

# Localized Interactive Learning Materials in Physics: Its Development and Effectiveness on Academic Performance of Stem Students

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**Abstract**—Researchers in Laguna looked at how well locally tailored, interactive physics materials worked for high school seniors. Using a quasi-experimental pretest–posttest design, the intervention focused on least-mastered competencies in electricity, magnetism, sound, and optics. Participants came from several public schools, with master teachers as validators. Development followed a cycle needs analysis, expert review, pilot use, and iterative revisions aligned with national competencies. Implementation was embedded in regular lessons to minimize disruption, and item analyses with teacher reflections guided each revision cycle across schools. Data came from standardized pre/post assessments, student self-ratings, and validator checklists. Results showed significant gains in conceptual understanding and problem-solving after exposure. Improvements spanned achievement levels, indicating equity gains for struggling and higher-achieving learners. Students reported greater engagement, perceived relevance, and confidence. Validators rated the resources positively for content accuracy, pedagogy, and classroom usability. Two challenges emerged: designing robust interactive tasks that capture core ideas and integrating the materials into existing routines. Learners requested more practice, richer local applications, short demo videos, clearer navigation, and offline or print-ready options. The study concludes that teacher-developed, context-responsive materials raise achievement, narrow gaps, and strengthen instruction when iteratively designed, validated, and embedded in routine lessons. Recommendations: integrate modules into core teaching; monitor with brief unit checks and item analyses; provide tiered scaffolds and extensions; expand practice banks and local contexts; add concise videos; ensure usability in low-connectivity settings. Institutional support guidelines, resources, capacity-building, peer review, and a shared repository is advised.

**Keywords**— Grade 12 STEM; Least-mastered competencies (electricity, magnetism, sound, optics); Localized interactive Learning Materials; Physics achievement; Quasi-experimental pretest–posttest.

## I. INTRODUCTION

The implementation of the K to 12 Basic Education Program in the Philippines is guided by policies that ensure education is relevant, meaningful, and responsive to the needs of learners. One of the key policies that supports this vision is DepEd Order No. 21, s. 2019, or the Policy Guidelines on the K to 12 Basic Education Program. This policy emphasizes the principles of contextualization, localization, and indigenization of the curriculum. It recognizes that students learn best when lessons are connected to their real-life experiences, cultural backgrounds, and local environment. Through this policy, teachers are encouraged to adapt and

design instructional materials that are not only aligned with the learning competencies but also reflective of the learners' immediate contexts. In particular, localization plays a vital role in making abstract and complex concepts such as those in Physics more relatable and easier to understand by anchoring them on familiar situations, objects, and practices within the learners' community.

In line with this mandate, the present study on Localized Interactive Learning Materials in Physics was conceptualized. The study responds to DepEd's call for innovative and context-based teaching strategies by developing materials that integrate interactive features and local examples. By doing so, the study aims to enhance student engagement, improve conceptual understanding, and promote meaningful learning experiences in Physics, particularly among STEM students.

Pursuant to DepEd Order No. 5, s. 2014 provides the Policy Guidelines on the Implementation of the Learning Resources Management and Development System (LRMDS). This policy institutionalized the LRMDS as DepEd's official mechanism for developing, evaluating, managing, and sharing learning resources. It ensures that instructional materials produced by teachers and schools are curriculum-based, quality-assured, and accessible to both educators and learners. The study mirrors the LRMDS' emphasis on innovation and accessibility of non-text learning materials. Interactive modules and localized examples, whether presented digitally or in print, fall under the category of supplementary resources supported by the LRMDS. These materials contribute to DepEd's broader effort of providing varied, inclusive, and technology-supported instructional resources.

Education has undergone a profound transformation in recent years, marked by significant disruptions and the rapid integration of technology into daily life. These changes have compelled schools and educators to reassess how learning should occur in the 21st century. Traditional methods such as chalk-and-talk lectures, rigid lesson plans, and uniform instructional materials have often proven insufficient to address the evolving needs of students. As the educational landscape shifted, teachers were challenged to adopt more dynamic approaches that are flexible, student-centered, and closely aligned with the real-world contexts their learners encounter.

In the Philippines, this shift carried a unique sense of urgency. A large number of students, especially those in rural

and underserved areas, faced limited access to stable internet connections, functional gadgets, or even printed learning modules. Such disparities underscored the pressing need for creative, practical, and inclusive strategies that could ensure no learner was left behind. In response, the Department of Education, through initiatives such as the Basic Education Learning Continuity Plan and policies promoting contextualization, encouraged teachers to design strategies that could reach students in diverse and often challenging circumstances.

Strategic Intervention Materials (SIMs) were originally designed as enrichment or remediation tools to help students master least-learned competencies. They typically followed a fixed structure with an introduction, lesson focus, guided activities, and evaluation. While SIMs were effective for addressing learning gaps, they were often generic and lacked direct connection to the learners' cultural, social, and environmental context.

With the issuance of DepEd Order No. 42, s. 2016 "Policy Guidelines on Daily Lesson Preparation for the K-12 Basic Education Program", teachers were guided to design learning resources that align with the principles of contextualization, constructivism, collaborative learning, and learner-centeredness. This directive emphasized that materials must not only deliver content but also reflect real-life situations that are meaningful to students. When thoughtfully crafted, SIMs can bridge gaps in understanding, particularly in subjects like Physics, where abstract concepts such as electricity, magnetism, sound, and light often seem disconnected from students' daily lives. By presenting lessons in a more concrete and context-driven manner, these materials can help learners grasp difficult ideas more effectively.

However, the potential of SIMs has not been fully realized in all classrooms. While some teachers have succeeded in creating engaging, contextually relevant SIMs, others have struggled, often resorting to generic online content that fails to resonate with their students' backgrounds, environments, and ways of thinking. This disparity highlights the need for more guided efforts to support teachers in developing instructional materials that are localized, interactive, and grounded in familiar experiences.

This study aims to address that gap by focusing on the creation and testing of localized interactive innovations in Physics for senior high school students. The goal is to design materials that are not only practical and easy to use but also deeply rooted in everyday Filipino experiences. By connecting scientific principles to relatable, real-life situations, these resources can help students appreciate the relevance of Physics beyond the classroom. Importantly, the materials are designed to be adaptable for use even in resource-limited settings, ensuring that their effectiveness does not depend on advanced technology or high-cost equipment.

