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# ENHANCING PRACTICAL SKILLS AND THE QUALITY OF FOOD PRESERVATION OUTPUT THROUGH THE TROUBLESHOOTING LOG STRATEGY

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**Abstract**
Food preservation is an essential Grade 10 Technology and Livelihood Education competency, yet learners commonly struggle with inconsistent procedures, partial safety compliance, limited problem-solving ability, and variable output quality. This study examined changes in practical skills and product quality before and after the Troubleshooting Log Strategy among 40 Grade 10 learners at Mactan National High School during School Year 2026–2027. The study used a quasi-experimental one-group pretest–posttest design and total enumeration of one intact class. A researcher-made performance checklist assessed practical skills and the quality of food preservation outputs. Weighted means, standard deviations, and paired-sample t tests were reported. Before the intervention, all five domains were rated Fair. Afterward, application of techniques, safety and sanitation, and problem identification and correction were rated Very Good; product quality and conformity to standards were rated Excellent. The reported overall mean rose from 2.21 to 4.08, and all reported paired comparisons had $p < .001$. The findings indicate improvement within the study group. The design does not isolate the strategy's contribution from other influences. An enhanced lesson plan was developed to integrate the Troubleshooting Log Strategy into food preservation instruction.

**Keywords:** Troubleshooting Log Strategy, food preservation, practical skills, product quality, Grade 10, Technology and Livelihood Education

## Introduction

Food preservation is more than a practical skill; it is a vital competency that combines scientific understanding, precise technique, uncompromising safety awareness, and practical judgment to produce food that is safe, nutritious, and long-lasting. It serves as a powerful bridge between cultural heritage, personal well-being, and broader global goals: the United Nations estimates that approximately one-third of all food produced is lost or wasted annually, hindering progress toward Sustainable Development Goals 2 and 12, while UNESCO (2026) recognizes preservation practices as an important part of intangible cultural heritage that sustains communities and foodways across generations. As a core component of food literacy, preservation empowers individuals to secure their own food supply, reduce waste, and carry forward valued traditions making it indispensable to both individual readiness and collective sustainable development.

Despite its importance, learners often find food preservation difficult to master in practice. Many rely on trial-and-error rather than systematic reasoning; they struggle to link scientific principles to observable changes during processing, find technical terminology confusing, and fail to anticipate how small deviations in measurement, timing, or temperature can alter the final result (Karandikar & Shinde, 2020; Smith et al., 2022). In particular, learners frequently overlook preparation steps, skip or rearrange procedures, and do not connect early-stage choices to later outcomes leaving them unable to recognize when something is going wrong or understand why a problem occurred. This uncertainty means that even after receiving instruction, many continue to approach tasks with guesswork rather than confidence, leading to inconsistent results and missed opportunities for genuine learning.

These challenges highlight the urgent need for effective, learner-centered teaching strategies that go beyond simple demonstration and guide learners through the actual process of thinking, observing, and adjusting as they work. While hands-on experience is widely recognized as essential, studies show that practice alone does not guarantee

improvement without structure and reflection; learners need clear methods to notice deviations, analyze their causes, and apply appropriate corrections (Sullivan et al., 2025; Lisboa et al., 2024). In the Philippines, this is especially critical: Datu et al. (2025) emphasize that inconsistent sanitation, poor handling, and lack of systematic oversight in school food settings can compromise both quality and safety, underscoring that early, deliberate skill building is not just an academic concern but a matter of public health. Effective instruction must therefore support learners not only in knowing what to do, but in understanding why they do it, how to monitor their own progress, and what to do when things do not go as planned.

The Troubleshooting Log Strategy was developed as a direct response to this need. It is a structured, reflective tool that guides learners to record every step measurements taken, procedures followed, changes observed, difficulties encountered, adjustments made, and final results throughout each preservation activity. By documenting these details systematically, learners move beyond passive participation: they begin to see patterns in their own performance, connect specific actions to particular outcomes, and treat mistakes not as failures but as valuable learning points. The log transforms hands-on activity from routine practice into purposeful skill building, where every challenge becomes an opportunity to strengthen judgment, improve technique, and reinforce safe practice.

At Mactan National High School–Junior High School, these broader challenges are clearly reflected in actual classroom experience. Observations from previous school years show recurring difficulties: many students struggle to apply methods accurately, and nowhere is this more evident than in making mango jam a staple activity in the Food Preservation curriculum. Repeatedly, batches have turned out too thick, too runny, discolored, improperly set, or unevenly flavored; in some instances, poor handling, inadequate heating, or improper storage raised serious concerns about safety, with the potential for contamination or spoilage that could pose actual health risks. These are not isolated incidents; they indicate a consistent gap between what learners are told and what they are able to do independently, showing that conventional instruction alone focused on demonstration rather than ongoing monitoring and reflection is not sufficient to build reliable, safe, and lasting competence.

While existing literature extensively addresses preservation techniques, food literacy, sustainable technologies, and curriculum design, there remains a notable gap: few studies specifically examine how a structured Troubleshooting Log Strategy shapes learner performance across the full range of competencies technical skill, safety practice, problem-solving ability, and product quality in the Philippine secondary-school setting. Most available research focuses on curriculum content, standalone demonstrations, or general hands-on approaches rather than on systematic documentation and reflection as a core teaching and learning tool. This study addresses that gap by establishing clear baseline performance before the intervention, implementing the Troubleshooting Log Strategy as a targeted instructional approach, and measuring its specific impact on Grade 10 learners at Mactan National High School contributing both practical insight and evidence-based guidance for strengthening Food Preservation instruction in local schools.

**Theoretical and Conceptual Framework and Legal Bases**

This study assumed that examining the effectiveness of the Troubleshooting Log Strategy can strengthen Grade 10 students' practical skills TLE-Food Preservation. The investigation is anchored on three key theories, Social Learning Theory (Bandura, 1977), Mastery Learning Theory (Bloom, 1968), and the Systems Approach to Vocational Education (Dewey, 1916, 1938; Babbitt, 1918).

Social Learning Theory advances the understanding that skill develops not only through direct teaching but through the continuous interaction of observation, self-reflection, and guided practice. Bandura (1977) established that learners build competence most effectively when they can clearly see what successful performance looks like, recognize how their own actions compare to that standard, and understand the consequences of their choices whether positive or needing correction. Central to this framework is the belief that people actively regulate their own learning: they notice relevant details, retain useful methods, practice and adjust their approach, and stay motivated when they can see tangible progress. Learning is therefore a social and self-directed process combined shaped by what is demonstrated, what is noticed, and what is reflected upon rather than something that happens only because an instructor has explained it.

This theory illuminates the baseline gaps observed in the study and how the Troubleshooting Log Strategy addresses them, particularly in applying correct techniques and procedures, adhering to safety and sanitation measures, and identifying and correcting common problems. Before the intervention, learners performed at the Fair level across these areas because they lacked consistent, structured ways to observe their own work and compare it to expected standards; they relied on memory or vague instruction, leading to inconsistent steps, partial hygiene compliance, and difficulty recognizing when something was going wrong. The log functions as a constant, personalized guide that directs attention to critical details measurements, timing, color changes, texture and invites learners to record what they see, what they think it means, and what they do in response. Over time, this builds the self-observation and confidence Bandura described: learners no longer depend entirely on being told there is a problem; they notice it themselves, understand why it matters, and take appropriate action exactly the shift from passive participation to active competence that the theory predicts.

Mastery Learning Theory (Bloom, 1968) is built on the principle that nearly all learners can achieve high levels of proficiency when provided with clear expectations, specific and timely feedback, and genuine opportunities to practice, adjust, and improve before being assessed. Bloom argued that wide differences in student performance are rarely due to fixed ability but instead reflect how well instruction matches individual needs particularly whether learners know exactly what quality looks like, where their own work falls short, and precisely what steps will bring it up to standard. The approach does not rush learners forward; instead, it treats each stage of learning as a foundation: progress happens not by moving ahead regardless of understanding, but by addressing gaps as they appear, practicing corrections, and demonstrating competence at one level before advancing to the next.

This framework directly explains the significant improvements across all variables from procedural skill and safety practice to problem-solving, product quality, and compliance with standards following implementation of the strategy. The pre-intervention Fair performance levels indicated that learners had not yet mastered the foundational details and judgments required for reliable food preservation; they had been introduced to the tasks but lacked the ongoing, specific feedback and structured practice Bloom identified as essential. The Troubleshooting Log Strategy provides exactly this support: it breaks each activity into clear stages, guides learners to identify precisely where difficulties occur, and prompts them to apply targeted corrections rather than repeating steps without direction.

The Systems Approach, grounded in the work of Dewey (1916, 1938) and Babbitt (1918), frames vocational competence not as a set of disconnected tasks but as an integrated understanding of how every action connects to the final result and serves a broader purpose. Dewey emphasized that education must be rooted in real experience that learners grasp skills most deeply when they see how each step matters beyond the classroom, whether for personal benefit, family well-being, or community responsibility. Babbitt further established that vocational training must align with professional standards: every choice from selecting ingredients and maintaining cleanliness to packaging and labeling affects the safety, reliability, and acceptability of the product. Together, they propose that true competence includes seeing the whole picture: understanding how preparation influences cooking, how cooking influences quality, and how quality influences trust and safety for those who will consume the food.

