

Strategic Intervention Material Development and Culinary Skills Competency in Junior High School Technology and Livelihood Education

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ABSTRACT

This study developed and evaluated a Strategic Intervention Material designed to strengthen culinary skills competency among junior high school learners in Technology and Livelihood Education. It used an iterative design-and-development approach with an embedded repeated-measures competency evaluation conducted at Rang-ayan National High School in the City of Ilagan, Isabela. Learners who demonstrated difficulty in selected cookery competencies participated through criterion-based cluster sampling, while qualified experts assessed the material's content alignment, clarity, usability, technical accuracy, and assessment suitability. Data were gathered through a diagnostic competency test, an analytic culinary performance rubric, and a material evaluation questionnaire.

Instrument quality was established through content validation, pilot testing, internal consistency analysis, test reliability, and interrater agreement. Many-Facet Rasch Measurement calibrated learner ability, task difficulty, performance criteria, and rater severity, while a linear mixed-effects growth model examined competency changes across baseline, midpoint, and final assessment. Results showed that the material achieved excellent expert evaluation and strong psychometric properties. Learners improved from emerging to proficient performance across preparation and organization, procedural accuracy, tool use, measurement, sanitation and food safety, time management, product quality, and independent task completion. The strongest outcome was observed in sanitation and food safety, whereas time management and independent performance remained areas for continued support. The findings support the use of focused, visually guided, and performance-based intervention materials in strengthening cookery instruction and learner competency.

Keywords: *culinary competency, junior high school, strategic intervention material, Technology and Livelihood Education, vocational education, work-based learning*

INTRODUCTION

Technology and Livelihood Education provide junior high school learners with opportunities to acquire knowledge and practical abilities that can be applied at home, in further training, and in future employment. Among its areas of specialization, cookery allows learners to develop food preparation skills while learning discipline, sanitation, safety, resource management, creativity, and responsible work habits. These competencies reflect the broader purpose of technical and vocational education, which is to equip young people with the knowledge, skills, values, and attitudes needed for productive employment, decent work, lifelong learning, and active participation in society. The value of cookery instruction, therefore, extends beyond completing recipes

because it prepares learners to perform practical tasks with care, accuracy, and responsibility (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2022).

The demand for relevant technical skills has placed greater pressure on schools to ensure that classroom instruction remains connected with actual work practices. In the Philippines, technical and vocational education is expected to support the development of a competitive and socially inclusive workforce. This expectation requires learning programs that respond to changing technologies, workplace requirements, and industry practices. Although junior high school learners are still at an exploratory stage, their early experiences in Technology and Livelihood Education can influence how they understand work, develop confidence in performing tasks, and consider future technical or livelihood pathways. Instruction must therefore move beyond memorization and provide learners with repeated opportunities to demonstrate what they know through observable performance (Asian Development Bank, 2021).

Cookery instruction in junior high school is organized around specific competencies that require both conceptual understanding and physical performance. Grade 9 learning materials cover the proper cleaning, sanitizing, and storage of kitchen tools and equipment, maintenance of kitchen premises, observance of workplace safety procedures, selection of ingredients, and preparation and storage of food products such as appetizers. Each competency involves a sequence of actions that must be understood and performed correctly. A learner may be able to identify a kitchen tool in a written activity yet still experience difficulty in using it safely, maintaining cleanliness, following a procedure, or producing food that meets acceptable standards. This difference between knowing and performing makes the teaching of cookery more demanding than the simple presentation of written information (Department of Education, 2022).

The standards for professional cookery also show why technical instruction must be kept accurate and responsive to workplace expectations. The Technical Education and Skills Development Authority [TESDA] (2024) amended the training regulations for Food Production or Professional Cookery NC II to address developments in technology, industry practices, manpower arrangements, and regional competency standards. The amended regulations recognize that culinary competence includes more than cooking a finished dish. It involves food safety, workplace communication, correct use of tools and equipment, preparation procedures, quality control, sanitation, and compliance with established standards. Junior high school cookery does not replace formal qualification training, but its competencies can provide learners with a sound foundation for higher-level technical education and employment preparation.