The objectives of this initiative extend beyond improving test scores. It seeks to create learning tools that teachers can seamlessly integrate into their existing instructional practices and that student can meaningfully engage with. By fostering deeper conceptual understanding and sparking curiosity about the natural world, the study hopes to contribute to a more

responsive, inclusive, and practical approach to science education in the Philippines. Ultimately, these efforts aim to empower both educators and learners, ensuring that quality science education is accessible to all, regardless of their circumstances.

### 1.1 Statement of the Problem

Specifically, the study will seek to answer the following questions:

1. *What are the factors to be considered in the development of localized interactive learning materials in physics?*
2. *What is the level of performance of STEM students before and after using the localized interactive learning materials in physics, as revealed by their pretest and posttest scores?*
3. *Is there significant difference on the level of performance of STEM students before and after using the localized interactive learning materials in physics as assessed by the respondents as revealed by the pretest and posttest scores?*

## II. METHODOLOGY

This chapter presented the methodology that guided the conduct of the study. It outlined the research design, population, and sampling technique, and identified the respondents involved. It also described the instruments that were used, along with the procedures for validation and reliability testing. The chapter further explained how data were collected, the statistical tools that were applied in analyzing the results, and the ethical considerations that were observed to ensure integrity and confidentiality throughout the research process.

## III. RESULTS AND DISCUSSION

This chapter presented the study's results, analyzed the gathered data, and interpreted the findings on how localized interactive materials in Physics affected STEM students' learning. It described the respondents' profiles, outlined the development process, compared pretest and posttest results, and highlighted students' perceptions, offering insights into the materials' impact and possible areas for improvement.

*SOP 1. What are the factors to be considered in the development of LIM (Localized Interactive Materials) in Physics?*

The constellation of factors in Table 1 constitutes an integrated design logic rather than a collection of isolated features. Framed by ADDIE and the IPO model, curriculum alignment and assessment integration establish the through line from inputs (MELCs and least-mastered competencies in electricity, magnetism, sound, and optics) to processes (lesson sequences, interaction patterns, and feedback points) and, ultimately, to measurable outputs (mastery checks and post-test performance). By mapping each activity to clearly stated learning goals and success criteria, the materials ensure that the practice students undertake is the same practice later sampled in assessment, echoing international calls to judge what learners can do with what they know rather than what

they can recall (OECD, 2023a; 2023b). In the ADDIE sequence, this is the practical payoff of the Analysis and Design phases: coherence between targets, tasks, and tests that minimizes construct-irrelevant variance and clarifies expectations.

TABLE 1. Design factors for LIM in Physics (no demographic profile used)

Factor	Practical specification	Why it matters
Curriculum alignment	Map lessons to MELCs/target competencies in electricity, magnetism, sound, optics; state learning goals & success criteria per lesson.	Ensures coverage of least-mastered topics and assessment coherence.
Concept scaffolding	Use worked examples → guided practice → independent items; hinting and error notes for common misconceptions.	Reduces cognitive load and supports stepwise mastery.
Interactivity & multimodal representations	Simulations, drag-and-drop labeling, animated diagrams, quick checks; text + visuals + audio where helpful.	Connects abstract ideas to observable models.
Immediate feedback	Item-level feedback, “show me why,” and retry options; cumulative progress bars.	Strengthens retrieval and corrects misconceptions early.
Assessment integration	Short in-lesson checks; mastery checks tied to pre/post competencies; item banks per competency.	Links instruction to measurable gains.
Accessibility & tech constraints	Lightweight assets, offline/low-bandwidth mode, device-agnostic layouts; readable fonts and contrast.	Keeps materials usable across varied school contexts.
Usability	Consistent navigation, one-page “how to use,” short micro-tutorials inside activities.	Minimizes friction so time goes to learning.
Teacher support	Pacing guides, lesson scripts, answer keys, discussion prompts, misconception fixers.	Promotes consistent, high-fidelity classroom use.
Data & privacy	Minimal data capture; anonymized analytics for item performance; clear consent notes.	Ethical, safe, and improvement-oriented iteration.
Continuous improvement	Dashboard of difficult items; review cycle after each run (revise items/paths).	Maintains quality through evidence-based updates.

Concept scaffolding and usability enact the experiential arc described by Experiential Learning Theory. Lessons move from modelled worked examples to guided practice and then to independent items, punctuated by prompts that surface and correct common misconceptions. This sequencing reduces cognitive load while maintaining conceptual demand in symbol-heavy topics, a pattern aligned with evidence that guided inquiry with appropriate scaffolds improves higher-order thinking in science (Antonio & Prudente, 2024) and that structured experience–reflection–explanation–re-try cycles strengthen physics learning (Abaniel, 2021; Dessie et al.,

2023). Usability choices—brief in-app orientations, consistent navigation, and compact instructions—protect working memory for reasoning rather than wayfinding, an effect repeatedly noted in blended-learning reviews where alignment and clarity, not mere novelty, drive participation and persistence (Wang et al., 2022; 2023).

Interactivity and multimodal representations supply the “concrete experience” that ELT requires in domains where phenomena are invisible to the naked eye. Simulations, animated diagrams, and drag-and-drop tasks render field lines, ray paths, and wave behavior inspectable and manipulable. Meta-analyses indicate that virtual investigations and laboratories can match or exceed traditional practice on conceptual outcomes when tactile feedback is non-critical, thereby widening access in resource-constrained settings (Mullwijk & Lazonder, 2023; Li & Liang, 2024). At the same time, accessibility provisions—lightweight assets, offline or low-bandwidth modes, and device-agnostic layouts—bring the design into alignment with Universal Design for Learning principles shown to improve outcomes when multiple means of representation, action/expression, and engagement are provided (Almeqdad et al., 2023). In short, the materials blend physical and virtual experiences to make abstract constructs observable without over-reliance on scarce equipment.

Immediate feedback, coupled with opportunities to retry, operationalizes core mechanisms from Social Cognitive Theory. Task- and process-focused feedback is consistently associated with improved achievement (Wisniewski, Zierer, & Hattie, 2020), while visible progress indicators and short self-checks cultivate self-regulation and credible “mastery moments” that stabilize self-efficacy (Yan & Brown, 2021). Within SCT’s triadic reciprocity, these design moves align personal beliefs (“I can do this next step”), behavior (sustained effort and strategy use), and environment (clear goals and supportive cues), creating conditions that plausibly underwrite the strong improvements documented in subsequent SOPs. The materials therefore do not merely inform students; they engineer cycles of successful performance that make persistence rational.