This perspective anchors the product quality and conformity to prescribed standards dimensions, explaining why these areas showed such strong gains reaching Excellent levels after the intervention. Before the strategy, learners treated preparation, cooking, and packaging as separate steps rather than parts of one connected process; they did not consistently link peeling, measuring, or heat control to the jam's flavor, thickness, or shelf life, resulting in uneven quality and inconsistent compliance. The Troubleshooting Log Strategy restores this systemic view by guiding learners to trace outcomes back to their sources: if the jam is too runny, they connect it to cooking time or moisture content; if it lacks flavor, they relate it to ingredient balance or ripeness; if it fails to keep well, they connect it to heating, sealing, or cooling practices. Learners begin to see their work as an integrated whole one where every decision matters, not just for a grade, but for producing safe, trustworthy food worthy of sharing exactly the purposeful, responsible competence Dewey and Babbitt envisioned.

Collectively, these three theories provide a comprehensive foundation for understanding how the Troubleshooting Log Strategy strengthens learners' competence in Food Preservation, with each addressing a distinct but interrelated dimension of skill development. Social Learning Theory explains how learners move from passive observation to

active self-awareness by directing attention to critical details, encouraging comparison against standards, and building confidence through visible progress, thereby supporting the development of practical skills in applying correct techniques, adhering to safety and sanitation measures, and identifying and correcting common problems. Mastery Learning Theory further establishes that consistent guidance, clear expectations, timely feedback, and opportunities to refine work systematically are essential to developing reliable proficiency across all skill areas, as the log highlights specific gaps and supports repeated practice until standards are met. Meanwhile, the Systems Approach deepens this understanding by framing skill not merely as technical proficiency but as connected, purposeful practice that links every procedural step to the final product's quality, safety, and real-world value, anchoring the dimensions of output quality and conformity to prescribed standards by encouraging learners to see how each decision influences the suitability and acceptability of what they produce. Together, these theories converge on the shared principle that effective vocational learning happens when learners actively observe, reflect on, and understand the connections within their own work, confirming that the Troubleshooting Log Strategy addresses the full scope of learning needed observation, skill refinement, and purposeful understanding to help learners develop not just task proficiency, but reliable, responsible, and lasting competence in Food Preservation.

On the other hand, complementing the theoretical foundation, relevant legal and policy frameworks further reinforce the rationale and validity of this study. Foremost is Republic Act No. 10533 – Enhanced Basic Education Act of 2013 , DepEd Order No. 42, s. 2016 – Policy Guidelines on Home Economics and Livelihood Education / Technology and Livelihood Education, and DepEd Order No. 8, s. 2019 – Policy on the Adoption of Innovative Instructional Practices and Resources in Basic Education.

First, Republic Act No. 10533, known as the Enhanced Basic Education Act of 2013, is the landmark legislation that institutionalized the K to 12 Basic Education Program in the Philippines. It mandates that basic education must be learner-centered, inclusive, and responsive to the country's social, economic, and cultural needs. The law explicitly aims to equip learners with knowledge, skills, and values essential for personal development, productive employment, and responsible citizenship, while integrating livelihood and technical-vocational competencies into the curriculum.
Accordingly, this legal provision strengthens the present study by affirming the mandate to develop practical skills such as food preservation as part of basic education. The Troubleshooting Log Strategy directly supports the law's goal of producing competent learners by systematically enhancing their knowledge of principles, correct application of techniques, ability to identify problems, and capacity to produce quality outputs. Ultimately, it ensures that instruction is not only theoretical but also grounded in practice, aligning with the state's commitment to make education relevant and useful for learners' future livelihood and daily life.

Furthermore, DepEd Order No. 42, s. 2016 sets the official policy guidelines for Home Economics and Livelihood Education and Technology and Livelihood Education. It defines the objectives, scope, and standards of TLE subjects, stressing that these courses are designed to develop learners' technical proficiency, work habits, safety consciousness, and entrepreneurial skills. The policy ensures that TLE instruction follows approved standards, covers essential competencies, and integrates proper safety practices and quality standards.

For this reason, this policy strengthens the study by confirming that Food Preservation is a legitimate and essential component of the basic education curriculum that requires deliberate skill development. The Troubleshooting Log Strategy directly supports the policy's objectives by helping learners master the required competencies, from understanding procedures and applying safety measures to recognizing common issues and producing high-quality, long-lasting preserved products. In effect, it provides a structured way to monitor and improve performance in line with national standards for TLE instruction.

Finally, DepEd Order No. 8, s. 2019 encourages schools and teachers to adopt, develop, and use innovative, evidence-based instructional practices, materials, and tools that improve the quality of teaching and learning. It promotes creativity, research-based interventions, and continuous improvement in pedagogy, allowing educators to explore new approaches that better address learners' needs, difficulties, and varying levels of ability.

Thus, this policy strengthens the study by explicitly supporting the introduction and evaluation of strategies like the Troubleshooting Log. It validates the researcher's initiative to test a structured, reflective tool that goes beyond

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conventional demonstration-based teaching. By assessing learners' baseline performance and measuring improvement across specific competency areas, the study adheres to the policy's call for innovative, learner-centered interventions that raise educational standards and ensure better mastery of essential skills.

Taken together, these theories and legal bases provide a solid framework that deepens understanding of why structured sequenced instruction is vital for mastering complex tasks like food preservation and further elaborates how Troubleshooting Log Strategy can effectively address gaps in consistency quality and standardization. Beyond these foundational principles and policy, related studies and literature further validate contextualize and expand these findings offering additional new knowledge into how similar strategies have been applied tested and proven effective across different learning settings and skill-based disciplines.

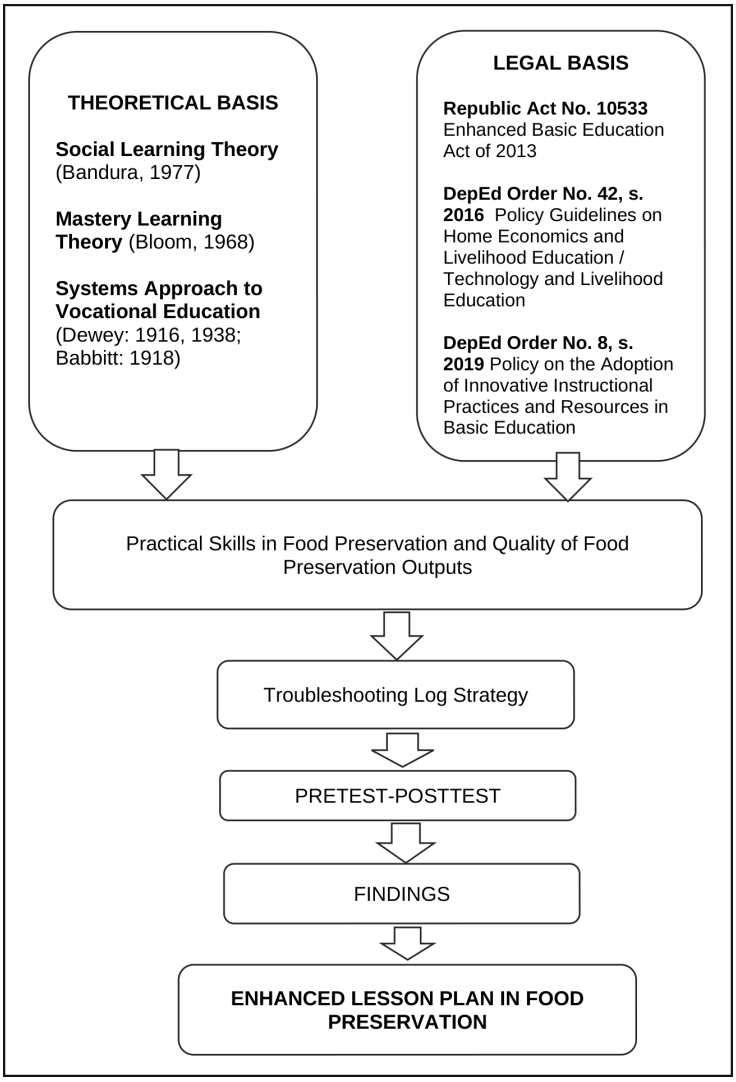



Figure 1
*Theoretical and Conceptual Framework of the Study*

**Related Literature**

On the other hand, there are also several related studies that give empirical evidence when it comes to the nature of the study.

First, multiple authors converge on the essential purpose of food preservation: preventing spoilage caused by microbes, enzymes, and chemical reactions; extending shelf life; retaining nutrition, flavor, and texture; and minimizing waste (Angelan, 2024; Ivanova, 2023; Sun, 2024). Similarly, Ariyamuthu et al. (2022) and Talib et al. (2024) both note that preservation has evolved from long-standing traditional practices, such as salting, drying, fermentation, curing, and canning, to include modern advances like pasteurization, irradiation, and bio preservation. In line with this, Sahoo et al. (2025) add that hurdle technology, cryopreservation, and ultrasound further expand available options, all aimed at protecting food from physical, chemical, and biological degradation throughout the supply chain. Likewise, Khama (2024) emphasizes that progress is driven by demands for better quality, safety, and sustainability, though widespread adoption is slowed by cost, scalability, and remaining safety questions.

