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Supplemental Activity Sheets for Enhancing Learning in Electrical Installation and Maintenance Exploratory Subject

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ABSTRACT

Purpose of the study: The purpose of this study is to design, develop, and validate supplemental activity sheets for the Exploratory Subject in Electrical Installation and Maintenance to enhance students' competencies, engagement, and mastery of skills in alignment with the TLE curriculum standards in Basic Education.

Methodology: A descriptive-developmental research design, guided by the modified ADDIE model, was employed to create Supplemental Activity Sheets using Canva for visual design. The DepEd Learning Resources Management and Development System (LRMDS) tool was used for evaluation by two TLE Master Teachers, two EIM teachers, and one licensed Master Electrician, with 5–16 years' teaching, industry, and material development experience.

Main Findings: The developed supplemental activity sheets in Electrical Installation and Maintenance were rated *Very Satisfactory* in content, format, presentation and organization, and accuracy and up-to-datedness by expert evaluators. The overall weighted mean was within the *Very Satisfactory* range, indicating high acceptability and alignment with the Most Essential Learning Competencies (MELCs).

Novelty/Originality of this study: This study introduces contextually relevant, standards-aligned supplemental activity sheets for Electrical Installation and Maintenance, integrating MELCs, disaster risk reduction, gender equity, and higher-order thinking skills. By combining pedagogical design principles with visual learning strategies, it advances instructional resource development in TLE, offering a replicable model for enhancing competencies despite limited textbooks and specialized teaching staff.

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1. INTRODUCTION

The overarching aim of education is to develop learners who can reason, decide, and act effectively amid real-world complexity capabilities that remain consequential long after graduation. In the Philippine context, this aim is institutionally codified in Section 2 of Republic Act No. 10533, which affirms the State's commitment to a functional basic education system that forms productive and responsible citizens through the development of competencies, skills, and values for lifelong learning and employment [1]. This policy direction sets a clear standard: curriculum reforms must translate into learning experiences that are not only content-compliant but also competence-building and equitable in practice.

Within this policy mandate, the K to 12 Basic Education Program stands as a major reform intended to strengthen basic education delivery by aligning learning outcomes with 21st-century skills, competencies, and

values comparable to global benchmarks [2]. Parallel to this reform agenda, the Department of Education emphasizes equitable access to quality and relevant learning, targeting outcomes that extend beyond academic attainment to include learners' readiness to confront future demands as competent, emotionally balanced, and self-reliant individuals [3]. Taken together, these commitments imply that the success of K to 12 depends not only on curriculum intent but also on the availability of instructional conditions that enable students to practice and demonstrate targeted competencies.

Technology and Livelihood Education (TLE) is central to this competency-driven thrust because it explicitly targets technological proficiency, entrepreneurship, work values, and life skills [4]. Effective instruction in TLE is therefore necessarily performance-oriented: it requires conceptual mastery, authentic application, critical thinking, and the formation of a strong work ethic [5]. Moreover, TLE performs a dual function supporting pathways to employment while also equipping learners with practical vocational skills, particularly for those who may not proceed to higher education [6]. However, the capacity of TLE to deliver these outcomes is constrained by persistent implementation barriers, especially inadequate facilities, tools, and learning materials that weaken skill development opportunities and reduce student engagement [7], [8]. In other words, the problem is not merely curricular alignment but the instructional infrastructure required to enact competency-based learning in real classrooms.

This constraint becomes more urgent when considered alongside systemic shortages in instructional resources. edcom 2 reports that while textbooks for grades 5 and 6 have been procured under the k to 12 curriculum, none have been supplied for grades 7 to 10 in tle [9]. such gaps are not isolated to a local narrative of scarcity; they interact with broader inequities in access to learning resources, which were heightened during the covid-19 pandemic and made more visible through disparities in technology access. International large-scale assessments and regional measures TIMSS 2019, PISA 2018, and SEA-PLM have underscored the urgency of improving learning conditions and access to resources to raise student performance and reduce learning disparities [10]–[12]. These indicators situate the local resource deficit within a wider empirical context: educational systems that fail to provide adequate learning supports risk perpetuating low performance and inequity, particularly in subjects that depend on structured practice and applied competence.

Within TLE, Electrical Installation and Maintenance (EIM) is a strand where instructional limitations are especially consequential because competence development relies on sequenced, supervised, and repetitive skill practice supported by appropriate equipment and well-designed learning tasks. When facilities and tools are limited, the quality of learning activities and the availability of carefully structured supplemental materials become even more decisive. Yet, the absence of supplemental instructional resources restricts learners' opportunities to engage in hands-on practice and to develop higher-order thinking through guided problem-solving and reflection. From an instructional design standpoint, this matters because structured worksheets can function as pedagogical scaffolds that align tasks with curriculum requirements, organize learning progression, and cultivate learner autonomy benefits highlighted by Fajriah and Suryaningsih [13]. Thus, the need is not simply for "more materials," but for materials that are deliberately designed to scaffold competence in contexts where standard supports are insufficient.

Viewed theoretically, the gap can be framed as a misalignment between (a) competency-based expectations in TLE/EIM and (b) the availability of validated, cognitively progressive learning scaffolds that can systematically move learners from surface engagement to more complex understanding and performance. The SOLO taxonomy offers a principled way to structure tasks toward increasing cognitive complexity and higher-order thinking, making it a suitable framework for designing supplemental activities that go beyond procedural repetition toward explanation, justification, and transfer [14]. However, despite the documented shortage of official learning resources in Grades 7–10 TLE and the known constraints in facilities and materials there remains a practical and pedagogical gap: locally responsive, curriculum-aligned, and empirically validated supplemental activity sheets for EIM that are explicitly designed to elicit higher-order thinking and competence progression are not sufficiently established in typical instructional provision.

Accordingly, the research problem addressed in this study is explicit: How can Supplemental Activity Sheets for Electrical Installation and Maintenance be systematically developed and validated to provide curriculum-aligned, resource-responsive learning scaffolds that strengthen learners' comprehension and motivation while promoting higher-order thinking through the SOLO taxonomy? This problem is anchored in the policy imperative to develop competencies and values for lifelong learning and employment the K to 12 commitment to globally aligned and equitable quality education and the on-the-ground realities of resource constraints and textbook absence in TLE which are further contextualized by the broader urgency signaled by international learning assessments.

Guided by this problem, the present study focuses on the development and validation of Supplemental Activity Sheets for EIM designed to enhance comprehension, motivation, and social skills, while deliberately cultivating higher-order thinking using the SOLO taxonomy [14]. The intended contribution and the novelty of this work lies in integrating (1) curriculum-aligned, competency-focused EIM tasks, (2) a SOLO taxonomy-based progression that operationalizes higher-order thinking within practical activities, and (3) advocacy-

oriented themes that support values formation alongside technical training, thereby offering a validated and context-responsive instructional resource for Grades 7–10 settings where standard TLE materials remain limited and where instructional conditions demand structured scaffolding to achieve the outcomes envisioned in K to 12 [9].

2. RESEARCH METHOD

2.1 Research design

This study designed, developed, and validated supplemental activity sheets for the exploratory subject in Electrical Installation and Maintenance (EIM) to address the shortage of instructional resources in the Technology and Livelihood Education (TLE) domain. EDCOM 2 reported that, following the K to 12 implementation, textbook procurement covered only Grades 5 and 6, leaving Grades 7–10 without adequate materials [15]. The COVID-19 pandemic further widened accessibility gaps, while teacher specialization mismatches and resource shortages compounded instructional challenges [16].