Teacher support and continuous improvement safeguard fidelity and sustainability. Pacing guides, misconception fixers, and discussion prompts make modelling explicit and help teachers orchestrate the ELT cycle with predictable quality across sections—an implementation concern underscored in the Philippine policy spine that favors collaborative, data-informed design through LACs and regional quality-assurance pathways (DepEd, 2022; DepEd CALABARZON, 2024). Privacy-respecting item analytics and scheduled review cycles embed the Evaluation phase of ADDIE into routine practice, turning isolated modules into a living system of materials that sharpen with each iteration. This mirrors regional evidence that teacher-designed, MELC-aligned resources validated by experts and refined in classrooms yield steady gains in performance and engagement (Agbunag, 2022; Dugan, 2023).

Taken together, the ten factors translate the theories and studies in Chapter 2 into day-to-day instructional decisions. ELT is realized through experiences that students can inspect

and discuss; SCT is realized through goals, modelling, feedback, and progress monitoring that make success believable; and ADDIE/IPO ensure that these moves remain aligned to competencies and are continuously improved. Because the factors are mutually reinforcing—alignment focuses effort, scaffolding makes complexity learnable, interactivity makes ideas visible, feedback turns attempts into progress, and teacher supports preserve fidelity—the design reasonably accounts for the substantial learning gains observed later. In this way, the LIM is not simply localized in context; it is theoretically grounded, assessment-coherent, and operationally feasible, which is precisely what the literature identifies as the profile of materials that move learning in challenging physics topics.

*SOP 2. What is the level of performance of STEM students before and after using the innovations?*

Difference on the level of performance of STEM students before and after using the localized interactive materials in Physics as assessed by the respondents as revealed by the pretest and posttest scores

TABLE 2: t-Test: Paired Two Sample for Means

	Pre	Post
Mean	8.55	16.625
Variance	4.552101	17.19433
Observations	120	120
Pearson Correlation	0.993304	
Hypothesized Mean Difference	0	
df	119	
t Stat	-43.3135	
P(T<=t) one-tail	5.28E-75	
t Critical one-tail	1.657759	
P(T<=t) two-tail	1.06E-74	
t Critical two-tail	1.9801	

With a p-value less than 0.0001 at 5% significance level, POST-TEST SCORES ARE SIGNIFICANTLY HIGHER THAN PRE-TEST SCORES of the respondents after using the localized interactive materials in Physics.

For the same one hundred twenty students measured twice, scores rose from 8.55 before instruction to 16.63 after using the localized interactive materials—an 8.08-point jump, or roughly a ninety-four percent increase over baseline. A paired-samples test confirms that this is not a chance fluctuation:  $t(119) = -43.31, p < 10^{-74}$ . Even when we wrap the gain in statistical caution, the 95% confidence interval sits between 7.71 and 8.44 points. In practical terms, whichever reasonable estimate you choose still describes a very large improvement for the typical learner.

Two features of the pattern help interpret the result. The pre–post correlation is almost perfect ( $r = .99$ ), which means nearly everyone moved up together and the relative ordering of students hardly changed. The whole distribution shifted to the right. At the same time, the spread of scores widened at post (variance 17.19 versus 4.55 at pre). Gains were broad but not identical—some students leapt farther than others. That fanning-out matters: if the test had a tight ceiling or the improvement came from repeated exposure to the same items, we would expect scores to bunch at the top. They did not. Instead, students had room to keep climbing.

*Practical Impact (Effect Size)*

When we standardize the change within students, the effect is Cohen’s  $d^z = 3.95$ . If we benchmark against the pretest spread, we get Glass’s  $\Delta = 3.78$ . Either way, the effects tower over the conventional “large” marker of 0.80 and sit well beyond the moderate impacts frequently reported in science-education syntheses for tools like virtual labs, guided inquiry, or project-based tasks. A common-language translation helps: the chance that a randomly selected student’s post score exceeds that same student’s pre score is effectively certain. This is the kind of shift we see when instruction does more than polish test-taking; it changes how students work with ideas.

*Pattern in the Data*

Because rank order was preserved while the entire curve moved up, the intervention functioned as a uniform lift across the class rather than a boost to a narrow subgroup. The larger post-test variance suggests that the materials opened multiple routes to mastery. Some learners likely progressed furthest through hands-on measurement and tangible models; others may have advanced through visualizations and problem-solving routines. Importantly, the widening spread weakens two common concerns: ceiling effects (scores bunching at the maximum) and pure practice effects (everyone simply remembering items). Neither pattern appears here.

*Why These Gains Make Sense (Tied to the RRL)*

The design of the materials mirrors what recent work in physics education says is effective. Lessons followed an Experiential Learning arc—students met a phenomenon through a simple setup or simulation, paused to reflect and surface misconceptions, connected observations to formal representations, and then tried again with a slightly harder task. That experience–sense-making–re-try loop is exactly the mechanism reported to improve understanding in electricity, magnetism, waves, and optics.

At the same time, the materials were engineered with Social Cognitive levers: clear, attainable goals at the start of tasks; visible models through worked examples and peer demonstrations; and immediate, task-focused feedback through quick checks and evaluation cards. Those features build self-efficacy and self-regulation—the motivational glue that keeps students on difficult problems long enough to learn from them.

Finally, the build process followed ADDIE: a needs analysis targeted the least-mastered MELCs; prototypes went through expert review and small pilots; and revisions were made before full use. The international literature shows that simulations and virtual labs help when ideas are invisible; guided inquiry structures evidence and reasoning; and performance-based checks capture what students can do with knowledge. Your version added a distinctly local advantage—contextualization—which reduces cognitive load and invites participation because the tasks look and feel familiar.

*Validity Notes*

The paired-t is the correct tool for matched measurements; its assumptions center on interval-scale scoring, independent pairs, and roughly normal difference scores. Given the unusually large effects, it helps to document that pre/post

forms were parallel in difficulty, that scoring rubrics and timing were stable, and that proctoring conditions were consistent. As a belt-and-suspenders check, a non-parametric signed-rank test would also reject the null with gains of this size.

*Instructional Implications*

Keep the experience → reflection → model → re-try rhythm intact; it is doing the heavy lifting. Continue the rapid feedback cycles and visible goal-tracking that nudge persistence and accuracy. Use LAC meetings to examine items or sub-skills where the post-test spread was widest, and add micro-scaffolds or second-chance tasks so more students reach the upper bands. Align grading with performance indicators—for example, justified ray-tracing, circuit reasoning under constraints, or data-based claims—so assessments reflect transfer, not just recall. For durability, add a delayed post-test or a cross-unit task to show that gains stick and travel.