Moving beyond general principles, several studies focus specifically on advanced and innovative methods. For instance, Sridhar et al. (2021) examine techniques particularly suited for heat-sensitive items such as fruits, vegetables, beverages, and spices, including electrothermal processing, pulsed electric fields, ozone treatment, and nanotechnology, all designed to reduce pathogens while preserving quality. In comparison, Fadahunsi (2025) observes that while traditional methods like refrigeration and chemical additives work, they often alter sensory properties or raise health concerns; non-thermal alternatives such as high-pressure processing and pulsed electric fields avoid excessive heat, better retaining nutrients and taste. Further, Srivastava et al. (2024) emphasize Process Intensification as a strategy that boosts efficiency, lowers resource use, and cuts emissions while improving safety and shelf life, distinguishing it from conventional methods that may consume more energy or produce greater waste. Additionally, Fadahunsi (2025) extends the discussion beyond processing itself, covering intelligent packaging, edible coatings, blockchain, and artificial intelligence as tools that strengthen traceability and control spoilage more precisely. In contrast, Angelan (2024) draws a clear distinction between food processing, the transformation of raw materials, and preservation, which specifically targets spoilage mechanisms to maintain quality over time; both are complementary but serve distinct roles in the food system.

Collectively, these studies show broad agreement that effective food preservation requires balancing tradition with innovation, safety with quality, and practicality with sustainability. However, while existing literature thoroughly describes methods, technologies, and their benefits, it rarely addresses how learners systematically identify, analyze, and resolve common problems during hands-on practice, a key concern in this research. Most sources focus on technical or industrial applications rather than instructional strategies that build competence across knowledge, correct technique, safety, troubleshooting, and product quality. Notably, gaps also appear in how learners move from knowing procedures to diagnosing errors and consistently producing high-quality outputs, precisely where the Troubleshooting Log Strategy offers value. By documenting steps, difficulties, adjustments, and results, this approach turns experience into structured learning, aligning with the core goals of preservation described across all reviewed studies while addressing the specific challenges observed among Grade 10 learners in TLE-Food Preservation.

**Significance of the Study**

This study determines the level of performance of Grade 10 learners in Food Preservation before and after the implementation of the Troubleshooting Log Strategy, specifically in terms of knowledge of principles and procedures, application of correct techniques and safety measures, identification of common problems, and quality and shelf life of preserved products. The findings of this research benefit the following groups:

Department of Education (DepEd) Officials and Curriculum Planners. This study provides empirical evidence to support the review and enhancement of TLE curricula and learning competencies related to Food Preservation. It offers clear data on how structured, reflective tools such as the Troubleshooting Log address identified gaps in knowledge, practical application, problem-solving ability, and product quality. The results guide policy formulation, instructional material development, and capacity-building programs that strengthen food-related education across schools in the division and region.

Grade 10 Students. This study helps learners become more conscious of their strengths and areas for improvement in performing food preservation tasks. Through the Troubleshooting Log Strategy, they develop systematic habits of monitoring their work, recognizing deviations, and applying appropriate corrections turning hands-on practice into

reliable, lasting competence that they use for home food safety, family livelihood initiatives, and future food-related learning.

TLE Teachers. The findings provide subject teachers with clear baseline data on learners' performance across all assessed competencies. This guides them in designing more targeted instruction, identifying which skills require additional practice or clarification, and integrating the Troubleshooting Log as a standard instructional tool that supports independent observation, critical thinking, and continuous improvement during practical activities.

School Administrators. This study informs school leaders about the current status of learners' performance in Food Preservation and the effectiveness of the Troubleshooting Log Strategy as an innovative intervention. It serves as evidence to support institutionalizing the tool across TLE classes, allocating necessary resources, and organizing professional development opportunities that strengthen the quality of vocational instruction in the school.

The Researcher. Conducting this study deepens the researcher's understanding of the challenges learners face in Food Preservation and how reflective documentation improves skill acquisition. It also enhances competence in designing, implementing, and evaluating educational interventions, contributes to professional growth in the field of Technical-Vocational Education, and fulfills academic requirements for the advanced degree.

Future Researchers. This research serves as a valuable reference and baseline material for related inquiries. It provides updated data on learners' performance, a detailed description of the Troubleshooting Log Strategy, and a structured framework that other researchers replicate, expand, or adapt to other grade levels, schools, or TLE specializations.

## Methods

### Design and Flow of the Study

This study employed a Quasi-Experimental Research Design, specifically the One-Group Pretest-Posttest Design. This design was appropriate for determining the effectiveness of an intervention in this case, the Troubleshooting Log Strategy by measuring learners' performance before and after its implementation. Since the study focused on assessing baseline competencies and observing changes within the same group of Grade 10 learners without forming separate control and experimental groups, this design was well-suited for evaluating the extent of improvement across the identified competencies: knowledge of principles and procedures, application of correct techniques and safety measures, identification of common problems, and the quality and shelf life of preserved products.

According to Fraenkel, Wallen, and Hyun (2012), the one-group pretest-posttest design involved administering a pretest to a single group, exposing the participants to a specific intervention, and then administering a posttest to measure changes that could reasonably be attributed to the treatment. This approach was widely adopted in educational research when random assignment of participants to distinct groups was not feasible, yet the researcher sought to examine the effect of a targeted instructional strategy or program. In this study, the design enabled a direct comparison of each learner's performance before and after the intervention, providing clear evidence of how the Troubleshooting Log Strategy influenced practical skill development, problem-solving ability, and output quality in Food Preservation. This study was guided by the Input-Process-Output (IPO) model, a structured framework that clearly outlined the components, procedures, and expected results of the research. It systematically organized what data was gathered, how the investigation was conducted, and what was produced at the end, ensuring that the study followed a logical and coherent flow fully aligned with its stated objectives. The model served as a visual and conceptual roadmap, linking every phase of the research to the core goal of assessing and strengthening learners' competence in Food Preservation through the Troubleshooting Log Strategy.

Input. The input phase included two primary sets of baseline data: the learners' practical skills in Food Preservation before the implementation of the Troubleshooting Log Strategy, specifically in the application of correct techniques and procedures, adherence to safety and sanitation measures, and the ability to identify and correct common food preservation problems; and the quality of learners' food preservation outputs prior to the intervention, measured in

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terms of product quality and conformity to prescribed product standards. These inputs established the starting point against which post-implementation improvement was measured.

Process. The process phase employed the Quasi-Experimental Research Design, specifically the One-Group Pretest-Posttest Design, to assess changes resulting from the intervention. It covered the complete sequence of activities: securing necessary approval from concerned authorities, obtaining informed consent from participating learners and their guardians, administering the assessment questionnaire as both pretest and posttest, retrieving and verifying completed instruments, implementing the Troubleshooting Log Strategy throughout the designated period, and applying the appropriate statistical treatment to analyze the gathered data.

Output. The anticipated output of this study was an Enhanced Lesson Plan that fully integrated the Troubleshooting Log Strategy into Food Preservation instruction. This lesson plan translated the findings into practical, usable teaching material that embedded systematic observation, problem-solving, and reflection directly into hands-on activities, providing TLE teachers with a structured tool to help learners improve their skills, produce safer and higher-quality preserved products, and develop lasting confidence in food preservation practices.