Using a descriptive-developmental research design, the study gathered data on instructional gaps and assessed the materials' acceptability, while iteratively designing and refining them to align with the Most Essential Learning Competencies (MELCs) [17]. Following a modified ADDIE (Analyze, Design, Develop, Evaluate) model [18], the implementation stage was excluded. The *Analyze* phase reviewed EDCOM 2 findings; *Design* integrated MELCs, disaster risk reduction principles (RA 10121) [19], and gender equity (DepEd Order No. 32, s. 2017) [20]; *Develop* incorporated DepEd core values, religious inclusivity (DepEd Order No. 72, s. 2009) [21], and higher-order thinking skills via the SOLO taxonomy [22].

Visual and color theory principles were applied, with graphics produced in Canva under granted permission, following studies highlighting color's role in sustaining attention and enhancing comprehension [23]–[25]. Validation employed the DepEd Learning Resources Management and Development System (LRMDS) tool, assessing content quality, instructional effectiveness, and accuracy. Expert feedback guided refinements, ensuring the final materials were pedagogically sound, contextually relevant, and standards-aligned to enhance student competencies in EIM.

2.2 Sampling procedures & respondents

This study utilized purposive sampling to form an expert panel for validating the developed Supplemental Activity Sheets. Purposive sampling is a non-probability technique in which respondents are intentionally selected because their expertise and professional experience directly match the evaluation demands of the study [26]. This approach is methodologically appropriate for instructional material development and validation because the primary objective at this stage is not statistical generalization, but the generation of credible, standards-based judgments on technical accuracy, curriculum alignment, pedagogical appropriateness, and implementability dimensions that require specialized knowledge and cannot be reliably assessed by non-expert raters [27]. Thus, purposive sampling strengthens the validity of the review by ensuring that feedback is informed, context-relevant, and actionable for revision.

To standardize expert selection and reinforce the integrity of the evaluation process, the study adopted the qualification criteria stipulated in the deped 2008 Regional Handbook in the content evaluation of supplementary materials [28]. These criteria specify that evaluators must: (a) be Filipino citizens; (b) hold a professional license as a teacher, subject area supervisor, or curriculum specialist with at least five years of relevant experience; (c) have no conflict of interest with the material being reviewed; and (d) maintain confidentiality throughout the evaluation [28]. Anchoring respondent selection to these guidelines provides a defensible methodological basis for defining expertise, while also reducing threats to validity related to insufficient competence and potential bias.

Based on these requirements, five evaluators were selected: two Master Teachers specializing in Technology and Livelihood Education (TLE), two teachers currently handling Electrical Installation and Maintenance (EIM), and one licensed Master Electrician. This panel structure was deliberately configured to integrate complementary expertise necessary for evaluating competency-based EIM materials: Master Teachers contribute advanced pedagogical and curriculum-informed judgment, EIM teachers provide classroom-grounded insights on feasibility and learner needs, and the Master Electrician verifies technical correctness and industry authenticity. Collectively, the evaluators brought five to sixteen years of teaching experience, relevant exposure to electrical technology practice, and experience in developing modules or learning activity sheets qualifications aligned with the study's validation purpose. Overall, this purposive, criteria-based sampling design is consistent with Creswell's position that purposive sampling is appropriate when research requires detailed expert feedback on specialized educational resources [29].

2.3 Research instruments

The study employed a structured Evaluation Guide as the primary research instrument, adapted from the Department of Education's 2008 Regional Handbook in the Content Evaluation of Supplementary Materials [30]. This tool was specifically designed to assess the content quality, format, presentation and organization, and accuracy and up-to-datedness of the developed supplemental activity sheets. Each of these four factors was rated using a four-point Likert scale: 1 Not Satisfactory, 2 Poor, 3 Satisfactory, and 4 Very Satisfactory, in accordance with the learning resources management and development system (LRMDS) guidelines .

The instrument included descriptors for each criterion, ensuring clarity and uniformity in the evaluation process. It was aligned with the standards set in Section 1.1.4 of the Instructional Materials Council Secretariat (IMCS) Guidelines and utilized the evaluation rating sheet and descriptors for print materials outlined in section 6.4 of the same framework [31]. This structured format allowed the evaluators comprising master teachers in technology and livelihood education, electrical installation and maintenance instructors, and licensed electrical practitioners to independently and objectively assess the materials.

To facilitate comprehensive validation, the evaluation instrument integrated both quantitative ratings and qualitative comments. Quantitative data provided measurable indicators of material quality, while qualitative feedback enabled targeted revisions during the iterative development phase, consistent with the principles of developmental research as described by Seels and Richey [32]. This dual approach enhanced the validity and reliability of the instrument, ensuring that the final instructional materials met deped's pedagogical and technical standards while addressing the contextual needs of the learners.

2.4 Data collection

The data collection process was designed to systematically gather expert evaluations and supporting references necessary for the development and validation of the supplemental activity sheets for the exploratory subject in Electrical Installation and Maintenance (EIM). The procedure followed a structured approach to ensure reliability, validity, and alignment with the study's descriptive-developmental design.

Initially, the researcher identified qualified evaluators based on the Department of Education (DepEd) 2008 *Regional Handbook in the Content Evaluation of Supplementary Materials* [30] [33]. The selection criteria included: (a) Filipino citizenship; (b) at least five years of relevant experience in teaching, supervision, or curriculum development in the TLE domain; (c) possession of a professional teaching license; and (d) absence of conflicts of interest. The research employed a purposive sampling method [34], selecting five expert evaluators: two Master Teachers in TLE, two teachers responsible for EIM, and one licensed Master Electrician. These evaluators were provided with the evaluation rating sheet and descriptors for print materials from the deped learning resources management and development system (LRMDS) [35], covering four main evaluation criteria: content, format, presentation and organization, and accuracy and up-to-datedness.

Data gathering commenced with the distribution of the draft supplemental activity sheets, accompanied by informed consent forms and clear instructions on evaluation procedures. Experts reviewed the materials independently to minimize bias, and feedback was documented using the likert-scale rating system provided in the evaluation tool. This approach allowed both quantitative and qualitative feedback to be collected for iterative revisions [36].

In addition to expert validation, secondary data were collected from academic references, technical manuals, and deped policy documents to ensure the activity sheets' technical accuracy and curriculum alignment. data triangulation [37] was applied by combining evaluator feedback, policy review, and literature synthesis, thereby increasing the credibility and dependability of the results. The completed evaluation forms were retrieved, tabulated, and subjected to statistical treatment using weighted mean analysis to determine the overall validity level of the developed materials. The systematic execution of these steps ensured that the final output met instructional standards, addressed identified learning gaps, and aligned with national educational policies.

2.5 Data analysis

The department of education learning resources management and development system (LRMDS) served as the primary evaluation framework for assessing the content quality, instructional effectiveness, technical attributes, accuracy, validity, and acceptability of the developed supplemental activity sheets for the exploratory subject in electrical installation and maintenance. Evaluation employed the weighted mean as the primary statistical tool to quantify expert ratings across four lrmds-prescribed criteria: (a) content, (b) format, (c) presentation and organization, and (d) accuracy and up-to-datedness [38]. the lrmds rating scale was applied as follows: 3.50–4.00 = very satisfactory (vs), 2.50–3.49 = satisfactory, 1.50–2.49 = poor, and 1.00–1.49 = not satisfactory.

3. RESULTS AND DISCUSSION

3.1 Development of the supplemental activity sheets for enhancing learning in electrical installation and maintenance exploratory subject

Five sets of supplemental activity sheets were created to align with the Most Essential Learning (MELCs) for the Grade 7 and 8 exploratory subject in Electrical Installation and Maintenance of the K-12 program. Each set of activity sheets utilized the SOLO taxonomy pioneered by [39], customized to suit each student's current comprehension level. This framework facilitated progression towards advanced knowledge levels and cultivates higher-order thinking skills. The model comprised of five levels of understanding. 1. Pre-structural: Students possess no understanding of the topic; 2. Uni-structural: Students demonstrate a superficial understanding of a single concept; 3. Multi-structural: Students express understanding across several relevant topics; 4. Relational: Students can apply integrative concepts learned to different contexts; and 5. Extended abstract: Students exhibit the highest level of complex understanding. This approach enhances the depth of learning and fosters critical thinking skills among students.