Learning to cook in a school laboratory places several demands on learners at the same time. They must interpret instructions, recognize visual changes in ingredients, use tools properly, control time and temperature, maintain an orderly work area, cooperate with classmates, and respond to the teacher's feedback. Research on practical culinary classes found that learners must combine information about ingredients, utensils, preparation stages, teamwork, cleaning, and time management while completing a culinary task. The interaction between the teacher and the learners throughout the practical activity was also identified as an important condition for successful learning. These findings indicate that learners who miss a demonstration, misunderstand a step, or work at a slower pace may need additional instructional support that they can study and use during practice (Koerich et al., 2024).

Evidence from Philippine cookery classes likewise shows the importance of active participation. A study involving Grade 9 learners reported significant relationships between individual and group hands-on activities and the learners' cookery competencies. Their personal learning experiences, including the integration of theory and practice, collaborative work, academic activities, and interaction during instruction, were also associated with competency development. This finding suggests that practical skills are strengthened when learners are allowed to apply procedures, reflect on their performance, work with others, and connect written lessons with actual kitchen tasks. Learners who have not fully mastered a skill may consequently benefit from materials that guide them through the procedure before, during, and after hands-on practice (Castillo, 2022).

Strategic Intervention Materials offer one way of providing focused support to learners who encounter difficulty with particular competencies. Unlike a general textbook or workbook, an intervention material is

developed from identified learning needs and presents selected content through manageable explanations, guided activities, practice tasks, and assessment exercises. In a Philippine study, contextualized Strategic Intervention Materials were developed from the least-mastered competencies of Grade 9 learners. The materials helped learners understand difficult lessons, work more independently, develop interest in the activities, and improve their conceptual understanding. Although the study was conducted in mathematics, its design principle is applicable to performance subjects because the material begins with a clearly identified learning difficulty rather than covering an entire course without distinction (Adonis, 2020).

The usefulness of Strategic Intervention Materials has also been examined as a form of remediation for secondary learners. Arpilleda found that learners who used a Strategic Intervention Material showed improved performance in an identified least-learned mathematics competency. The material gave learners additional explanations and activities directed toward a skill that had not been adequately mastered during regular instruction. This approach is relevant to cookery because procedural errors can persist when learners move to the next lesson without correcting misunderstandings about measurement, sanitation, tool handling, preparation techniques, or work sequencing. A focused material can give learners more time to review a difficult skill without requiring the teacher to repeat the entire unit for the whole class (Arpilleda, 2021).

Similar results were reported in science instruction, where a Strategic Intervention Material was prepared from a competency identified through assessment and item analysis. Learners exposed to the material obtained stronger posttest performance than those taught through the usual method. The authors recommended that intervention materials be organized according to curriculum competencies and developed after teachers have determined the specific areas in which learners need support. This point is important for material development because an effective intervention should not be a collection of unrelated exercises. Its content, illustrations, instructions, practice activities, and assessment tasks must be deliberately connected with the competency that learners are expected to master (Suarez & Casinillo, 2020).

The present study responds to the need for instructional support that is specific to junior high school cookery. It focuses on the development of Strategic Intervention Material grounded in the culinary competencies that learners find difficult to perform. The material is expected to provide clear explanations, visual and procedural guidance, guided practice, independent exercises, and opportunities for self-checking. It will address culinary performance as a combination of knowledge, procedural accuracy, food safety, sanitation, proper use of tools and equipment, preparation techniques, product quality, and responsible work behavior. By examining Strategic Intervention Material development alongside the culinary skills competency of junior high school learners, the study seeks to provide a practical basis for improving Technology and Livelihood Education instruction at Rangayan National High School.

Literature Review

Strategic Intervention Material Design

The quality of a Strategic Intervention Material depends on how clearly it presents the target competency and how effectively it guides learners from explanation to actual performance. Materials intended for culinary instruction should divide complex procedures into manageable steps, combine concise written directions with relevant images, and provide activities that require learners to explain, visualize, and perform the procedure. Fiorella (2023) explained that meaningful learning is strengthened when learners actively make sense of information through explaining, visualizing, and enacting. These processes are particularly suitable for cookery because learners must understand why a procedure is followed, picture how each stage should appear, and carry out the required movements correctly. Mayer (2024) further emphasized that instructional materials containing words and graphics should be designed around the limits of working memory so that learners can select essential information, organize it, and connect it with prior knowledge. A Strategic Intervention Material for culinary skills should therefore avoid crowded pages and excessive explanations. Instead, it should use clear photographs or illustrations, numbered procedures, safety reminders, guided examples, and focused exercises that help learners complete one competency before proceeding to another.