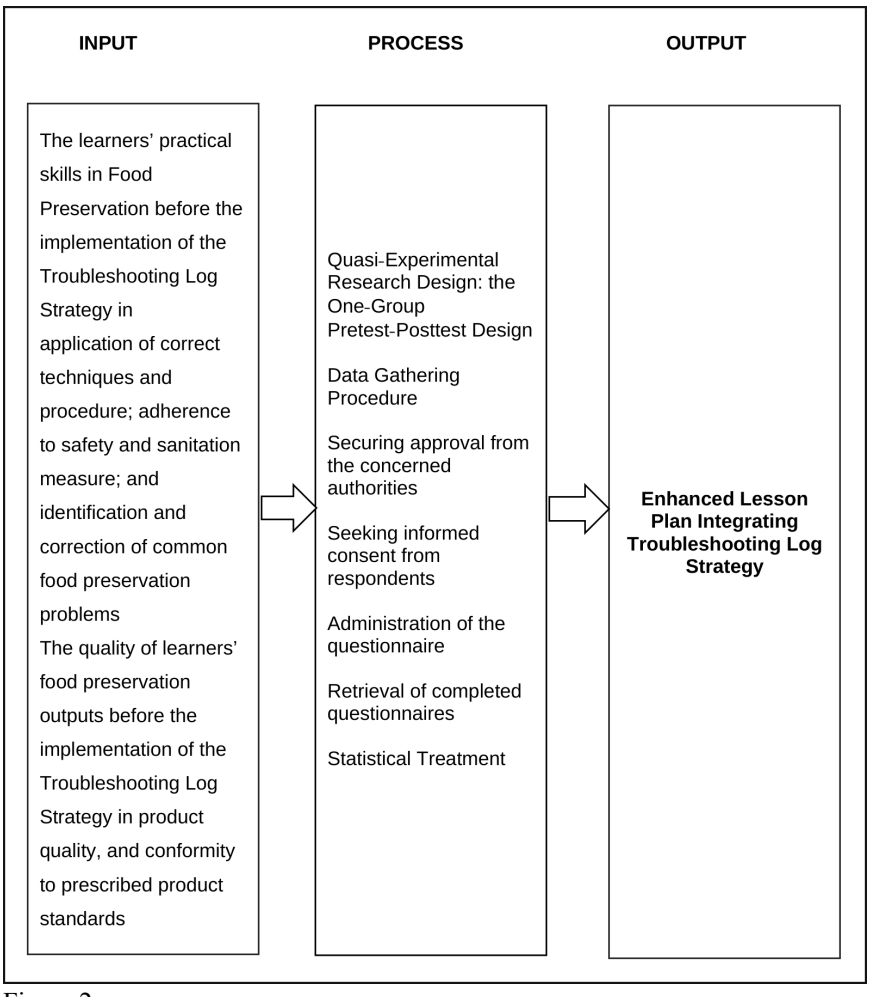



Figure 2
*Flow of the Study*

**Research Environment and Respondents**

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The study was conducted at Mactan National High School, situated in Mactan, Lapu-Lapu City, Cebu. Classified as a very large public secondary institution under the leadership of Principal IV Rowena Sagarino, the school serves a diverse student population and implements the full range of basic education programs. This setting is highly appropriate for the present investigation for several compelling reasons. First, the school offers Technology and Livelihood Education (TLE) as a core component of its curriculum, with Food Preservation included as a major competency for Grade 10 learners, ensuring that the subject matter directly aligns with existing instructional programs and learner needs. Second, observations from the previous school year consistently showed that students frequently encounter difficulties in mastering food preservation skills, committing errors in procedures, safety practices, and quality assessment, issues that the Troubleshooting Log Strategy specifically aims to address. Third, the school has adequate facilities such as TLE laboratories, preparation areas, and basic preservation tools that allow for the safe and proper conduct of hands-on activities and the implementation of the intervention.

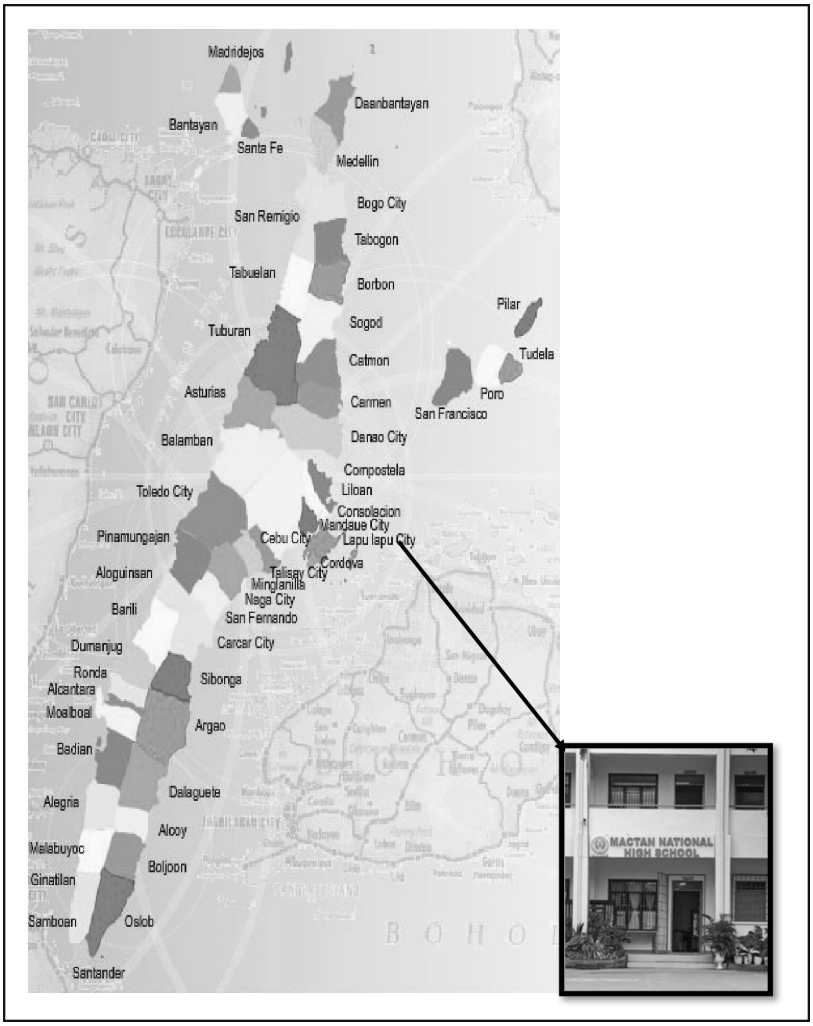



Figure 3
*Location Map of the Research Environment*

The respondents of this study were the entire population of forty (40) Grade 10 learners composing one intact class at Mactan National High School for School Year 2026-2027. The study employed Total Enumeration, a method in which every individual belonging to the target population was included as a respondent, eliminating the need for sampling or selection. The population was defined as all Grade 10 learners enrolled in the TLE program, where Food Preservation stood as one of the core competencies that every student was required to develop and master during the

school year. Since the entire class of forty learners met this definition and all were taking part in the same Food Preservation activities, no one was excluded from the investigation, and all forty participants completed both the pretest and post-implementation activities.

Table 1
*Distribution of Respondents of the Study in Mactan National High School*

| **Mactan National High School** | **Frequency (f)** | **Percentage (%)** |
|---|---|---|
| Grade 10 | 40 | 100 |
| Total | 40 | 100 |

**Instrument and Scoring**

The main data-gathering tool used in this study was a researcher-made assessment checklist titled "Practical Skills and the Quality of Food Preservation Before and After Troubleshooting Log Strategy." This instrument was specifically developed because no existing standardized tool fully covered the combined set of competencies procedural technique, safety practice, problem identification and correction, product quality, and conformity to standards that the study intended to measure. It was designed to capture both the learners' hands-on performance and the quality of their preserved outputs, using a consistent 5-point rating scale where 5 meant Excellent / Consistently observed, 4 meant Very Good / Frequently observed, 3 meant Satisfactory / Sometimes observed, 2 meant Fair / Rarely observed, and 1 meant Poor / Never observed.

The instrument consisted of two major parts organized into five subsections. Part I assessed Learners' Practical Skills across three dimensions: 1.1 Application of Correct Techniques and Procedures with 10 indicators; 1.2 Adherence to Safety and Sanitation Measures with 10 indicators; and 1.3 Identification and Correction of Common Food Preservation Problems with 10 indicators. Part II assessed Product Quality and Compliance across two dimensions: 2.1 Product Quality with 10 indicators, and 2.2 Conformity to Prescribed Product Standards with 10 indicators. In total, the instrument contained 50 indicators, each directly aligned with the Food Preservation competencies in the Grade 10 TLE curriculum.

To ensure the instrument was valid and reliable, it underwent a rigorous validation and testing process. Content validity was established through review by three experts, all of whom held master's degrees in Technology and Livelihood Education. They examined each indicator for clarity, alignment with learning objectives, appropriateness for Grade 10 learners, and coverage of the study's variables; their feedback guided revisions to wording, organization, and scoring criteria. Following validation, the instrument was subjected to pilot testing at Mactan Airbase High School with a group of Grade 10 learners who did not participate in the actual study but shared similar learning backgrounds. Reliability analysis using Cronbach's alpha yielded an overall coefficient of 0.92, indicating excellent internal consistency. Dimension-by-dimension results were: Application of Correct Techniques and Procedures (0.90), Adherence to Safety and Sanitation Measures (0.93), Identification and Correction of Common Food Preservation Problems (0.89), Product Quality (0.91), and Conformity to Prescribed Product Standards (0.88). All values exceeded the 0.80 threshold, indicating internal consistency in the pilot sample. Once validated and tested, the final version was administered as both pretest and posttest to ensure direct and fair comparison of performance.

The learners' performance in Food Preservation was assessed using a 5-point Likert scale based on the validated assessment checklist and rubrics. The scores obtained will be interpreted using the following range, descriptive rating, and qualitative description:

Table 2
*Performance Scoring Procedure*

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| Scale | Numerical Range | Descriptive Rating | Qualitative Description |
|---|---|---|---|
| 5 | 4.21 – 5.00 | Excellent (E) | Performs all tasks correctly; consistently applies principles, techniques, and safety measures; identifies and resolves problems independently; produces outputs with excellent quality and expected shelf life. |
| 4 | 3.41 – 4.20 | Very Good (VG) | Performs most tasks correctly; applies principles and techniques properly with minimal guidance; identifies common problems; produces outputs with good quality and acceptable shelf life. |
| 3 | 2.61 – 3.40 | Satisfactory (S) | Performs tasks with occasional errors; requires some prompting in applying procedures and safety; recognizes some difficulties; produces outputs with fair quality and shelf life. |
| 2 | 1.81 – 2.60 | Fair (F) | Shows partial understanding; commits frequent mistakes in techniques or safety; struggles to identify problems; outputs have inconsistent quality or shorter shelf life. |
| 1 | 1.00 – 1.80 | Poor (P) | Lacks understanding of principles and procedures; fails to apply correct techniques or safety practices; cannot identify or address problems; outputs are unsafe, spoiled, or do not meet basic standards. |

**Data Gathering Procedure**

The data gathering for this study was conducted in three major stages: Preliminary Stage, Data Gathering Stage, and Post-Data Gathering Stage. Each stage outlined systematic steps to ensure the credibility, validity, and rigor of the entire research process.