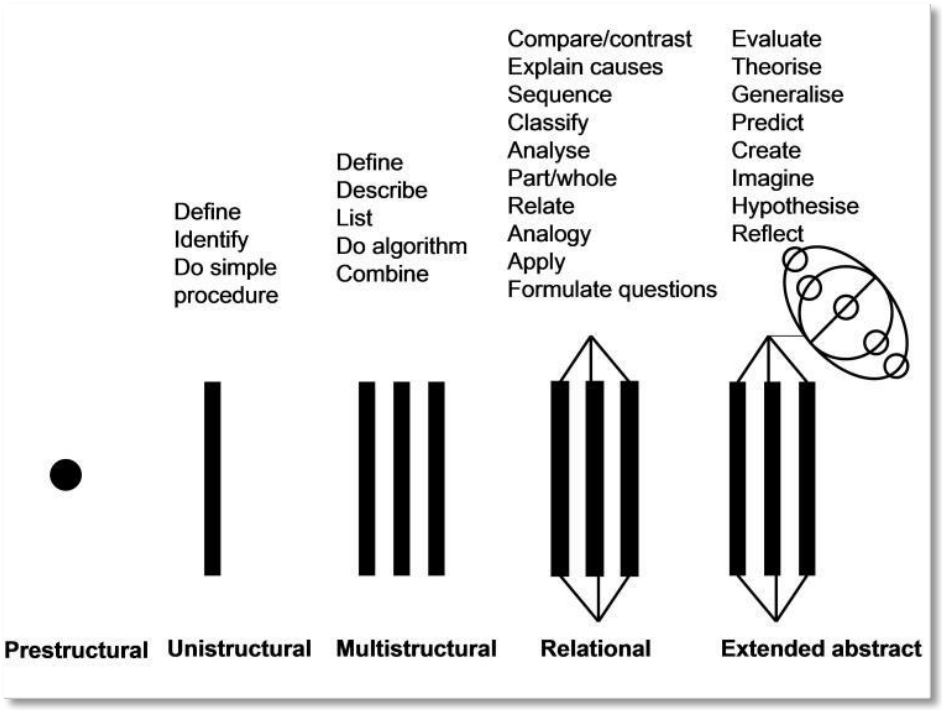


Figure 1: The SOLO framework adapted from biggs and collis (1982).

Additionally, the supplemental activity sheets had an activity guide per lesson and contained graphics from Canva.com. Likewise, each set of activity sheets utilized the SOLO taxonomy pioneered by [39], customized to suit each student's current comprehension level. This framework facilitated progression towards advanced knowledge levels and cultivates higher-order thinking skills. Additionally, the supplemental activity sheets integrated important advocacies, including gender equality, values formation, disaster readiness and risk reduction, multicultural appreciation, teamwork and accountability.

Table 1. shows the matrix of the topics, most essential learning competencies and specific objectives of each developed supplemental activity sheet.

Set No.	TOPIC	Most Essential Learning Competencies	Specific Objectives
1.	Practice Occupational Health and Safety Procedure	Identify Hazards and Risks *(TLE_IAEI7/8OS-0h-1)* Control hazards and risks *(TLE_IAEI7/8OS-0i-2)* Practice OHSP *(TLE_IAEI7/8OS-0j-3)*	1.1 List down hazards and risks in the workplace 2.1 Determine effects and hazards risks 2.2 Evaluate hazards and risks Follow procedure for controlling hazards and risks in the workplace
2	Prepare Electrical Materials and Tools	Prepare Electrical Materials and tools for the task *(TLE_IACP7/8UT-0a-1)*	1.1 Prepare a list of electrical tools and materials for a specific job.

		Request Appropriate electrical supplies materials and tools applicable to a specific job *(TLE_IAEI7/8UT-0a-2)*	1.1 Use the appropriate form in requesting for electrical tools, supplies and materials for a specific job
		Receive and inspect electrical supplies, materials and tools *(TLE_IAEI7/8MT-0b-2)*	1.1 Check and control received items on the list
3	Perform Mensuration and Calculations	Select electrical measuring tools and instruments *(TLE_IAEI7/8MC-0c-1)*	1.1 Identify object or component to be measured 1.2 Choose test instruments to be used for specific tasks 1.3 Identify alternative measuring tools without sacrificing cost and quality of work
		Carry Out measurements and calculations *(TLE_IAEI7/8MC-0c-2)*	1.1 Use appropriate measuring devices for specific tasks 1.2 Compute for required data 1.3 Convert data to its equivalent unit of measurement
4	Interpret Technical Drawings and Plans	Analyze signs, electrical symbols and data *(TLE_IAEI7/8ID-0e-1)*	1.1 Read and interpret electrical signs, symbols and data 1.2 Analyze Electrical components and materials based on electrical signs, symbols and data
5	Maintain tools and equipment	Check condition of tools and equipment *(TLE_IAEI7/8MT-0f-1)*	1.1 Label functional and non-functional tools and equipment
		Perform basic Maintenance *(TLE_IAEI7/8MT-0f-2)*	1.1 Clean and lubricate tools 1.2 Observe periodic preventive and maintenance of electrical tools and equipment 1.2.1 Sharpening 1.2.2 Oiling 1.2.3 Insulating
		Store tools and equipment *(TLE_IAEI7/8MT-0g-3)*	1.1 Prepare inventory of tools and equipment 1.2 Store tools and equipment in their proper places

Supplemental activity sheet no. 1 covers occupational health and safety aligned with melcs on identifying and controlling hazards and risks (TLE_IAEI7/8OS-0h-1; TLE_IAEI7/8OS-0i-2). Students list workplace hazards/risks, describe effects, evaluate risks, and apply control procedures to promote safe work and prevent injuries. Supplemental Activity Sheet No. 2 focuses on preparing electrical materials and tools—listing needed tools/materials, properly requesting supplies using forms, and receiving/inspecting items (TLE_IACP7/8UT-0a-1; TLE_IAEI7/8UT-0a-2; TLE_IAEI7/8MT-0b-2). It also introduces measuring tools used in wiring installations and proper use to avoid damage and ensure efficiency. Supplemental activity sheet no. 3 develops mensuration and calculations using measuring devices, computing required data, and converting units (TLE_IAEI7/8MC-0c-2). supplemental activity sheet no. 4 trains students to interpret technical drawings/plans by reading electrical signs, symbols, and data and using them to analyze components/materials (TLE_IAEI7/8ID-0e-1). Supplemental activity sheet no. 5 emphasizes tool/equipment maintenance—checking condition, performing basic maintenance, and proper storage (TLE_IAEI7/8MT-0f-1; 0f-2; 0g-3) to save time and resources.

All sheets include an activity guide, localized/contextualized tasks, melc-based measurable objectives, and a teacher's copy with an answer key. In addition, the developed supplemental activity sheets were structured using a common set of design features to ensure instructional coherence, learner accessibility, and consistent implementation across lessons; these features are presented and discussed in the succeeding section.

The first feature of the developed supplemental activity sheets is the cover design shown in Figure 2, which predominantly uses blue, yellow, and white—colors aligned with the author's personal preference. The cover illustration portrays a mother–child bond as a symbolic parallel to the teacher–student relationship in electrical installation and maintenance. Set beneath the glow of a light bulb, the image represents the teacher's guidance and knowledge: the soft yellow light signifies wisdom that illuminates students' learning, while the silhouette suggests the lasting influence of mentorship toward competence and innovation. Overall, the cover is intended to evoke assurance and camaraderie as teachers and students work toward excellence. It also serves as a

tribute to the author's late mother, Enedina Ocampo Macasinag (+), and includes a brief author bio note on the back cover.