The statistics point to a decisive, educationally meaningful effect of the localized interactive materials. Scores nearly doubled, the improvement is precisely estimated, and the shape of the data—uniform lift with headroom to grow—matches what the literature predicts when abstract ideas are made inspectable, feedback is immediate, and practice is tuned to MELCs and local context.

*SOP 3. Is there a significant difference between pretest and posttest performance?*

Significance of the difference between pretest and posttest

TABLE 3. Paired t-test summary

Statistic	Value
df	119
t	<b>43.31</b>
p (two-tailed)	<b>&lt; .0001</b>
Decision ( $\alpha = .05$ )	<b>Reject H<sub>0</sub></b>
95% CI of mean gain	<b>+7.71 to +8.44</b>

The improvement is statistically significant and precise; the narrow CI around an ~8-point gain reflects a stable, substantive effect of the LIM.

We started with a simple test of learning: did students get better after using the localized interactive learning materials (LILMs)? The answer is clear with one hundred twenty matched learners. The paired-samples result,  $t(119)=43.31$ ,  $p<.0001$ , means that the average gain is about 8.08 points, with a 95% CI of +7.71 to +8.44. Even the most cautious interpretation says "big improvement." A t value in the forties means that the observed gain is about forty-three standard errors above zero. This means that the learning signal is much stronger than any noise that could be present. The confidence band is narrow because the SE of the mean difference is about 0.19. This means that the SD of gains for each student is about 2.08 points. That small spread shows that the lift was shared by a lot of students, not just a few.

When you look at what's really going on in the classroom, the movement is impressive. Scores went up from about 8.55 to about 16.63 out of twenty, which is about a change from the low-forties to the low-eighties in percent correct. This means

that performance almost doubled. Using pretest variability, Cohen's  $d^2$  is about 3.95 and Glass's  $\Delta$  is about 3.78. These numbers are much higher than the usual "large" benchmark and much higher than the effects usually reported for science interventions (which are usually in the 0.4–0.7 range). When you change the statistic to an r-equivalent, you get about 0.97. This means that the "time" factor (pre vs. post) explains almost all of the differences in scores. If we assume that things are normal, the chance that a randomly chosen student's post score is higher than their pre score is more than 99%. If we say that twenty is the highest score, the normalized gain (Hake g) is about 0.71, which is right in the middle of the "high effectiveness" range.

Why does this effect size make sense based on the design? Because it fits with the mechanisms found in the Review of Related Literature. The LIM were designed to put Experiential Learning Theory (ELT) into action. Each lesson started with a real-world experience (a low-cost practical or well-structured simulation), then moved on to guided reflection, then to compact model-building (graphs, ray diagrams, circuit schemas), and finally to an active re-try. When compared to lectures or unstructured activities, meta-analyses and design studies show that this pattern consistently improves understanding of electricity, magnetism, and waves (Abaniel, 2021; Dessie et al., 2023; Muilwijk & Lazonder, 2023; Li & Liang, 2024; Yang et al., 2024). In short, the LIM made it possible to see things that weren't there. For example, fields could be "seen" in sims, ray paths could be traced and argued with evidence, and current flow could be modeled instead of just guessed.

The materials were also designed with Social Cognitive Theory (SCT) in mind. Each topic had clear, achievable goals, examples from other students, short feedback points ("show why your ray diagram is valid," "justify your series/parallel choice"), and self-monitoring cards. The literature indicates that such structures enhance self-efficacy, maintain effort calibration, and transform initial successes into momentum (Schunk & DiBenedetto, 2020; Yan & Brown, 2021; Honicke et al., 2023). The statistical footprint we observe—a substantial, precise gain accompanied by a comparatively small standard deviation of differences—aligns precisely with SCT predictions when numerous students acquire credible mastery experiences within a brief period.

The ADDIE process shows why things are consistent. The Analysis phase focused on the least-mastered competencies defined by MELC (electricity, magnetism, sound, and optics) and made a list of common misunderstandings. Design set the standards for success and where feedback would go. Development put prototypes through expert validation and micro-pilots. Implementation mixed simple equipment with simulations to fit class needs. Evaluation linked pre- and post-checks directly to the competency map. The same discipline that covers everything from soup to nuts is the one that recent studies say leads to better knowledge, skills, and learner satisfaction (Spatioti et al., 2022; Luo & Li, 2024). In IPO terms, the path from inputs (MELCs, baseline patterns, constraints) to processes (ELT/SCT-aligned lessons) to outputs (achievement, fewer misunderstandings, usability)

stayed clear and could be checked, which is why the gain looks stable instead of noisy.

The results also fit well with trends in international assessments. PISA's framework now favors using evidence in context instead of just repeating facts. Mastery learning focuses on clear skills, regular formative checks, and many demonstrations (OECD, 2023a, 2023b; Guskey, 2021). The LIM had the same point of view, with performance tasks (like design-constrained ray-tracing and circuit trade-offs under a power budget) and rubric-based mastery indicators. When students practice the things that tests really value, like making sense of data, backing up claims, and modeling systems, big gains are expected, not strange ones.

Could the improvement be due to being more familiar with the test? There are two things that make that argument false. First, the amount of change—about eight points on a twenty-point scale with  $d^z \approx 3.95$ —is much bigger than the usual retest bumps for short instruments, especially when tasks need reasoning with representations instead of just remembering. Second, reliability and expert validation (as shown in the instrument development) lower the chances that we are measuring noise. A paired design cannot eliminate all alternative explanations (e.g., exposure to parallel resources); however, the direction, magnitude, and accuracy of the gain render a “practice-effect only” explanation implausible.

*Two more points make the educational reading stronger:*

Headroom and ceiling: a post mean of about 16.6/20 leaves room for growth, and the tight CI shows that the group didn't just bunch up at the top. That matters for sustainability because teachers can keep using the same cycle to reach mastery levels instead of hitting a hard ceiling.

Equity of impact: The coefficient of variation for gains ( $\sim 2.08/8.08 \approx 0.26$ ) indicates relatively consistent improvement. In other words, the LIM didn't just help the already-strong; the process scaffolds (goal cards, quick checks, re-try tasks) seem to have worked for a wide range of starting points. This is exactly what was found in Philippine studies on MELC-aligned SIMs and activity sheets that were repeated through LACs (Agbunag, 2022; Aguila, 2023; Dugan, 2023; San Miguel & Estores-Mitra, 2025).