Preliminary Stage. The researcher first secured formal approval from the School Head of Mactan National High School to secure final permission to conduct the study to the Grade 10 learners. Before actual data collection, the research instrument underwent rigorous validation to ensure it accurately and reliably measured the intended variables. The checklist was reviewed by three experts, all holders of master's degrees in Technology and Livelihood Education, who examined each indicator for clarity, alignment with learning competencies, appropriateness for Grade 10 learners, and completeness of coverage. Their comments and suggestions guided necessary revisions to wording, structure, and scoring criteria, after which the refined tool was pilot-tested at Mactan Airbase High School to establish reliability. Following validation and testing, the researcher met with the selected respondents during their free time to briefly explain the study's purpose, scope, and procedures. When they expressed willingness to participate, the researcher distributed the informed consent forms, which clearly outlined the study details as well as the participants' rights including voluntary involvement and the freedom to withdraw at any time without penalty and secured written assent from the learners themselves alongside parental or guardian consent.

Once all necessary approvals were secured and informed consent obtained from the school administration, parents or guardians, and participating learners, the actual data gathering proceeded in three distinct stages: pre-implementation and pretest, implementation of the Troubleshooting Log Strategy, and post-implementation and posttest.

During the first stage, the researcher oriented the 40 Grade 10 learners at Mactan National High School on the study's purpose and general flow. The respondents performed the assigned food preservation tasks without using the Troubleshooting Log Strategy; they followed standard instructions and applied their existing knowledge and skills to complete the activity as they normally would. Immediately after finishing the task, they responded to the assessment checklist based entirely on their actual experience and output. This pretest measured their baseline performance in applying correct techniques and safety measures, identifying common problems, and producing quality preserved products, and the results served as the reference against which post-intervention improvement was compared.

Next, the researcher conducted a dedicated orientation and demonstration on the proper use of the Troubleshooting Log Template, explaining its purpose, sections, and completion guidelines, and emphasizing that the tool was designed to support learning rather than penalize mistakes. The strategy was then implemented over one week consisting of three 45-minute sessions focused on Mango Jam preparation. On the first day, the researcher and TLE subject-teacher guided the learners through each section of the log, showed a sample completed entry, and helped them record preliminary details such as the activity objective, measured ingredients, and pre-processing observations on raw material condition; no cooking took place on this day, ensuring every learner understood how to observe, document, and analyze their work systematically. On the second day, the learners prepared Mango Jam while using the log throughout the process, recording measurements, monitoring changes in consistency, color, and aroma, and noting any deviation such as the mixture becoming too thick, too thin, scorching, or failing to set along with its suspected cause, the corrective action applied, and the final result. Even when no problem occurred, learners documented that all steps proceeded smoothly to practice consistent observation. Upon completing cooking, cooling, and packaging, they checked compliance with standards and submitted both their finished jam and completed log. On the third day, the researcher returned the logs with specific, constructive feedback, facilitated a group discussion on common challenges, and guided the learners to complete their reflections on what worked well, what was difficult, and what they would improve in future activities. Selected learners shared their insights to reinforce shared standards, while the researcher recorded ongoing performance observations.

Finally, immediately after the intervention period, the learners performed similar food preservation tasks while applying the Troubleshooting Log Strategy, and then responded to the same assessment checklist and rubric used in the pretest. This posttest measured changes in their practical skills and output quality across all assessed dimensions. All completed assessments, log sheets, and product evaluation forms were collected, verified for completeness, tallied, and subjected to statistical analysis to determine whether the observed improvements were statistically significant. Following data collection, the study analyzed the pretest and posttest scores using the procedures described below.

**Ethical Considerations**

Informed consent was secured from the Grade 10 participants and their parents or legal guardians; because the learners were minors, both parental permission and the students' own assent were obtained to ensure their voluntary and willing involvement. All parties were fully briefed on the study's purpose, procedures, potential benefits, and rights including voluntary participation and the freedom to withdraw at any time without penalty or effect on academic grades.

Confidentiality was strictly observed. All data and personal details were coded, kept private, accessible only to authorized persons, and disposed of properly after the study.

Objectivity and integrity were maintained by using validated assessment tools and avoiding bias; all were properly cited. Learners' safety and welfare were prioritized during hands-on activities through proper supervision and adherence to safety and sanitation protocols.

Declaration on the Use of Artificial Intelligence (AI): The researcher confirmed that AI tools were used only for drafting, organizing, and refining the paper's structure and wording. All content, ideas, analysis, and conclusions are based on the researcher's own understanding, reviewed literature, and planned procedures. AI was not used to generate data, fabricate findings, or replace independent judgment; all AI-assisted text were reviewed, verified, and validated by the researcher.

**Statistical Treatment**

Weighted means summarized learners' performance, and standard deviations described the spread of scores. Paired-sample t tests compared the pretest and posttest scores of the same learners.

**Operational Definitions**

Application of Correct Techniques and Procedures. Refers to the observable ability of Grade 10 learners to follow the exact sequence of steps, measure ingredients accurately, prepare raw materials properly, maintain required processing conditions, handle tools safely, and complete all tasks within the allocated time frame as measured by the assessment checklist before and after the intervention.

Adherence to Safety and Sanitation Measures. Refers to the consistent practice of proper handwashing, wearing of complete personal protective equipment, use of sanitized tools and work areas, prevention of cross-contamination, proper handling of sharp and hot items, and maintenance of cleanliness throughout the activity as rated in the pretest and posttest.

Conformity to Prescribed Product Standards. Refers to how closely the preserved output matches the specified net weight, container type, seal integrity, label requirements, shelf-life estimate, safety criteria, and presentation standards outlined in the activity rubric, as assessed by the researcher and TLE teacher.

Enhanced Lesson Plan Integrating the Troubleshooting Log Strategy. Refers to the improved instructional guide developed from the study's findings, which embeds the structured log template into Food Preservation activities to guide learners in observing, recording, analyzing, and correcting their work in real time.

Food Preservation. Refers to the core competency in Grade 10 Technology and Livelihood Education involving methods such as making jams, pickles, or dried products to prevent spoilage and extend the shelf life of food, which served as the practical context for assessing learners' skills in this study.

Identification and Correction of Common Food Preservation Problems. Refers to the learners' capacity to detect deviations in texture, color, smell, or proportion during processing; link these to specific causes; select and apply appropriate adjustments; and record the problem, cause, and solution as practiced through the log and measured in the posttest.

Practical Skills. Refers to the hands-on, demonstrable abilities assessed in this study: applying correct procedures, observing safety standards, and recognizing and resolving issues during food preservation tasks, expressed as mean performance scores from the pretest and posttest.

Product Quality. Refers to the sensory and stability characteristics of the preserved output, including color, aroma, taste, texture, uniformity, absence of spoilage, flavor retention, consistency, visual appeal, and stability over the initial observation period, as rated on the 5-point scale.

Troubleshooting Log Strategy. Refers to the reflective instructional tool used during the intervention, consisting of a structured template that guides learners to record observations, note difficulties, identify causes, apply corrections, and document results at every stage of the food preservation activity.

**Results and Discussion**

Tables 3–12 show the item ratings by domain before and after implementation. Table 2 defines the rating categories. The reported domain means were Fair at baseline; the three practical-skills domains were Very Good at posttest, and both output-quality domains were Excellent.
Legend: 4.21-5.00 Excellent (E); 3.41-4.20 Very Good (VG); 2.61-3.40 Satisfactory (S); 1.81-2.60 Fair (F); 1.00-1.80 Poor (P)

**Pretest Performance**

Table 3
*Application of Correct Techniques and Procedures*

INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
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| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Selects the appropriate food preservation method suited to the type of raw material being processed. | 2.25 | 0.79 | F |
| 2. Follows the exact logical sequence of steps outlined in the standard procedure without skipping or rearranging major steps. | 2.10 | 0.62 | F |
| 3. Measures ingredients and preservatives accurately using correct weighing/measuring devices and units. | 2.03 | 0.69 | F |
| 4. Prepares raw materials properly cleaning, sorting, peeling, slicing, or cutting uniformly and according to required specifications. | 2.05 | 0.71 | F |
| 5. Applies the preservation agent (salt, sugar, vinegar, oil, heat, etc.) at the right concentration and at the correct stage of processing. | 2.05 | 0.63 | F |
| 6. Maintains required processing conditions temperature, time, pressure, or moisture level throughout the activity. | 2.10 | 0.77 | F |
| 7. Handles and operates tools and equipment correctly and safely as specified in the operating guidelines. | 2.18 | 0.77 | F |
| 8. Performs intermediate checks during preparation to ensure each stage meets expected standards before proceeding to the next. | 2.15 | 0.76 | F |
| 9. Follows prescribed cooling, resting, or settling periods before packaging or storing the product. | 2.15 | 0.69 | F |
| 10. Completes all procedural steps within the allocated time frame without rushing critical stages. | 2.15 | 0.73 | F |
| Overall | 2.12 | 0.72 | F |