In terms of physical production, the supplemental activity sheets consist of 88 pages printed on 80 gsm white book paper. The contents were produced using colored inkjet printing, while the cover was laser-printed, laminated, and perfect-bound for durability and usability.

Figure 2: Cover Design of the developed Supplemental Activity Sheets in Electrical Installation and Maintenance

The next feature is the activity guide shown in figure 3, which functions as the students' primary orientation tool in each supplemental activity sheet. It provides the essential background and overview of the lesson topic, clarifies what learners are expected to do, and helps them navigate the tasks in a structured manner. Consistent with several studies [40], [41], activity guides enhance learning by offering clear task sequences and guidance that support students in processing complex concepts, strengthening observation and problem-solving skills, and sustaining inquiry-based learning as learners define, organize, and carry out their investigations.

Figure 3: Sample Activity Guide integrated in the developed supplemental activity sheets

Another feature is the inclusion of trivia-based prompts, as shown in figure 4, designed to capture students' attention and support the retention of key concepts. Trivia has been shown to strengthen engagement, make learning experiences more enjoyable, and reinforce essential facts and ideas. As noted in the study [42], integrating trivia into instruction can help learners recall information more effectively by encouraging active participation rather than passive reception. In this way, trivia functions as a practical active-learning strategy that promotes deeper understanding and longer-term retention in classroom settings.

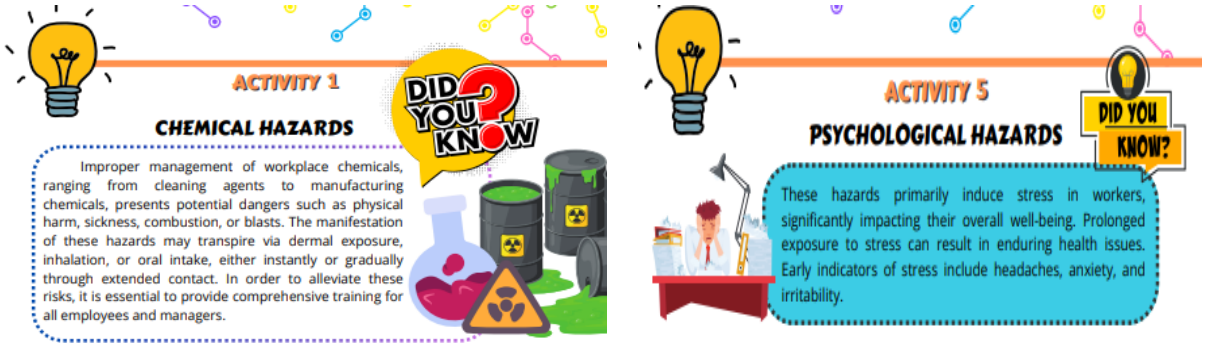


Figure 4: Sample trivia-based prompts used as one of the features of the developed supplemental activity sheets

The next feature is the Picture analysis shown in figure 5 in activity sheets is invaluable for enhancing students' visual literacy skills, critical thinking abilities, and overall comprehension of the content. [43] found that picture-based activities effectively enhance English-speaking abilities among grade seven students, yielding high levels of student satisfaction. Additionally, [44] emphasized that integrating pictures into pre-algebraic reasoning improves students' understanding and problem-solving skills at the algebra level, albeit with a need for refinement in instructional approaches and content.

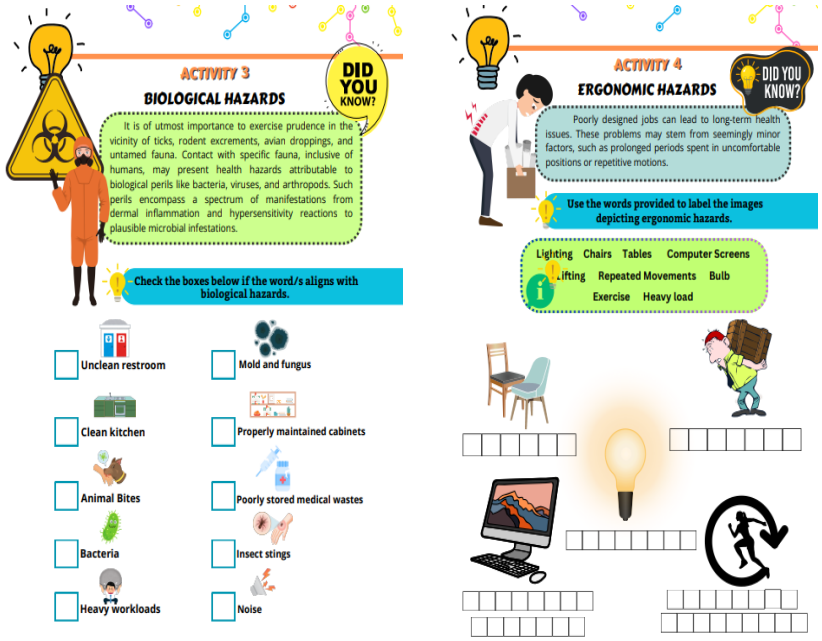


Figure 5: Sample picture analysis activity integrated in the supplemental activity sheets

The integration of solo taxonomy by john biggs and kevin collis was customized to suit students' diverse levels of comprehension. This framework enables progression toward higher knowledge levels and promotes the development of higher-order thinking skills. For instance, in the study of [45], using SOLO taxonomy in biology classes significantly increases students' cognitive activity and conceptual comprehension, leading to 39% higher achievement rates compared to non-SOLO taxonomy-based classes. This continuity was evident across lessons 1 to 5, where this feature remained consistent throughout.

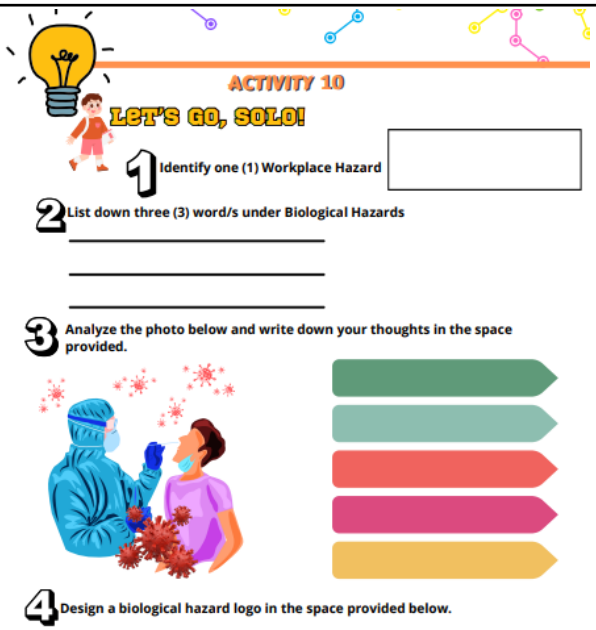
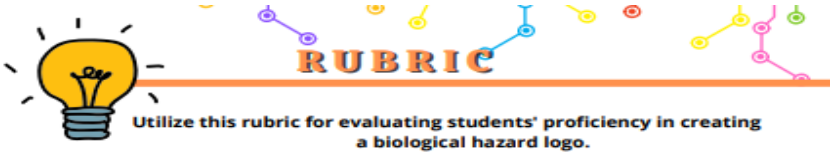


Figure 6: Sample SOLO-Framework-based Activity use in the supplemental activity sheets

To comprehensively evaluate the extended abstract level of the SOLO taxonomy, a rubric was provided. Rubrics serve as indispensable tools in education, fostering clarity, consistency, and feedback while supporting student learning. They uphold fair and accurate assessment practices, bolster student comprehension and engagement, and bolster the overall effectiveness of teaching and learning. In the developed supplemental activity sheets, four scales were utilized to assess learners: 4 - Excellent, 3 - Good, 2 - Fair, and 1 - Poor. The evaluation focus varied depending on the specific activity being assessed; hence, it may differ across lessons. As demonstrated by [46], employing scoring rubrics in performance assessments can enhance reliability, promote learning, and refine instruction by delineating expectations and criteria explicitly.