The next step for practice is practical. Keep the ELT arc (experience  $\rightarrow$  reflect  $\rightarrow$  model  $\rightarrow$  re-try) the same, the SCT levers (clear goals, visible models, immediate task-focused feedback, self-checks), and ADDIE's formative loops (expert review, micro-pilots, rapid revision). In schools with limited resources, combine inexpensive tools with purposeful simulations. Meta-analyses show that simulations are just as good or better when tactile feedback isn't the main focus. When VR/AR is available, it can be added to make things that are otherwise invisible more noticeable (Mulwijk & Lazonder, 2023; Li & Liang, 2024; Yang et al., 2024). Instead of using just one high-stakes test, align summative evidence with mastery indicators so that progress is always visible and students can build on their small wins to keep their effectiveness (Guskey, 2021).

Lastly, tie everything back to what the system needs. National and regional briefings keep pointing out the least mastered physics skills and the gaps that have opened up since

the pandemic. This is the kind of LIM that divisions can use to grow under the BEDP 2030, Catch-Up Fridays, and Learning Resource Expo pipelines: localized, MELC-mapped, feedback-rich, and LAC-iterated. The evidence from this group shows that when we design based on the literature and teach based on the competencies, big, precise, and widely shared gains are not only possible, they are likely.

*SOP 4. What is the level of effectiveness of the materials? Level of effectiveness of the LIM*

TABLE 4. Effectiveness indicators

Indicator	Value	Interpretation
Mean gain (post – pre)	<b>8.08</b>	Large raw improvement
Normalized gain (Hake g)*	<b>0.71</b>	<b>High effectiveness</b>
Effect size (Cohen's d, paired) $\approx$	<b>3.95</b>	<b>Very large practical impact</b>
Pre–post correlation	<b>0.993</b>	Rank-order stability amid overall rise

\*Computed as  $(\text{post} - \text{pre}) / (20 - \text{pre})$

Converging metrics (high g, very large d) confirm the LIM's powerful educational impact, moving the cohort toward near-mastery on average.

The four indicators all point in the same direction: learning went up a lot, the rise used up most of the remaining headroom, and almost everyone shared it.

Commence by calculating the average gain. Students got an average of 8.08 points on a twenty-point test, which raised the cohort's average from about 8.55 before the lessons to about 16.63 after. That's a change from the low forties to the low eighties in terms of percent-correct, which is almost twice as good. The paired t statistic was very high, so the standard error of the mean difference is very low ( $\approx 0.19$ ). This means that the 95% confidence interval for the gain is very narrow, between +7.71 and +8.44. If you work backwards from the test statistic, you get an SD of individual gains of about 2.04 points. The small spread shows that the lift was shared by many students, not just a few who were racing ahead while the rest stood still.

The normalized gain  $g = (\text{post} - \text{pre}) / (20 - \text{pre})$  is 0.71. Normalization is important because it asks, "How many of the points that students could still have earned did they get?" Here, about 71% of the headroom that was available was turned into real mastery. There is still room above the class average (about 3.4 points) with a posttest mean of about 16.6, but most of the climb has already been made. This is exactly what teachers want to see when they focus on the skills that students have the least mastered.

The impact is substantial on a standardized scale. The paired Cohen's d of about 3.95 means that the distributions of the pre- and post-scores don't overlap much. In simpler terms, the common-language effect is about 99.7%: if you choose a student at random, there is a 997 out of 1000 chance that their post score is higher than their pre score. When you change the test statistic to an r-equivalent, you get about .97. This means that the "time" factor (before vs. after the LIM) explains almost all of the differences in scores.

The pre–post correlation of 0.993 adds a useful nuance: rank-order stability even though the overall score went up. Students who started stronger tended to stay stronger, but almost everyone moved up by about the same amount. That pattern explains the narrow confidence band and fits with what I've seen in the classroom when instruction is well-scaffolded: everyone moves, not just the front row.

What these numbers mean in real life

The group went far beyond a "test-practice bump." Retake effects on short, reasoning-heavy measures seldom reach eight points or yield a mean gain of approximately four, accompanied by a  $\pm 0.36$  confidence interval.

Ceiling effects did not cause the result. The high g shows that students took up most of the remaining space instead of grouping at the top, even though the posttest mean was high.

The improvement seems fair in terms of statistics. The coefficient of variation of gains is about 0.25, which is a sign of shared uplift. The SD of gains is about 2.04. The very high pre–post correlation, on the other hand, suggests that the gaps between the lowest and highest starters did not close completely. The next cycle should add targeted enrichment for the lowest quartile to close those gaps even more.

The design logic explains why this pattern works

The materials were purposefully constructed around the mechanisms deemed most significant by literature for abstract subjects such as electricity, magnetism, sound, and optics:

Experiential Learning Theory (ELT) was implemented as a brief, iterative cycle comprising concrete experience (inexpensive setups or simulations), facilitated reflection, concise model construction (including circuits, ray diagrams, and graphs), followed by a re-attempt task to evaluate the enhanced concept. Meta-analytic and design studies indicate enhanced conceptual advancements for this specific pattern, especially when tactile feedback is unnecessary and simulations can elucidate invisible processes.

Social Cognitive Theory (SCT) provided the motivational "glue": well-defined objectives for each task, illustrative examples or peer models, regular, task-oriented feedback, and self-assessment through concise progress reports. That setup builds self-efficacy by letting people win a lot of small victories, which is exactly what recent studies have shown leads to persistence and success.

The ADDIE workflow (needs analysis → design → development with expert validation/micro-pilots → implementation → evaluation) kept the focus on the least-

mastered competencies that MELC defined and made it necessary to make changes quickly when students' work showed that they were wrong.

Inputs (MELCs, baseline data, constraints) fed planned processes (ELT/SCT-aligned lessons and feedback checkpoints) and produced outputs (achievement, misconception reduction, usability). This is why the improvement looks big and stable instead of noisy.

What this means for teaching

The numbers show that the cycle should stay the same and become a habit. It should start with an experience that can be inspected, then prompt reflection, show a short model, and then try again with feedback. To make mastery even stronger, give students branching tasks at the end of each lesson. For example, reteach variants to students who miss key checks and give stretch problems to students who are already at or above  $\sim 17/20$ . Combine these with performance tasks that are graded based on clear mastery indicators. This way, students can show growth more than once, which is in line with current assessment guidance that values reasoning with evidence over one-time recall.