Table 4
*Adherence to Safety and Sanitation Measures*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Washes hands thoroughly with soap and water before starting, after handling raw ingredients, and after touching non-work surfaces. | 2.18 | 0.63 | F |
| 2. Wears complete and appropriate PPE clean apron, hairnet, closed footwear, and removes jewelry before the activity. | 1.90 | 0.70 | F |
| 3. Uses only thoroughly washed and sanitized utensils, cutting boards, work tables, and containers before beginning work. | 2.03 | 0.61 | F |
| 4. Keeps raw and ready-to-eat ingredients separate to avoid cross-contamination throughout preparation. | 1.98 | 0.65 | F |
| 5. Handles sharp tools, hot surfaces, and equipment with caution and uses proper grip/holding techniques at all times. | 2.15 | 0.69 | F |
| 6. Maintains a clean and clutter-free work area; places waste in designated containers immediately rather than leaving it scattered. | 2.08 | 0.57 | F |
| 7. Verifies that raw materials are fresh, free from spoilage, pests, or foreign matter before any preparation begins. | 1.98 | 0.69 | F |
| 8. Avoids touching food with bare hands; uses clean tongs, spoons, or disposable gloves when direct contact is necessary. | 1.95 | 0.59 | F |

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| Indicators | WM | SD | VD |
|---|---|---|---|
| 9. Stores processed or semi-processed food at proper temperatures and covers it securely to protect from dust, insects, or other contaminants. | 2.08 | 0.65 | F |
| 10. Cleans, sanitizes, and arranges all tools and equipment, and disposes of waste properly immediately after finishing the task. | 2.13 | 0.64 | F |
| Overall | 2.04 | 0.65 | F |

Table 5
*Identification and Correction of Common Food Preservation Problems*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Notices visible signs of spoilage mold, discoloration, off-odors, or sliminess in raw materials or during processing. | 2.28 | 0.63 | F |
| 2. Detects deviations in texture over-softening, excessive hardness, or uneven consistency as the process unfolds. | 2.18 | 0.77 | F |
| 3. Recognizes incorrect proportions too much/little salt, sugar, acid, or preservative and links it to observable changes in the mixture. | 2.03 | 0.76 | F |
| 4. Identifies signs of contamination or poor hygiene cloudiness, unpleasant smell, or film formation during preparation or storage. | 1.98 | 0.61 | F |
| 5. Associates' problems with specific causes e.g., insufficient heating, improper sealing, poor drying, or unsanitary handling. | 2.13 | 0.59 | F |
| 6. Selects the most feasible corrective action suited to the identified issue rather than applying random or unrelated fixes. | 2.0 | 0.71 | F |
| 7. Adjusts ingredient quantities or processing conditions concentration, time, temperature to bring the process back on track. | 1.93 | 0.65 | F |
| 8. Removes or separates affected portions immediately to prevent the problem from spreading to the rest of the batch. | 1.95 | 0.67 | F |
| 9. Modifies packaging, sealing, or storage methods to address detected issues such as leakage or air exposure. | 1.78 | 0.79 | P |
| 10. Records or describes the observed problem, its suspected cause, and the solution applied for future reference and improvement. | 1.9 | 0.70 | F |
| Overall | 2.01 | 0.71 | F |

Table 6
*Product Quality*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Has a natural, appetizing color consistent with the standard appearance of the preserved product. | 2.5 | 0.77 | F |
| 2. Possesses the characteristic aroma of the preserved food, free from sour, rancid, or fermented off-smells. | 2.38 | 0.83 | F |
| 3. Exhibits the expected taste balanced, not overly salty/sweet/sour, with no unpleasant or bitter aftertaste. | 2.55 | 0.77 | F |
| 4. Has uniform texture firmness, crispness, or tenderness appropriate to the specific preservation method used. | 2.33 | 0.79 | F |

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VOLUME 5, ISSUE NO. 6

| Indicators | WM | SD | VD |
|---|---|---|---|
| 5. Maintains consistent size, shape, and cut uniformity of ingredients throughout the finished product. | 2.34 | 0.83 | F |
| 6. Shows no signs of spoilage mold, gas formation, fizzing, or liquid separation at the time of submission. | 2.40 | 0.77 | F |
| 7. Retains natural flavor and nutritional quality; ingredients do not appear overcooked, burnt, or flavorless. | 2.40 | 0.77 | F |
| 8. Has the right consistency not too watery, too thick, too dry, or too oily as expected for the product type. | 2.25 | 0.89 | F |
| 9. Remains visually appealing and appetizing when presented, with no discoloration or drying at the surface. | 2.48 | 0.67 | F |
| 10. Maintains stable quality; no deterioration in appearance, smell, or texture is observed within the initial observation period. | 2.28 | 0.84 | F |
| Overall | 2.39 | 0.799 | F |

Table 7
*Conformity to Prescribed Product Standards*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Matches the required net weight or volume specified in the activity instructions with acceptable margin of difference. | 2.53 | 0.71 | F |
| 2. Is packaged in the exact type, size, and material of container designated for the specific preserved food. | 2.48 | 0.77 | F |
| 3. Sealed properly and completely no leaks, loose caps, or unsealed edges as required by standards. | 2.55 | 0.71 | F |
| 4. Label includes all mandatory information: product name, ingredients, preparation date, expiry/estimated shelf life, and maker's name. | 2.43 | 0.80 | F |
| 5. Meets the standard shelf-life estimate for the preservation method applied; likely to stay safe for the intended period. | 2.48 | 0.74 | F |
| 6. Complies with set standards for safety free from harmful microorganisms, toxins, or chemical hazards. | 2.48 | 0.71 | F |
| 7. Uses only approved, permitted ingredients and preservatives within recommended limits; no prohibited or questionable substances included. | 2.53 | 0.74 | F |
| 8. Follows specifications for appearance, arrangement, and presentation as provided in the rubric or product standard. | 2.53 | 0.67 | F |
| 9. Satisfies all specific requirements outlined for the assigned product category e.g., pickles, jams, dried fish, cured meat. | 2.23 | 0.85 | F |
| 10. Passes general acceptability standards; meets the minimum quality criteria for home consumption or community use. | 2.48 | 0.81 | F |
| Overall | 2.47 | 0.76 | F |

**Posttest Performance**

Table 8
*Application of Correct Techniques and Procedures*

INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
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VOLUME 5, ISSUE NO. 6

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Selects the appropriate food preservation method suited to the type of raw material being processed. | 4.0 | 0.63 | VG |
| 2. Follows the exact logical sequence of steps outlined in the standard procedure without skipping or rearranging major steps. | 3.90 | 0.62 | VG |
| 3. Measures ingredients and preservatives accurately using correct weighing/measuring devices and units. | 3.88 | 0.64 | VG |
| 4. Prepares raw materials properly — cleaning, sorting, peeling, slicing, or cutting uniformly and according to required specifications. | 3.98 | 0.65 | VG |
| 5. Applies the preservation agent (salt, sugar, vinegar, oil, heat, etc.) at the right concentration and at the correct stage of processing. | 3.68 | 0.57 | VG |
| 6. Maintains required processing conditions — temperature, time, pressure, or moisture level — throughout the activity. | 4.05 | 0.67 | VG |
| 7. Handles and operates tools and equipment correctly and safely as specified in the operating guidelines. | 3.88 | 0.68 | VG |
| 8. Performs intermediate checks during preparation to ensure each stage meets expected standards before proceeding to the next. | 3.80 | 0.68 | VG |
| 9. Follows prescribed cooling, resting, or settling periods before packaging or storing the product. | 3.75 | 0.66 | VG |
| 10. Completes all procedural steps within the allocated time frame without rushing critical stages. | 3.88 | 0.64 | VG |
| Overall | 3.88 | 0.65 | VG |

Table 9
*Adherence to Safety and Sanitation Measures*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Washes hands thoroughly with soap and water before starting, after handling raw ingredients, and after touching non-work surfaces. | 3.88 | 0.64 | VG |
| 2. Wears complete and appropriate PPE clean apron, hairnet, closed footwear, and removes jewelry before the activity. | 4.0 | 0.67 | VG |
| 3. Uses only thoroughly washed and sanitized utensils, cutting boards, work tables, and containers before beginning work. | 3.85 | 0.69 | VG |
| 4. Keeps raw and ready-to-eat ingredients separate to avoid cross-contamination throughout preparation. | 3.95 | 0.71 | VG |
| 5. Handles sharp tools, hot surfaces, and equipment with caution and uses proper grip/holding techniques at all times. | 3.95 | 0.67 | VG |
| 6. Maintains a clean and clutter-free work area; places waste in designated containers immediately rather than leaving it scattered. | 3.98 | 0.61 | VG |
| 7. Verifies that raw materials are fresh, free from spoilage, pests, or foreign matter before any preparation begins. | 3.95 | 0.55 | VG |
| 8. Avoids touching food with bare hands; uses clean tongs, spoons, or disposable gloves when direct contact is necessary. | 3.80 | 0.64 | VG |

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VOLUME 5, ISSUE NO. 6

| Indicators | WM | SD | VD |
|---|---|---|---|
| 9. Stores processed or semi-processed food at proper temperatures and covers it securely to protect from dust, insects, or other contaminants. | 3.83 | 0.67 | VG |
| 10. Cleans, sanitizes, and arranges all tools and equipment, and disposes of waste properly immediately after finishing the task. | 3.88 | 0.51 | VG |
| Overall | 3.91 | 0.64 | VG |