Utilize this rubric for evaluating students' proficiency in creating a biological hazard logo.

CRITERIA	EXCELLENT (4)	GOOD (3)	FAIR (2)	POOR (1)	SCORE
CREATIVITY	The logo demonstrates creativity and originality in its design, effectively conveying the concept of biological hazard.	The logo shows some creativity in its design, capturing the concept of biological hazard to some extent.	The logo lacks creativity in its design, with a generic or uninspired representation of biological hazard.	The logo is unoriginal and fails to convey the concept of biological hazard.	
CLARITY	The logo is clear and easily recognizable, with distinct elements that effectively communicate the message of biological hazard.	The logo is mostly clear and recognizable, but some elements may be slightly ambiguous or unclear.	The logo is somewhat unclear or difficult to interpret, with unclear elements that hinder understanding.	The logo is unclear and difficult to interpret, making it hard to discern its message or meaning.	
RELEVANCE	The logo is highly relevant to the concept of biological hazard, incorporating elements that directly relate to the topic.	The logo is relevant to the concept of biological hazard, but some elements may be irrelevant or less directly connected to the topic.	The logo's relevance to the concept of biological hazard is limited, with only a few elements that relate to the topic.	The logo is not relevant to the concept of biological hazard, with elements that do not relate to the topic at all.	
OVERALL IMPRESSION	The logo leaves a strong and lasting impression, effectively capturing attention and conveying the message of biological hazard.	The logo leaves a positive impression, but may not be particularly memorable or impactful in its design.	The logo leaves a neutral or mixed impression, lacking the wow factor or impact expected for a biological hazard logo.	The logo leaves a negative impression, failing to engage or communicate effectively.	
TOTAL SCORE					

Figure 7: Sample rubric use in assessing students' outputs integrated in the supplemental activity sheets

The next feature, the incorporation of definitions of terms shown in Figure 8, in activity sheets, was crucial for fostering clarity, enriching vocabulary development, promoting inclusivity, encouraging independent learning, aligning with learning objectives, and cultivating enhanced critical thinking skills in students. By providing precise explanations of key terms, educators can create more effective and engaging learning experiences that support students' academic progress and success. Moreover, as noted by several researchers [47] [48], clear definitions aid in translating non-technical requirements into technically feasible ones, thereby enhancing the practicality and usability of the developed materials.

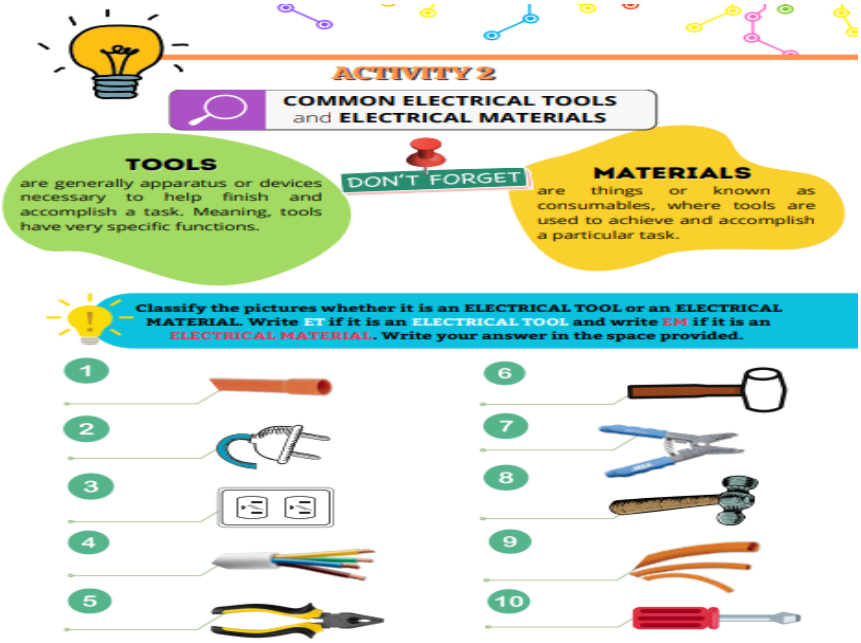


Figure 8: Unlocking difficulty through defining terms used in the development of supplemental activity sheets

Several studies underscore the importance of contextualization by incorporating local common names into activity sheets, demonstrating that this approach enhances learning across subjects [49], [50]. Additionally, researchers also emphasized the importance of developing localized materials that resonate with learners' contexts, thereby improving mastery of different competencies [51]-[53]. Moreover, integrating contextualization and localization in teaching materials has been found to enhance acceptability and effectiveness among both teachers and students, resulting in heightened understanding and engagement in the learning process. Figure 9 shows the sample of contextualization used in the developed supplemental activity sheets.

Figure 9: Contextualization features integrated in the supplemental activity sheets

Figure 10 shows a sample of integration of Disaster and Risk Reduction (DRR) in the developed supplemental activity sheets [54]. Emphasized that integrating Disaster Readiness and Risk Reduction (DRR) in activity sheets is crucial for raising awareness and preparedness levels among students, as shown by the positive impact of contextualized DRRM modules on student performance and engagement. Underscored that steps such as mitigation, preparedness, response, and recovery can enhance societies' coping and adaptive capacities, thereby building disaster-resilient communities. Integrating DRR with Sustainable Development Goals (SDGs) is gaining traction, highlighting the need for stakeholder readiness and mechanism analysis to fulfill global DRR agendas. [55] highlighted that involving communities in DRR activities can significantly reduce disaster losses, emphasizing community-based disaster risk reduction and capacity building. Republic Act 10121, Section 14, further supports these initiatives. Therefore, integrating DRR in activity sheets educates and empowers individuals to effectively mitigate and respond to disasters.