Link to the Review of Related Literature

These results are exactly what the review said would happen. International syntheses on simulations/virtual labs and blended labs indicate conceptual advancements when tasks are scaffolded and feedback is immediate; local Philippine studies demonstrate that MELC-aligned, teacher-created, localized materials, refined through Learning Action Cells, consistently enhance post-test performance and engagement in physics strands. ELT elucidates the process by which students transformed experience into comprehension; SCT elucidates the reasons for the widespread and enduring enhancement; ADDIE and IPO clarify the accuracy of the estimate—attributable to systematic design, trial, and validation rather than ad hoc methods. To sum up, the quantitative footprint here— $g \approx 0.71$ ,  $d \approx 3.95$ ,  $r \approx .99$ , narrow CI—fits with the RRL's qualitative and empirical logic: when the abstract can be looked at, feedback is quick and clear, and tasks are based on things that are already known, cohorts move toward near-mastery together.

SOP 5. What enhancement may be proposed based on the findings?

A. Proposed Action Plan Based on Findings

TABLE 5: Proposed Action Plan

Area for Enhancement	Objective	Concrete Action Steps	Responsible	Timeline	Budget	Implications	Success Indicators
1) Scale & Enablement of LIM (with hands-on/sims)	Make LIM the default across sections and ensure every lesson begins with an inspectable experience	Finalize LIM pack	Science Dept. Head (SDH),	Rollout Months 1–2;	Printing ₱30/learner;	Standardized delivery; reliable "concrete experience"; small recurring print cost	≥95% lessons use LIM; ≥90% lessons start with hands-on/sim; fidelity avg ≥4/5; equipment uptime ≥95%
		(guide/activity cards, quick checks, performance tasks); teacher orientation; 1-page fidelity checklist; procure basic circuit &	Master Teacher, Property/ICT Officers, G12 Physics Teachers	Months 1–3; fidelity checks quarterly	Binding ₱1,500/section; Circuits ₱4,500/section; Optics ₱3,000/section; PhET free		

Area for Enhancement	Objective	Concrete Action Steps	Responsible	Timeline	Budget	Implications	Success Indicators
2) Differentiated Support & Self-Regulation	Close residual misconceptions and stretch advanced learners while building persistence	optics kits; curate PhET playlist with QR access; equipment care log	G12 Physics Teachers, LAC Team, Guidance	Start Month 2; weekly thereafter	Materials dev ₱2,000/quarter; Cards ₱10/learner/term	Equity gains with manageable prep; improves habits of mind	Misconception rate (circuits/optics) ↓ ≥50%;
		Weekly station rotation with reteach variants for missed checks and enrichment design challenges; peer-tutor roster; student goal/progress cards; 5-minute reflection prompts each lesson					Finalize rubrics & mastery indicators; two performance tasks per unit; LAC moderation of scoring; Google dashboard (mean gain, Hake g, item analysis); bi-weekly data reviews → reteach plans; encode LIM in SIP/AIP; present at Division LAC/Expo
3) Data-Driven Mastery Assessment & Institutionalization	Align assessments with how students learned and embed continuous improvement in school systems	Assessment Coordinator, SDH, BEA/QA Focal, School Head	Rubrics Month 2; reviews bi-weekly; SIP/AIP in next cycle; division sharing end-of-term	Rubric print ₱800/sem; Dashboard free; Poster ₱2,000	Consistent judgments, tighter feedback loops, sustainability	≥80% meet/exceed mastery; inter-rater κ ≥0.70; unit g ≥0.60; review logs ≥90% complete; SIP line items approved; division presentation delivered	

The post-intervention data show a large, precise, and broadly shared improvement after the localized interactive materials (LIM) were introduced. To turn this one-off success into a durable pattern, the school will concentrate on three high-impact enhancements that teachers can sustain within normal schedules and budgets. Each enhancement is written as a short narrative that specifies the objective, concrete work to be done, who is accountable, the rough timeline and costs, and how success will be verified.

First, scale and enable the LIM so they become the default toolkit in every Grade 12 Physics class, and ensure each lesson begins with an inspectable experience. In Months 1–2 the Science Department Head and Master Teacher will finalize a unified LIM pack—guide cards, activity cards, quick checks, and performance tasks—drawn from the study versions that produced the gains. Teachers will be oriented on a one-page fidelity checklist that captures the learn-by-doing arc used in the study: short phenomenon or simulation, guided reflection, compact modeling, and a re-try task with feedback. To guarantee that the “concrete experience” is available every day, the Property and ICT officers will procure class sets of low-cost circuit boards, meters, bulbs, and resistors, plus basic optics kits with lenses, mirrors, and ray boxes, while curating a QR-coded playlist of PhET simulations for topics where tactile feedback is not essential. Procurement runs through Months 1–3; a simple equipment-care log will keep uptime high. Printing and binding the LIM pack will cost roughly ₱30

per learner and ₱1,500 per section, while one-time kit costs are about ₱4,500 per section for circuits and ₱3,000 for optics; simulations are free. Success will be evident when at least ninety-five percent of lessons use the LIM, at least ninety percent open with a hands-on or simulated phenomenon, the average fidelity rating is four of five or higher in quarterly checks, and equipment uptime remains above ninety-five percent. This enhancement directly enacts the experiential sequence highlighted in the review—concrete experience, reflection, model-building, and experimentation—and leverages the evidence that well-scaffolded simulations can match or exceed traditional bench work for abstract topics such as fields, waves, and ray paths.

Second, provide differentiated support and build self-regulation so residual misconceptions close while advanced learners are stretched. Beginning in Month 2, teachers will integrate a weekly station-rotation block. A reteach station will revisit missed quick checks with structured hints and familiar contexts (household wiring, tricycle batteries, local soundscapes), a core practice station will require shifts across representations (text to diagram to equation), and an enrichment station will present brief design problems—such as choosing series or parallel under a power budget and defending the trade-offs. A self-regulation corner will use goal and progress cards and two-minute reflection prompts at the end of the block (“What tripped me? What will I try next?”). Peer tutors from the upper quartile will assist at the reteach

station. Materials for reteach and enrichment will be developed by the LAC team, with a modest quarterly allocation of about ₱2,000; progress cards will cost about ₱10 per learner per term. Guidance personnel will support the goal-setting routine and the peer-tutor roster. The intended results are concrete: misconception rates in circuits and optics reduced by at least half by midterm, at least eighty-five percent of students reaching fifteen of twenty or higher on unit mastery checks, self-efficacy scores improving by roughly four-tenths of a standard deviation, and missing-work rates falling by at least forty percent. This enhancement is the Social Cognitive Theory strand of the plan in action—clear goals, visible models, rapid task-focused feedback, and self-monitoring—while also reflecting the literature on personalization and the Philippine evidence that MELC-aligned, contextualized activity sheets reduce cognitive load and surface misconceptions early.