Table 10
*Identification and Correction of Common Food Preservation Problems*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Notices visible signs of spoilage mold, discoloration, off-odors, or sliminess in raw materials or during processing. | 3.65 | 0.57 | VG |
| 2. Detects deviations in texture over-softening, excessive hardness, or uneven consistency as the process unfolds. | 3.70 | 0.64 | VG |
| 3. Recognizes incorrect proportions too much/little salt, sugar, acid, or preservative and links it to observable changes in the mixture. | 4.0 | 0.71 | VG |
| 4. Identifies signs of contamination or poor hygiene cloudiness, unpleasant smell, or film formation during preparation or storage. | 3.85 | 0.53 | VG |
| 5. Associates' problems with specific causes e.g., insufficient heating, improper sealing, poor drying, or unsanitary handling. | 3.80 | 0.64 | VG |
| 6. Selects the most feasible corrective action suited to the identified issue rather than applying random or unrelated fixes. | 3.88 | 0.64 | VG |
| 7. Adjusts ingredient quantities or processing conditions concentration, time, temperature to bring the process back on track. | 3.55 | 0.63 | VG |
| 8. Removes or separates affected portions immediately to prevent the problem from spreading to the rest of the batch. | 3.58 | 0.74 | VG |
| 9. Modifies packaging, sealing, or storage methods to address detected issues such as leakage or air exposure. | 3.38 | 0.48 | S |
| 10. Records or describes the observed problem, its suspected cause, and the solution applied for future reference and improvement. | 3.95 | 0.67 | VG |
| Overall | 3.73 | 0.66 | VG |

Table 11
*Product Quality*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Has a natural, appetizing color consistent with the standard appearance of the preserved product. | 4.48 | 0.63 | E |
| 2. Possesses the characteristic aroma of the preserved food, free from sour, rancid, or fermented off-smells. | 4.30 | 0.64 | E |
| 3. Exhibits the expected taste balanced, not overly salty/sweet/sour, with no unpleasant or bitter aftertaste. | 4.53 | 0.63 | E |
| 4. Has uniform texture firmness, crispness, or tenderness appropriate to the specific preservation method used. | 4.43 | 0.63 | E |

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VOLUME 5, ISSUE NO. 6

| Indicators | WM | SD | VD |
|---|---|---|---|
| 5. Maintains consistent size, shape, and cut uniformity of ingredients throughout the finished product. | 4.45 | 0.67 | E |
| 6. Shows no signs of spoilage mold, gas formation, fizzing, or liquid separation at the time of submission. | 4.45 | 0.71 | E |
| 7. Retains natural flavor and nutritional quality; ingredients do not appear overcooked, burnt, or flavorless. | 4.40 | 0.73 | E |
| 8. Has the right consistency not too watery, too thick, too dry, or too oily as expected for the product type. | 4.35 | 0.76 | E |
| 9. Remains visually appealing and appetizing when presented, with no discoloration or drying at the surface. | 4.35 | 0.65 | E |
| 10. Maintains stable quality; no deterioration in appearance, smell, or texture is observed within the initial observation period. | 4.45 | 0.71 | E |
| Overall | 4.42 | 0.68 | E |

Table 12
*Conformity to Prescribed Product Standards*

| Indicators | WM | SD | VD |
|---|---|---|---|
| 1. Matches the required net weight or volume specified in the activity instructions with acceptable margin of difference. | 4.45 | 0.71 | E |
| 2. Is packaged in the exact type, size, and material of container designated for the specific preserved food. | 4.23 | 0.76 | E |
| 3. Sealed properly and completely no leaks, loose caps, or unsealed edges as required by standards. | 4.23 | 0.70 | E |
| 4. Label includes all mandatory information: product name, ingredients, preparation date, expiry/estimated shelf life, and maker's name. | 4.58 | 0.70 | E |
| 5. Meets the standard shelf-life estimate for the preservation method applied; likely to stay safe for the intended period. | 4.53 | 0.59 | E |
| 6. Complies with set standards for safety free from harmful microorganisms, toxins, or chemical hazards. | 4.48 | 0.63 | E |
| 7. Uses only approved, permitted ingredients and preservatives within recommended limits; no prohibited or questionable substances included. | 4.55 | 0.63 | E |
| 8. Follows specifications for appearance, arrangement, and presentation as provided in the rubric or product standard. | 4.33 | 0.72 | E |
| 9. Satisfies all specific requirements outlined for the assigned product category e.g., pickles, jams, dried fish, cured meat. | 4.58 | 0.63 | E |
| 10. Passes general acceptability standards; meets the minimum quality criteria for home consumption or community use. | 4.45 | 0.67 | E |
| Overall | 4.46 | 0.68 | E |

**Summary of Performance and Paired Comparisons**

Table 13
*Reported Pretest and Posttest Performance by Domain*

INTERNATIONAL MULTIDISCIPLINARY JOURNAL OF RESEARCH FOR INNOVATION, SUSTAINABILITY AND EXCELLENCE
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VOLUME 5, ISSUE NO. 6

| Indicators | WM (Before) | WM (After) | Mean Difference | VD |
|---|---|---|---|---|
| Application of correct techniques and procedure | 2.12 | 3.88 | 1.76 | VG |
| Adherence to safety and sanitation measure | 2.04 | 3.91 | 1.87 | VG |
| Identification and correction of common food preservation problems | 2.01 | 3.73 | 1.72 | VG |
| Product quality | 2.39 | 4.42 | 2.03 | E |
| Conformity to prescribed product standards | 2.47 | 4.46 | 1.99 | E |
| Overall | 2.21 | 4.08 | 1.87 | VG |

The reported overall weighted mean increased from 2.21 to 4.08, a difference of 1.87 points. Product quality showed the largest reported gain (2.03 points), followed by conformity to product standards (1.99 points).

Table 14
*Reported Paired-Sample t Tests*

| Indicators | Mean (Before) | Mean (After) | Mean Difference | t-value | p-value | Decision | Interpretation |
|---|---|---|---|---|---|---|---|
| Application of correct techniques and procedure | 2.12 | 3.88 | 1.76 | 28.58 | <0.001 | Reject $H_0$ | There is a significant difference |
| Adherence to safety and sanitation measure | 2.04 | 3.91 | 1.87 | 46.58 | <0.001 | Reject $H_0$ | There is a significant difference |
| Identification and correction of common food preservation problems | 2.01 | 3.73 | 1.72 | 27.82 | <0.001 | Reject $H_0$ | There is a significant difference |
| Product quality | 2.39 | 4.42 | 2.03 | 28.61 | <0.001 | Reject $H_0$ | There is a significant difference |
| Conformity to prescribed product standards | 2.47 | 4.46 | 1.99 | 30.98 | <0.001 | Reject $H_0$ | There is a significant difference |
| Overall Weighted Mean | 2.21 | 4.08 | 1.87 | 43.99 | <0.001 | Reject $H_0$ | There is a significant difference |

The reported t statistics ranged from 27.82 to 46.58; all reported comparisons had $p < .001$. These tests describe within-group change. Because the study used one group without a comparison group, it cannot isolate the effect of the strategy.

The discussion links the observed changes to the log's use of demonstration, observation, and feedback (Bandura, 1977) and to repeated practice and correction (Bloom, 1968). The log asked learners to record deviations as they occurred, identify possible causes, and document adjustments. This emphasis on monitoring and adjustment is consistent with the process considerations discussed by Srivastava et al. (2024). The quality and standards ratings also reflect the study's emphasis on assessing the finished product alongside the preparation process.

**Output of the Study**

The proposed enhanced lesson plan responds to the Fair baseline ratings across practical skills and product quality. It uses mango jam preparation to combine correct procedures and sanitation with practice in identifying and correcting common preservation problems.

The plan incorporates a Troubleshooting Log that asks learners to record measurements, observe changes, identify possible causes, document corrections, and assess the final product. These activities are components of the proposed lesson plan; the reported findings come from the study's pretest and posttest.

**Rationale**

Food preservation is a core competency in Technical-Livelihood Education that equips learners with practical skills for safe food handling, enterprise development, and community food security. However, pre-implementation assessments at Mactan National High School–Junior High School revealed that Grade 10 learners performed only at the Fair level across procedural technique, safety and sanitation, problem-solving, product quality, and compliance with standards. These gaps stemmed not from lack of instruction but from the absence of a structured guiding strategy learners had no consistent framework to detect deviations, diagnose causes, apply corrections, or reflect on their practice during hands-on activities.

This intervention is anchored on Mastery Learning Theory by Benjamin Bloom (1968), which asserts that all learners can achieve high levels of competence when provided with clear performance standards, sufficient practice opportunities, targeted feedback, and time to refine skills until mastery is attained. It is further supported by Social Learning Theory (Bandura, 1977), emphasizing observation, self-regulation, and guided reflection, and the Systems Approach to Vocational Education (Dewey, 1916, 1938; Babbitt, 1918), which links every procedural step to final product quality and real-world utility. The Troubleshooting Log Strategy was developed to operationalize these principles a structured tool where learners systematically record observations, identify difficulties, analyze causes, apply adjustments, and document results at every stage of food preservation. Empirical literature confirms that while preservation methods are well-documented, there is limited guidance on instructional approaches that build systematic troubleshooting competence precisely the gap this strategy addresses.

**Objectives**

This intervention aims to enhance learners' practical skills and output quality in Food Preservation through the Troubleshooting Log Strategy. Specifically, it seeks to:

Strengthen learners' ability to apply correct procedures and maintain safety and sanitation standards consistently;
Develop competence to observe, identify, and resolve common preservation problems independently using the Troubleshooting Log; and

Elevate the quality of preserved outputs to meet home, community, and prescribed standards through systematic monitoring and reflection.