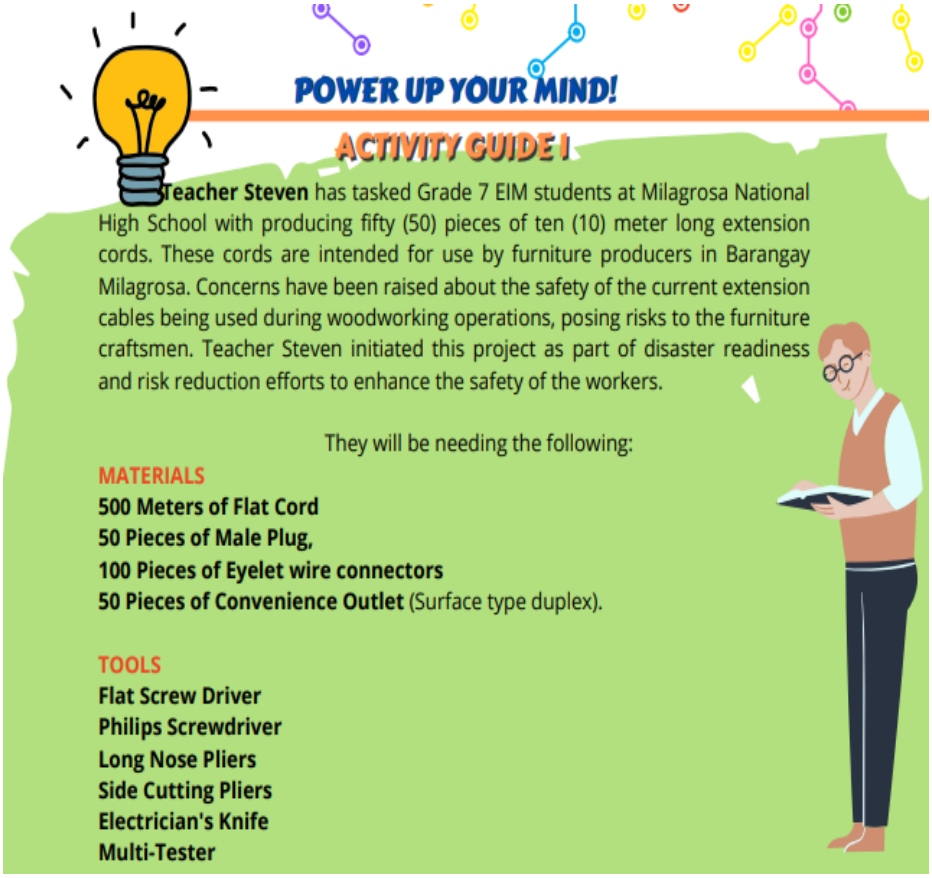
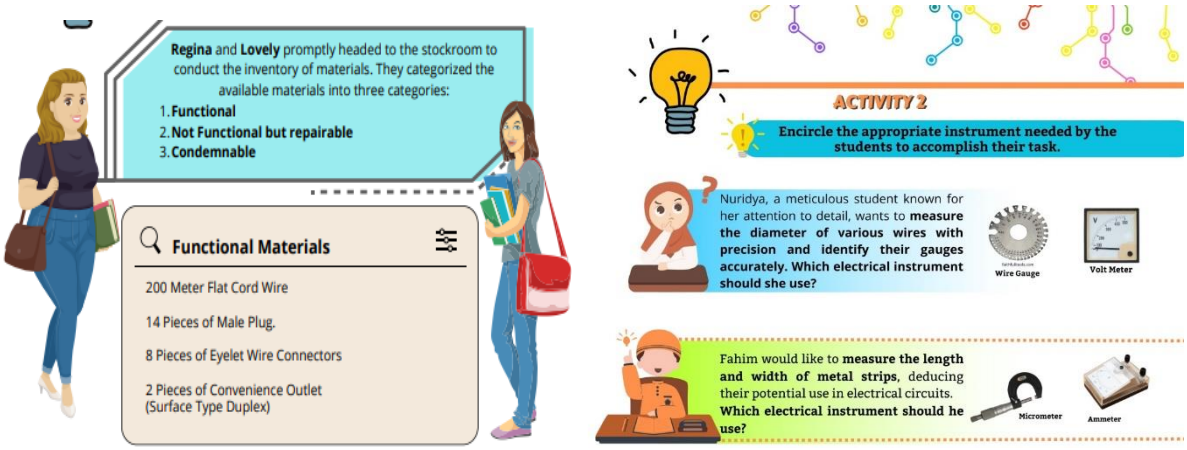


Figure 10: Sample activity integrating disaster risk and reduction

The next feature is Holistic Integration of Values, Inclusivity, and Equity shown in figure 11. In line with DepEd Order No. 41, s. 2003 on Values Education, the supplemental activity sheets deliberately embed core values—Maka-Diyos, Maka-tao, Makakalikasan, and Makabansa—within TLE learning tasks to develop students' character alongside technical competence. This reflects DepEd's directive to meaningfully integrate values formation across disciplines and is consistent with evidence that values-based instructional frameworks can help shape well-rounded learners and foster positive attitudes essential for both individual and community development [56]. Alongside values integration, the sheets operationalize inclusivity consistent with DepEd Order No. 72, s. 2009 on Inclusive Education, which advances acceptance of learners regardless of race, body size, shape, skin color, ability, or disability. This is reflected in the representation of characters with varied body types and skin tones, which supports a sense of belonging and body positivity among students. Inclusivity was further strengthened through deliberate counter-stereotypical representations. The materials intentionally highlighted Muslim students' integral role in society to challenge deficit-based portrayals commonly observed in some instructional texts, where Muslims are framed as inferior, dependent, or limited to low-status roles [57]. By portraying Muslim learners as visible contributors within the community, the activity sheets aimed to dispel misconceptions and affirm that their participation is normal and valued in the broader social context.



a. b.

Figure 11: Holistic integration of values, inclusivity, and equity: A featured characters with diverse body sizes and skin colors, b. presence of muslim characters

The sheets also embed gender equity and SOGI-sensitive representation shown in figure 12 through the inclusion of a transgender teacher in the activity guide, challenging stereotypes that electrical installation and maintenance are exclusive to heterosexual individuals. This design choice communicates that the discipline is accessible to people of diverse gender identities and supports a learning environment grounded in respect and non-discrimination. These elements align with DepEd Order No. 32, s. 2017 (Gender-Responsive Basic Education Policy), which mandates gender equality, gender sensitivity, non-discrimination, and human rights in basic education, including the use of gender-fair language. This requirement is consistent with Civil Service Memorandum Circular No. 12, s. 2005, which calls for non-sexist language in government communications, and with research indicating that gender-fair language can reduce gender stereotyping and discrimination through strategies such as neutralization and feminization [58].

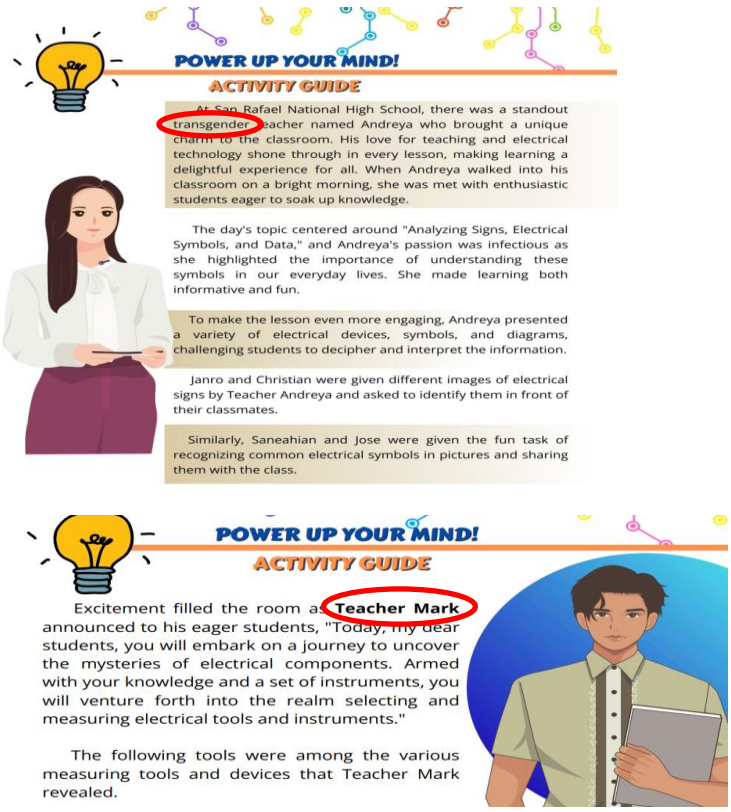


Figure 12: Integration of gender equity on the basis of sexual orientation and gender identity, and the use of gender fair languagepresence of muslim characters

Finally, the activity guide integrates values through concrete social practices, particularly teamwork and accountability as shown in Figure 13. Teamwork is illustrated through collaborative interactions, reinforcing cooperation as a core workplace and classroom value. This emphasis is consistent with findings that group work can strengthen conceptual understanding, promote critical and analytical thinking, and improve performance [59], and that structured team tasks can cultivate practical lessons in collaboration within construction-related learning contexts [60]. Accountability is similarly modeled through Teacher Christine's careful inventory of tools and equipment prior to transfer, highlighting responsibility, transparency, and proper stewardship of resources as expected professional dispositions of educators and public officials.

