

The substantial and statistically significant improvement in learning outcomes (N-Gain = 0.799; $t(27) = 13.512$, $p < .001$) is consistent with international evidence on Station Rotation in blended learning. A recent meta-analysis found medium-to-high effect sizes of Station Rotation on academic achievement (Ramadan et al., 2025), and a systematic review reported parallel gains in

motivation, engagement, and satisfaction (Anagnostopoulou & Casillas-Martín, 2025), as well as improved interest, collaboration, and learner autonomy (Yılmaz & Açıkgül Fırat, 2026). These convergent findings suggest that the mechanism underlying the model's effectiveness is not idiosyncratic to this setting but reflects a more general property of station-based blended designs: requiring active, varied output at each station appears to translate into deeper engagement and stronger learning gains than single-mode, lecture-dominated instruction.

Three theoretical explanations help account for this result. First, constructivist theory frames improvement as a product of active knowledge construction: at every station, students discussed, explored materials, or solved problems rather than passively receiving information. Second, Blended Learning Theory attributes part of the gain to the flexibility and learner control afforded by combining face-to-face and digital modes (Horn et al., 2017), directly realized in the rotation structure. Third, Multimedia Learning Theory (Mayer, 2021) accounts for the role of the hypercontent materials themselves: presenting information through simultaneous verbal and visual channels appears to have reduced cognitive load and strengthened conceptual understanding, consistent with prior hypercontent implementations reporting improved comprehension (Johan et al., 2022; Turmudi et al., 2022).

At the same time, the single case of score decline (−7 points) and the wide range of individual gains (−7 to +40) indicate that the model's effectiveness is moderated by individual factors prior readiness, motivation, and participation a pattern also noted in prior Station Rotation research (Ramadan et al., 2025). This suggests the model should not be assumed to produce uniform benefit across all learners, and that lecturer facilitation at each station may need to be adapted to individual student needs.

Limitations

Several limitations qualify these findings. The study was conducted with a relatively homogeneous sample from a single study program at a single institution, limiting generalizability. The trial period was short, precluding assessment of longer-term retention or sustained behavioral change. Effectiveness was measured primarily through cognitive outcomes (pretest–posttest scores), without in-depth measurement of affective or psychomotor domains. Implementation depended on stable internet access and digital devices, and on the lecturer's classroom-management skill in coordinating station transitions and pacing both potential sources of variation if the model is replicated elsewhere.

5. Conclusion

This study developed, validated, and tested a Station Rotation-based learning model supported by Hypercontent teaching materials for the Introduction to Education course, integrating the Dick, Carey and Carey instructional-design framework with Rowntree's materials-development model. Expert validation confirmed the model as highly feasible (instructional design = 3.73; content = 3.85; media = 3.76, on a 4.00-point scale) and highly practical (average = 3.76). Field-trial results demonstrated that the model was effective in improving student learning outcomes, with mean scores rising from 66.11 to 91.46, an average N-Gain of 0.799 (high category), and a statistically significant paired-samples t-test result, $t(27) = 13.512$, $p < .001$. These findings support the model as a valid, practical, and effective alternative to lecturer-centered instruction for conceptually oriented courses in higher-education settings with adequate technological infrastructure. Future research should test the model across multiple institutions and study programs, extend the observation period to examine retention and affective/psychomotor outcomes, and examine boundary conditions such as internet reliability and lecturer facilitation skill that may moderate its effectiveness.

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