**Scheme of Implementation**

Table 15
*Implementation Scheme*

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| Phase | Activities | Timeline | Responsible Party |
|---|---|---|---|
| Phase 1: Preparation | Finalize log template; orient learners on purpose, parts, and proper use; prepare materials and reference standards; review pre-implementation results | Week 1 | Researcher & TLE Teacher |
| Phase 2: Integration | Integrate log into every hands-on activity record before, during, and after processing; identify problems, causes, actions, and outcomes | Weeks 2–8 | Learners, Researcher & TLE Teacher |
| Phase 3: Monitoring & Feedback | Review logs within 48 hours; provide specific feedback; brief check-ins on recurring difficulties | Throughout | Researcher & TLE Teacher |
| Phase 4: Evaluation | Post-implementation assessment; compare results with pre-intervention data | Week 9 | Researcher |
| Phase 5: Institutionalization | Present results to school administration; propose adoption as standard instructional tool | Week 10 | Researcher & School Administration |

**TROUBLESHOOTING LOG — MANGO JAM**

Mango Jam Preparation

Name: _____ Date: _____

Table 16

*Troubleshooting Log Template*

| Section | Details & Responses |
|---|---|
| Objective | • Produce safe, standard-quality mango jam<br>• Observe and record changes throughout processing<br>• Identify problems, determine causes, apply corrections, and document results |
| Materials & Measurements | • Ripe mango pulp: _____ g<br>• White sugar: _____ g<br>• Calamansi juice: _____ mL<br>• Other ingredients/materials: _____ |
| Pre-Processing Observations | • Raw mango condition: ☐ Fresh ☐ Overripe ☐ Underripe ☐ Spoiled parts present<br>• Pulp color: _____<br>• Pulp consistency: ☐ Thick ☐ Watery ☐ Fibrous ☐ Lumpy<br>• Cleanliness & readiness: _____ |
| During Processing — Problems & Deviations | ☐ Mixture too thick / drying out too fast<br>☐ Mixture too thin / not thickening<br>☐ Scorching / burning at the bottom<br>☐ Darker color than expected<br>☐ Unpleasant or sour odor<br>☐ Not setting / remains runny after cooling<br>☐ Foam not disappearing<br>☐ Other: _____<br>When did it appear? ☐ Early ☐ Mid-cooking ☐ Near end ☐ After cooling |
| Suspected Cause | |

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| Section | Details & Responses |
|---|---|
| Corrective Action Taken | |
| Result After Adjustment | • Problem: ☐ Fully resolved ☐ Improved ☐ Unchanged ☐ Worsened<br>• Description: _____ |
| Final Product Quality Rating | Color: ☐ Excellent ☐ Very Good ☐ Fair ☐ Poor<br>Aroma: ☐ Excellent ☐ Very Good ☐ Fair ☐ Poor<br>Taste: ☐ Excellent ☐ Very Good ☐ Fair ☐ Poor<br>Texture/Spreadability: ☐ Excellent ☐ Very Good ☐ Fair ☐ Poor<br>Freedom from defects: ☐ Excellent ☐ Very Good ☐ Fair ☐ Poor<br>Overall rating: ☐ Excellent ☐ Very Good ☐ Fair ☐ Poor |
| Packaging & Compliance Check | • Jar cleanliness: ☐ Yes ☐ No<br>• Seal tightness: ☐ Yes ☐ No<br>• Label complete: ☐ Yes ☐ No<br>• Label includes: Product name / Ingredients / Date / Est. shelf life |
| Summary & Reflection | • What worked well: _____<br>• What was challenging: _____<br>• One specific improvement for next time: _____<br>• Most important lesson learned: _____ |

Enhanced Lesson Plan Integrating the Troubleshooting Log Strategy

Subject: TLE – Food Preservation | Grade: 10 | Topic: Mango Jam Making | Time: 45 minutes

I. OBJECTIVES
At the end of the 45-minute session, the learners shall be able to:
Follow the standard procedure for mango jam while observing safety and sanitation practices;
Use the Troubleshooting Log to identify common problems, determine causes, and apply appropriate corrections; and
Produce mango jam that meets the prescribed quality and packaging standards.

II. SUBJECT MATTER
Reference: DepEd TLE–Food Preservation Learning Module
Materials: Ripe mango pulp, sugar, calamansi juice, measuring cups/spoons, cooking pan, wooden spoon, sterilized jars, labels, Troubleshooting Log sheets
Values Integration: Precision, cleanliness, responsibility, problem-solving

III. PROCEDURE
Table 17
*Lesson Procedure*

| Part | Time | Activities |
|---|---|---|
| Preparation & Orientation | 5 min | Greetings, attendance, quick review. Distribute Troubleshooting Logs and explain each section briefly: "We will watch, record, and fix as we go." Show sample entries for clarity. |
| Motivation | 3 min | Display two jam samples, one good, one with consistency issues. Ask: "What is different? How can we fix it?" Introduce the log as the tool to catch and solve these problems. |

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| Part | Time | Activities |
|---|---|---|
| Activity Proper | 25 min | Step 1- Preparation (5 min): Measure ingredients accurately; wear PPE; wash hands and workspace. Complete Log Section 2–3.<br>Step 2 -Cooking & Monitoring (12 min): Combine mango pulp, sugar, and calamansi juice; stir constantly over medium heat. Observe changes in thickness, color, and aroma. Complete Log Section 4 as problems appear.<br>Step 3 — Troubleshooting & Adjusting (5 min): Discuss suspected causes → apply fixes (add liquid if too thick, extend cooking if too thin) → record results. Complete Log Section 5–7.<br>Step 4 — Cooling & Packaging (3 min): Transfer jam to clean jars; seal and label. Complete Log Section 8. |
| Analysis & Reflection | 7 min | Quick sharing: "What issue did you encounter? How did you fix it?" Teacher confirms correct responses and clarifies common mistakes. Learners complete Log Section 9. |
| Wrap-up & Assignment | 5 min | Collect logs and outputs. Remind: "Mistakes help you improve when you learn from them." Assignment: Review standard specifications for next session. |

I

V. EVALUATION

Assessed based on:

Procedure & Safety : correct sequence, proper measurements, hygiene and PPE use

Troubleshooting Practice : log completeness, accurate observation, appropriate corrective action

Product Quality : color, aroma, taste, texture, consistency, proper packaging and labeling

V. ASSIGNMENT

Finish the reflection section of your Troubleshooting Log

Review the next preservation topic in your module

Conclusion

Based on the findings of the study, it is concluded that the Troubleshooting Log Strategy is a highly effective instructional intervention that transforms learners' competence and output quality in Food Preservation. Grounded in Mastery Learning Theory (Bloom, 1968), the study confirms that when learners are provided with clear standards, structured opportunities to identify and address their own gaps, and repeated practice with corrective feedback, they can progress from basic, inconsistent performance to reliable, high-quality achievement. The strategy moves beyond simple task completion by fostering self-regulation, diagnostic thinking, and continuous improvement essential attributes of skilled practice. It bridges the gap between knowing procedures and applying them consistently, turning learners into active, confident practitioners who can produce safe, standard-compliant, and marketable food products. Ultimately, the study demonstrates that vocational learning is strengthened not only by what is taught but by how learners are guided to monitor, reflect on, and refine their own work a principle that aligns with the core purpose of Technical-Livelihood Education: equipping learners with practical skills, professional responsibility, and the adaptability needed for meaningful employment, entrepreneurship, and community contribution.

Recommendations

In light of the findings, conclusions, and proven effectiveness of the Troubleshooting Log Strategy, the following specific recommendations are offered.

School administrators are advised to institutionalize the Troubleshooting Log Strategy as a standard instructional tool across all TLE–Food Preservation classes at Mactan National High School–JHS. It should be integrated into daily lesson plans and performance task rubrics to ensure sustained use rather than temporary application. Administrators

should also organize a hands-on orientation workshop led by the researcher for all TLE teachers, and allocate funds for printed log templates and materials so every learner has a personal copy from the start of the school year.

TLE–Food Preservation teachers should integrate the log into every hands-on activity, guiding learners to record observations, deviations, and adjustments before, during, and after processing. Entries should be reviewed within two days to provide timely, specific feedback. Teachers should give focused attention to the areas of lowest initial performance adjusting ingredient concentrations, modifying packaging and storage methods, and applying mid-process corrections by modeling these steps explicitly and sharing sample entries. Periodic peer review should also be encouraged to reinforce standards and build shared learning habits.

Grade 10 learners are encouraged to maintain their logs as personal reference guides throughout the quarter and into future activities. These should be treated not merely as requirements but as reusable records of what works, what goes wrong, and how to resolve issues resources valuable for home projects, family livelihood initiatives, or advanced food technology subjects. Learners should be thorough and honest in documenting challenges and solutions, and apply the same reflective approach across other TLE subjects to build independence and transferable problem-solving skills.

Curriculum planners and district supervisors are recommended to pilot the Troubleshooting Log Strategy across related TLE specializations such as Cookery, Bread and Pastry Production, and Agricultural Crop Production to assess broader applicability. They should also incorporate its core elements structured observation, cause analysis, corrective action, and documentation into official district instructional guides so that troubleshooting competence becomes a consistent focus rather than an optional add-on.

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