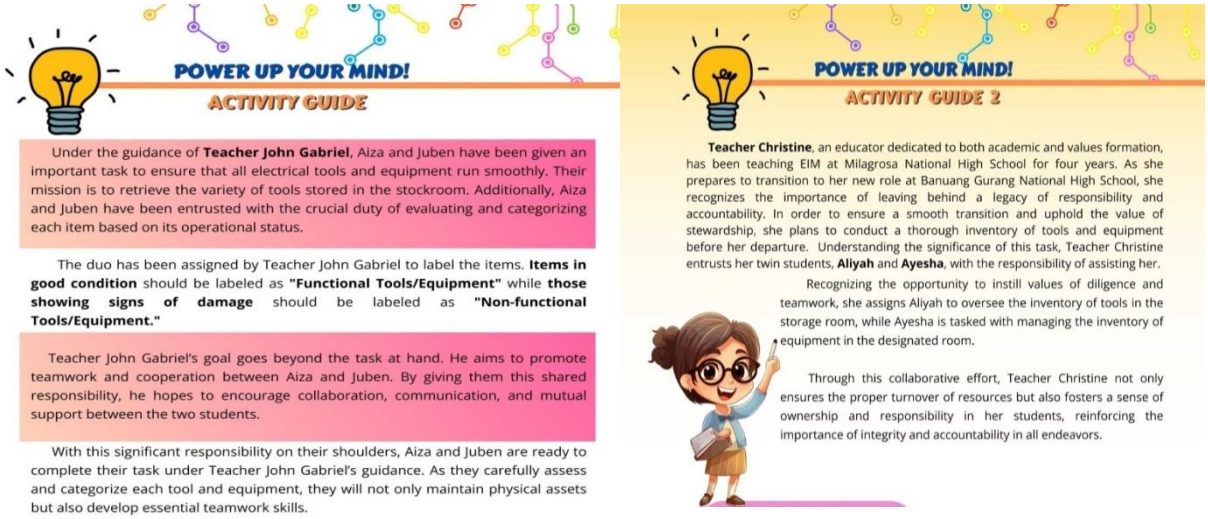


Figure 13. Integration of teamwork among students

Overall, the features embedded in the supplemental activity sheets demonstrate a deliberate, standards-aligned development process that prioritized both instructional quality and learner inclusivity. Across the cover and Lessons 1–5, the materials consistently integrated core pedagogical supports alongside contextual and values-oriented elements. These design features reflect an intentional effort to ensure coherence, accessibility, and relevance of the supplemental sheets, while reinforcing holistic learner development and socially responsive instruction during the development phase.

Table 2. Summary of the Features Supplemental Activity Sheets

Lesson No.	Features
The Cover	Logo Description Authors Bio note
1	Activity guide Presentation of information in trivial form Picture Analysis SOLO Taxonomy Activity Rubric QR Code (Key to correction)
2	Activity Guide Picture Analysis Uses of Definition of Terms Contextualization using common Filipino names Integration of Disaster Readiness and Risk Reduction Integration of DepEd Core values Featured characters with diverse body sizes and skin colors. Integration of Mathematics SOLO Taxonomy Activity Rubric QR Code (Key to correction)
3	Activity guide Presence of Muslim Characters

	Solo Taxonomy Activity Rubric QR Code (Key to correction)
4	Integration of Gender Equity on the basis of Sexual Orientation and Gender Identity and the use of Gender fair language Picture Analysis Solo Taxonomy Activity Rubric QR Code (Key to correction)
5	Activity guide Picture Analysis Presence of Muslim Character Integration of Teamwork Integration of Accountability Solo Taxonomy Activity Rubric QR Code (Key to correction)

3.2 Expert validation of the developed supplemental activity sheets for enhancing learning in electrical installation and maintenance exploratory subject

Following the development phase where the supplemental activity sheets were designed with consistent instructional features and contextualized, inclusive elements the materials were subjected to expert validation to determine their suitability, quality, and readiness for classroom use. For the expert evaluation process, the researcher employed the learning resources management and development system (LRMDS) Evaluation Rating Sheet for Print Resources, which assesses four key factors: (a) content, (b) format, (c) presentation and organization, and (d) accuracy and up-to-datedness of information. Each factor was rated using a four-point scale: 1 – not satisfactory, 2 poor, 3 – satisfactory, and 4 – very satisfactory, with descriptors aligned to each 0

Satisfactory outcome with a mean rating of 4.00. This suggested that the content of the material met the required standards set by the department where the evaluation tool was acquired. Experts consistently affirmed the strength and adequacy of the content, noting that it was appropriate for the learners and aligned with the intended learning outcomes.

Table 3. Result of experts' evaluation on content

Content	Mean Rating	Descriptive Rating
1. Content is suitable to the student's level of development	4.0	Very Satisfactory
2. Material contributes to the achievement of specific objectives of the subject area and grade/year level for which it is integrated	4.00	Very satisfactory
3.Material provides for the development of higher cognitive skills such as critical thinking, creativity, learning by doing, inquiry, problem solving, etc.	4.00	Very satisfactory
4. Materials are free of ideological, cultural, religious, racial and gender biases and prejudices.	4.00	Very satisfactory
5. Material enhances the development of desirable values and traits	4.00	Very Satisfactory
6. Material has the potential to arouse interest of target reader.	4.00	Very Satisfactory
7. Adequate warning/cautionary notes are provided in topics and activities where safety and health are of concern.	4.00	Very Satisfactory
Average	4.00	Very Satisfactory

The findings in the study [61], regarding the evaluation of worksheets align closely with the criteria emphasized in the present study. Maranan's research emphasized the significance of factors such as content, clarity of presentation, and usability in determining the acceptability of learning materials. These findings resonated with the preferences expressed by the respondents in the current study, who also identified these aspects as crucial in evaluating educational materials. In essence, Maranan's research provided valuable support for emphasizing these criteria in the present investigation.

Meanwhile, findings from [62]-[64] highlighted the effectiveness of evaluated learning activity sheets and worksheets, as they were deemed appropriate and commendable by validators. Consequently, respondents

demonstrated substantial improvements in their achievement performance. Additionally, Buniel's research highlighted a significant disparity in academic achievement between students utilizing established instructional materials and those employing conventional approaches [65]. Suggested that simplified activity sheets serve as a valuable tool in ongoing efforts to stimulate student engagement during class hours. Moreover, these sheets can effectively guide students' learning beyond the classroom setting [66]. further emphasized the importance of worksheets, noting that blank spaces within them serve as opportunities for students to construct knowledge. Thoughtfully crafted questions within worksheets, coupled with effective teaching methods, can pique students' interest and facilitate deeper learning. They not only enhance academic performance but also foster active student engagement and facilitate meaningful learning experiences.

In terms of Format, the results shown in table 4 indicated that the supplemental activity sheets received a highly favorable rating, with an average score of 3.98. Despite this overall positive assessment, there were specific sub-indicators that required attention for improvement. These include: (1) enhancing spaces between letters and words to facilitate reading; and (2) the use of realistic or appropriate colors. These observations were also reflected in the qualitative feedback of the evaluators. For instance, one expert noted that *"the layout would benefit from improved spacing between letters and words to make it easier to read,"* while another emphasized that *"increasing white space and adjusting spacing can significantly improve readability."* Such recommendations are consistent with [67] position that visual spacing supports consistency and readability in printed materials.

With respect to color use, evaluators likewise emphasized that color choices should not only be aesthetic but also functional for learning. One expert suggests considering using colors more strategically to support attention and retention, especially in key sections. This perspective aligns with [68], who reported that color can influence learning outcomes depending on the task's cognitive demand.