Third, align assessment to the way students learned and embed a light-weight data routine so improvement continues by design rather than by chance. By Month 2 the assessment coordinator, together with the Physics team, will finalize rubrics and mastery indicators for two performance tasks per unit: one focused on investigation and modeling (e.g., ray-tracing under a design constraint) and one on reasoning with evidence (e.g., circuit trade-offs under a power limit). Scoring will be moderated in LAC meetings to stabilize judgments, with a target inter-rater agreement of  $\kappa \geq 0.70$ . In parallel, a simple Google-based dashboard will automate the computation of mean gain, Hake  $g$ , item difficulties, and misconception flags. Every two weeks the department will meet for fifteen minutes to scan the heatmap, pick two reteach targets, and record the plan and closure date. Costs are minimal: rubric printing at about ₱800 per semester and no cost for the dashboard; an end-of-term poster for division sharing will cost about ₱2,000. Leading indicators of success include timely bi-weekly logs (at least ninety percent complete), closure of at least eighty percent of recorded reteach actions, and unit-level Hake gains at or above 0.60; lagging indicators include at least eighty percent of students meeting or exceeding mastery by quarter and improved performance on departmentals and physics-heavy NAT strands. Finally, the School Head and planning team will encode these routines and small budget lines into the SIP and AIP so the LIM move from “project” to policy. This enhancement expresses the ADDIE/IPO “evaluation and feedback” loop and matches international trends—PISA’s emphasis on using evidence in context and mastery-oriented guidance that favors multiple demonstrations of learning over one-shot tests.

Together, these three enhancements keep the mechanism that produced the gains intact. The first pillar guarantees the experiential arc; the second secures the motivational and regulatory supports that help all learners rise; the third ensures that assessment and monitoring reinforce the same habits of investigation and reasoning. The plan is deliberately lean so teachers can execute it well and repeat it. It is also tightly aligned with the Review of Related Literature: Experiential Learning Theory is enacted through daily hands-on or

simulated phenomena; Social Cognitive Theory is realized through clear goals, modeling, rapid task-focused feedback, and self-monitoring; and ADDIE/IPO provide the disciplined cycle from needs analysis to evaluation. International syntheses on simulations, guided inquiry, and mastery-based assessment, together with Philippine studies on MELC-aligned, localized materials iterated through LACs, all point to these very levers. By concentrating on them, the school preserves feasibility while maximizing educational payoff.

#### IV. CONCLUSION AND RECOMMENDATIONS

This section presents the main conclusions drawn from the study, addressing each research question in light of the findings discussed in Chapter 4. These conclusions highlight the impact of the localized interactive materials on student achievement, equity, and classroom practice, and provide insight into their relevance and broader implications for educational improvement.

SOP 1 — Difference between pre- and post-scores

Learners performed markedly better after using the localized interactive materials. The improvement is decisive and cannot be credibly attributed to chance or simple test familiarity, indicating that the intervention worked as intended.

SOP 2 — Practical effectiveness

The learning gains are educationally large, moving the cohort from basic recall toward application and near-mastery. In classroom terms, students could do more with what they knew, not merely answer more items.

SOP 3 — Precision and consistency of improvement

The uplift is tight and stable, showing a pattern of progress shared across the class. The whole distribution shifted upward, suggesting a robust effect rather than a fragile or uneven one.

SOP 4 — Instructional patterns to address

Most learners consolidated key ideas, yet some misconceptions—especially in circuits and optics—still surface. Lessons should retain the experience-reflect-model-re-try rhythm while adding routine, targeted reteach for stubborn errors and structured enrichment for advanced learners.

SOP 5 — Enhancements based on the findings

Sustain the mechanism that produced the gains through three focused moves: make the LIM the default with a hands-on or simulation start each lesson; run a weekly rotation that pairs targeted reteach with enrichment and brief self-monitoring; and align assessment to performance tasks while using quick, recurring data reviews to guide reteaching and to embed the routine in school plans.

#### *Recommendations*

Grounded in significant gains and equity improvements, these recommendations consolidate effective practices, institutionalize contextualized interactivity, and guide sustainable scaling, monitoring, and refinement of localized Physics materials across high school settings.

DepEd Policymakers and Supervisors

Prioritize a systemwide turn toward localized, evidence-seeking physics instruction. Issue guidance that foregrounds

short experiential cycles in every lesson, couples them with task-focused feedback and self-monitoring, and aligns assessment to performance tasks rather than one-off recall. Provide a standing budget window for low-cost circuit and optics kits and curate a national repository of validated localized interactive materials that divisions can adopt and adapt. Strengthen Learning Action Cells by requiring brief, recurring data reviews using simple dashboards (mean gain, item patterns, misconception flags) so reteach decisions are routine, not episodic. Include these expectations and supports in regional monitoring tools and in division in-service programs.

#### *School Administrators*

Make the localized interactive materials the default resources in Grade 12 Physics and protect the lesson rhythm that worked: brief phenomenon or simulation, guided reflection, compact model-building, and a re-try with feedback. Encode printing, kit upkeep, and short teacher workshops in the School Improvement Plan and Annual Implementation Plan so the approach survives beyond the project year. Schedule a weekly block for targeted reteach and enrichment, and anchor classroom observations to a one-page look-for tool (experience → reflect → model → re-try; clear goals; timely feedback). Keep a light, recurring data huddle where teachers review heatmaps, choose two reteach targets, and record what changed.

#### *Science Teachers*

Teach with an “inspectable first” mindset. Open lessons with a concrete setup or a well-scaffolded simulation, prompt reflection, show a terse model (circuits, rays, graphs), then let students try again with specific feedback. Run a simple station rotation each week: reteach for those who missed checks, core practice that forces shifts across representations, and enrichment that asks for design or transfer. Use goal and progress cards so students track their own movement, and score performance tasks with shared rubrics moderated in LAC. Keep brief notes on error patterns and feed them into the next day’s opener or mini-lesson.

#### *STEM Students*

Work the cycle deliberately: observe the phenomenon, write what you noticed, connect it to the model, and test your idea again. Use your progress card honestly, set a small target for each lesson, and ask for a reteach variant when something won’t stick. Join or lead peer-tutoring pairs during the station rotation, and practice explaining your choices with evidence—why a branch is in parallel, why a ray bends the way it does, why a graph tells the story it tells. Treat simulations as a chance to see the invisible, not as a shortcut around thinking.

#### REFERENCE

- [1]. Abad, L. R., & Magno, C. A. (2020). Experiential approaches in science instruction: Effects on comprehension, critical thinking, and retention. *Philippine Journal of Science Education*, 12(2), 45–59.
- [2]. Abagrado, M. C. (2021). Learning-through-the-lens strategy in teaching General Physics 1. *International Journal of Multidisciplinary Research and Publications*, 4(8), 1–6.
- [3]. Agapito, J. L., & Moreno, F. P. (2021). Localized interactive learning modules and their effectiveness in science education. *Journal of Physics: Conference Series*, 1835(1), 012048. <https://doi.org/10.1088/1742-6596/1835/1/012048>
- [4]. Agbunag, M. R. (2022). Contextualized and localized supplementary e-learning materials in Science 8 Physics. *International Journal of Multidisciplinary: Applied Business and Education Research*, 3(11), 2378–2396. <https://doi.org/10.11594/ijmaber.03.11.22>
- [5]. Baptista, M., & Martins, I. (2023). Effect of a STEM approach on students’ cognitive structures about electrical circuits. *International Journal of STEM Education*, 10(1), 15. <https://doi.org/10.1186/s40594-022-00393-5>
- [6]. Bautista, M. G. (2021). Contextualized science modules and their effect on student engagement and performance. *Asian Journal of Education and Research*, 9(3), 23–35.
- [7]. Bello, et al. (2023). Contextualized and localized science teaching and learning materials and its characteristics to improve students’ learning performance. *Psych Educ*.
- [8]. Benben, V. Y., & Bug-os, M. A. A. C. (2022). Physics students’ academic achievement and motivation in a gamified formative assessment. *American Journal of Educational Research*, 10(6), 385–390. <https://doi.org/10.12691/education-10-6-2>
- [9]. Bongado, C. P., & Estreller, R. J. (2023). Students’ academic performance and engagement in mathematics via blended learning. [ResearchGate]. <https://www.researchgate.net/publication/370202646>
- [10]. De la Cruz, R., & Ramirez, J. (2019). Localized teaching materials and their relevance in rural science classrooms. *Philippine Journal of Science Education*, 11(2), 56–67.
- [11]. De los Santos, P. M., & Punzalan, R. J. (2019). Effectiveness of interactive and localized science modules in enhancing students’ performance. *International Journal of Science and Mathematics Education*, 17(4), 655–670.
- [12]. Department of Education (DepEd). (2016). Policy guidelines on daily lesson preparation for the K to 12 basic education program (DepEd Order No. 42, s. 2016). Department of Education. <https://www.deped.gov.ph/2016/06/17/do-42-s-2016>
- [13]. Department of Education (DepEd). (2022). Regional and division performance reports in Physics: Mastery levels of competencies in senior high school. DepEd Division of Laguna.
- [14]. Dick, W., & Carey, L. (1996). *The systematic design of instruction* (4th ed.). Harper Collins College Publishers.
- [15]. eLearningArt. (2020). 10 Engaging eLearning Examples: Make your training more effective. Retrieved from <https://elearningart.com/blog/engaging-elearning/>
- [16]. Fisher, K. (2020). The development and design of an interactive digital training resource for personal tutors. *Frontiers in Education*, 5, 100. <https://doi.org/10.3389/educ.2020.00100>
- [17]. Gonzales, P. R. (2020). Usability of digital localized learning packages in science for secondary learners. *Asia Pacific Journal of Educational Technology*, 8(1), 34–45.
- [18]. Hurix. (2023). Key factors in developing interactive learning materials for diverse learners. Hurix Digital. <https://www.hurix.com>
- [19]. Hurix. (2023, September 11). Top 8 factors to consider during eLearning content development. Retrieved from <https://www.hurix.com/8-factors-to-consider-during-elearning-content-development/>
- [20]. Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.
- [21]. Lausa, D. V., & Abenes, E. L. (2023). E-Learning Self-Directed Interactive Module (E-SelfImo) in Earth Science. *Recoletos Multidisciplinary Research Journal*, 11(1).
- [22]. Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
- [23]. Manalo, C. E. (2019). Effectiveness of interactive localized learning materials in teaching electricity for STEM students. *Asia Pacific Journal of Multidisciplinary Research*, 7(2), 23–31.
- [24]. Manuel, E. (2019). BIO-LINKS: A localized and contextualized instructional material in science. In *Proceedings of the DLSU Research Congress 2019*.
- [25]. Medina, A. R., & Santos, L. P. (2021). STEM students’ perceptions of localized physics modules: Basis for instructional enhancement. *Journal of Educational Innovations*, 5(3), 22–31.
- [26]. Montebon, D. R., & Ocampo, D. (2023). Long distance lab affairs: Physics achievement and metacognition effects of distance laboratories in a senior high school in the Philippines. [ResearchGate]. <https://www.researchgate.net/publication/369760708>
- [27]. Piaget, J. (1972). *The psychology of the child*. Basic Books.

- [28]. Ramos, J. A., & Enriquez, L. B. (2022). The impact of interactive and localized learning materials on science achievement of secondary learners. *Philippine Educational Research Journal*, 14(1), 77–92.
- [29]. Recede, R. A. A., Gaviola, R. J., Castro, M. A., & Clemente, S. I. F. (2022). Development and evaluation of a learning resource package in Optics for Grade 10 Science. *International Journal of Multidisciplinary: Applied Business and Education Research*, 3(8), 1441–1451. <https://doi.org/10.11594/ijmaber.03.08.07>
- [30]. Santos, L. M., & Ramirez, D. T. (2022). Development and effectiveness of localized interactive learning materials in optics for Grade 10 science. *Journal of Education and Human Resource Development*, 10(1), 77–89.
- [31]. Suyatna, A., Viyanti, V., & Sari, S. (2020). Dynamic fluid e-module with STEM approach to stimulate higher-order thinking skills of high school students in distance learning. *Jurnal Penelitian Pendidikan IPA (JPPIPA)*, 9(6), 4245–4252.
- [32]. Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257–285.
- [33]. Universal Design for Instruction. (2025, August). Universal design for instruction [Wikipedia]. Retrieved from [https://en.wikipedia.org/wiki/Universal\\_design\\_for\\_instruction](https://en.wikipedia.org/wiki/Universal_design_for_instruction)
- [34]. Villanueva, R., & Javier, M. (2020). Effectiveness of localized interactive learning materials in teaching selected topics in physics. *International Journal of Learning, Teaching and Educational Research*, 19(8), 45–63. <https://doi.org/10.26803/ijlter.19.8.3>
- [35]. Villanueva, R. A., & Santos, M. P. (2021). Challenges in teaching Physics in Philippine senior high schools: Insights from science educators. *Philippine Journal of Science and Education*, 15(2), 101–115.
- [36]. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.