Table 4. results of experts' evaluation on format

Format	Mean Rating	Descriptive Rating
1. Prints		
1.1 Size of letters is appropriate to the intended user.	4.00	
1.2 Spaces between letters and words facilitate reading.	3.80	
1.3 Font is easy to read.	4.00	
1.4 Printing is of good quality (i.e., no broken letters, even the density of, correct alignment, properly placed screen registration).	4.00	
2. Illustrations		
2.1 Simple and easily recognizable	4.00	
2.2 Clarity and Supplement text	4.00	
2.3 Properly labeled or captioned (If applicable)	4.00	
2.4 Realistic / appropriate colors	3.80	
2.5 Attractive and appealing	4.00	
2.6 Culturally relevant	4.00	Very Satisfactory
3. Design and Layout		
3.1 Attractive and pleasing to look at	4.00	
3.2 Simple (i.e., does not distract the attention of the reader)	4.00	
3.3 Adequate illustration in relation to text.	4.00	
3.4 Harmonious blending of elements (e.g., illustrations and text)	4.00	
4. Paper and Binding		
4.1 Paper used contributes to easy reading	4.00	
4.2 Durable binding to withstand frequent use.	4.00	
5. Size and Weight Resource		
5.1 Easy to Handle.	4.00	
5.2 Relatively light	4.00	
Average	3.98	

In line with these findings, a study [69] highlighted the crucial role of material availability and adequacy in fostering enhanced classroom interaction. Moreover [70]-[72] suggested that educational materials must be not only effective but also suitable and adaptable to the diverse needs of students. In classrooms with mixed ability levels, the scarcity or inadequacy of materials can pose significant challenges, hindering both student interaction and the learning process itself. This underscored the importance of ensuring that educational resources are comprehensive and accessible to all learners, thereby facilitating more inclusive and effective teaching environments.

Table 5 displays the outcomes of the third factor, focusing on presentation and organization. The experts' evaluation yielded a highly satisfactory rating, with a mean score of 3.92. This indicated that the material is well presented and organized according to the required indicators, achieving a Very Satisfactory rating overall. While the material met the general standards set forth, some indicators could benefit from enhancement—particularly those related to vocabulary and sentence length. This concern surfaced in the validators' remarks, such as: *"Some terms may be too advanced for the intended readers; simplifying vocabulary or adding brief explanations will improve understanding,"* and *"Several sentences are long; consider breaking them into shorter, clearer statements appropriate for the learners' level."* Relatedly, one evaluator emphasized that, *"the ideas are correct, but simplifying the language will make the instructions more accessible and learner-friendly."*

Table 5. Result of the experts' evaluation on presentation and organization

Presentation and Organization	Mean Rating	Descriptive Rating
Presentation is engaging, interesting, and understandable	4.00	Very satisfactory
There is logical and smooth flow of ideas.	4.00	Very satisfactory
Vocabulary level is adapted to target reader's likely experience and level of understanding.	3.80	Very satisfactory
Length of sentences is suited to the comprehension level of the target reader.	3.80	Very satisfactory
Sentences and paragraph structures are varied and interesting to the target reader.	4.00	Very satisfactory
Average	3.92	Very Satisfactory

Table 6 presents the results of the experts' evaluation of the developed supplemental activity sheets along accuracy and up-to-datedness of information. This factor examined grammatical accuracy and the suitability of the information integrated into the material, alongside the inclusion of up-to-date facts pertinent to delivering the steps of the skill being practiced. Ensuring grammatical correctness is vital as it contributes to students' clarity and comprehension of the content. Likewise, the appropriateness of the information presented is crucial for facilitating compelling learning experiences. By incorporating recent facts and relevant information, the material enhances students' understanding of the subject matter and ensures they are equipped with the most current knowledge and skills. Thus, this factor plays a pivotal role in the overall effectiveness of the learning material, impacting the quality of learning outcomes for students.

Table 6. Results of the experts' evaluation on accuracy and up-to-datedness of information

Accuracy and Up-to-Datedness of Information	Mean Rating	Descriptive Rating
1. Conceptual errors.	4.00	Very Satisfactory
2. Factual errors.	4.00	Very Satisfactory
3. Grammatical errors.	3.75	Very Satisfactory
4. Computational errors.	4.00	Very Satisfactory
5. Obsolete information	4.00	Very Satisfactory
6. Typographical and other minor errors (e.g., inappropriate or unclear illustrations, missing labels, wrong captions, etc.).	4.00	Very Satisfactory
Average	3.96	Very Satisfactory

The results revealed a Very Satisfactory rating with a mean rating of 3.96. However, one expert recommended that language mechanics and grammar be reviewed by an appropriate authority to further strengthen the quality of the written text. This recommendation was consistent with the qualitative feedback emphasizing the need for careful proofreading, such as: *"Please check grammar, spelling, and punctuation to ensure clarity and professionalism,"* and *"a final proofreading pass is recommended before reproduction to ensure the material is error-free and easy to follow."* These suggestions also support Jimenez's position that simpler, clearer language tends to be more acceptable and effective for learners.

Finally, Table 8 presents the consolidated expert evaluation of the supplemental activity sheets across four quality factors. The materials obtained very satisfactory ratings for content (4.00), format (3.98), presentation and organization (3.92), and accuracy and up-to-datedness of information (3.96), yielding an overall mean of 3.97 (very satisfactory). This indicates that the developed activity sheets meet DepEd-aligned quality indicators for print learning resources and are acceptable for use as supplemental instructional materials

Table 8. Summary of expert's evaluation

General Factors	Mean Rating	Descriptive Rating
Content	4.00	Very Satisfactory
Format	3.98	Very Satisfactory
Presentation and Organization	3.92	Very Satisfactory
Accuracy and Up-to-datedness of information	3.96	Very Satisfactory
Average	3.97	Very Satisfactory

Taken together, the pattern of results suggests that the strongest contribution of the developed material lies in its instructional adequacy (content) and technical integrity (accuracy/up-to-datedness), while the slightly lower—yet still very satisfactory ratings in presentation/organization and selected format indicators point to targeted refinements rather than a need for structural redesign. Prior studies likewise emphasize that worksheet effectiveness and acceptability depend not only on content alignment but also on clarity, usability, and design features that minimize reading friction and sustain engagement [65]–[66]. In the same way, the validators' suggestions related to spacing, strategic color use, and language simplification are pedagogically consequential because visual organization and color can influence attention and task performance, particularly in procedural learning contexts [67]–[68]. Overall, the expert ratings support the interpretation that the activity sheets can function as a practical instructional scaffold, with minor revisions that may further strengthen accessibility and inclusivity for diverse learners—an imperative consistently noted in literature emphasizing adequate and adaptable learning resources for improving classroom interaction and supporting learners across ability levels [69]–[72].

4. CONCLUSION

This study achieved its primary objectives by designing, developing, and expert-validating supplemental activity sheets for the grade 7–8 electrical installation and maintenance (EIM) exploratory subject as a practical response to the limited availability of instructional resources in technology and livelihood education. Guided by a descriptive-developmental approach and a modified ADDIE process (analyze–design–develop–evaluate), the study produced five sets of activity sheets aligned with the most essential learning competencies (MELCs) for EIM. The materials were deliberately structured to support skills-focused learning through sequenced tasks, while embedding safety-oriented and values-related themes to reinforce responsible practice and learner formation alongside technical competence.

The expert validation results, using DepEd LRMDS-based evaluation criteria, indicate that the developed activity sheets attained a Very Satisfactory quality level across content, format, presentation and organization, accuracy, and up-to-dateness. These findings substantiate that the materials meet DepEd-aligned indicators for print learning resources and are therefore acceptable and suitable as supplemental instructional materials to support classroom delivery and guided practice in EIM, particularly in contexts where standard learning resources are constrained.

Because this study concentrated on expert validation, further research is warranted to strengthen evidence beyond quality and alignment specifically, evidence of instructional effectiveness and implementation feasibility. Future work should include classroom-based field testing with learners to examine usability, learning gains, and skills performance outcomes, and to guide iterative refinement using student and teacher feedback. Complementary rigor-enhancing procedures such as additional reliability analyses and a clearly documented revision trail may also be incorporated to further strengthen methodological transparency and replicability of the development process.

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