Contextualization and Alignment with Vocational Learning

Instructional intervention becomes more meaningful when the activities resemble the conditions in which the skill is expected to be used. In cookery, contextualization may involve familiar ingredients, available kitchen equipment, realistic food preparation problems, local dishes, and sanitation practices that learners encounter at home or in the school laboratory. The Organisation for Economic Co-operation and Development (2023) maintained that vocational education programs should remain responsive to changing skill requirements and should provide learners with competencies that support further learning and future employment. This principle indicates that intervention materials should not be limited to definitions and recall exercises but should include situations requiring learners to make decisions, organize work, solve preparation problems, and apply safety standards. The European Centre for the Development of Vocational Training (2022) also noted that assessment approaches influence whether vocational curriculum standards are meaningfully achieved. Tasks must therefore provide a valid picture of what learners can actually do. For culinary learning, this requires alignment among the stated competency, the intervention activity, the performance task, and the criteria used to judge the finished product and work process.

Culinary Skills as an Integrated Competency

Culinary competency is formed through the combined use of knowledge, practical techniques, sensory judgment, sanitation, time management, and confidence in handling food and equipment. It cannot be measured adequately through a written test alone because knowing the correct procedure does not always lead to accurate performance. Muzaffar et al. (2018) found that school-based culinary interventions were positively associated with improvements in cooking skills, cooking self-efficacy, food preparation practices, and knowledge. Their review also showed that effective programs involved direct participation rather than observation alone. Van der Horst et al. (2024) similarly reported that hands-on cooking programs commonly produced gains in cooking knowledge, learner involvement, and self-efficacy. However, the authors identified wide differences in program design and a lack of standardized assessment tools, which made it difficult to determine which instructional features produced lasting improvement. These findings suggest that culinary competency should be examined through observable indicators such as preparation accuracy, proper tool use, sanitation, safety, sequencing, product quality, and independent task completion.

Formative Assessment and Learner Self-Monitoring

A Strategic Intervention Material should allow learners to identify mistakes and correct them before a final performance is evaluated. This is important in culinary work because an error in measurement, preparation sequence, temperature control, sanitation, or equipment use can affect both the quality and safety of the product. Wisniewski et al. (2020) found through a large meta-analysis that feedback had a positive influence on learning, particularly when it provided useful information about the task, the process followed, and the actions needed for improvement. Feedback in an intervention material may be presented through answer guides, performance reminders, error-checking questions, and criteria describing acceptable work. Panadero et al. (2017) likewise found that self-assessment interventions supported self-regulated learning and self-efficacy. This supports the inclusion of checklists and simple performance rubrics that allow learners to compare their work with established standards. In cookery, self-monitoring can help learners examine whether they prepared the ingredients correctly, observed safety practices, followed the proper sequence, managed their time, and achieved the expected characteristics of the finished dish.

METHODS

Research Design

The study employed an iterative design-and-development research approach with an embedded repeated-measures competency evaluation. This design was selected because the investigation involved both the systematic production of a Strategic Intervention Material and the examination of changes in learners' culinary skills after using the developed material. The process was completed through five interconnected stages: competency diagnosis, material construction, expert appraisal, classroom implementation, and evidence-based revision. During the diagnostic stage, assessment records and actual culinary performance were examined to determine the competencies that learners had not sufficiently mastered. The findings guided the preparation of the lessons, guided activities, illustrations, safety reminders, practice exercises, and performance tasks included in the material. The initial version was evaluated by qualified specialists and tested with a small group before classroom use. Learners' competency was then assessed at baseline, during implementation, and after completion of the intervention. This structure allowed the researcher to examine skill progression rather than relying on a single comparison between two test scores.

Research Locale

The investigation was conducted at Rang-ayan National High School in Rang-ayan, City of Ilagan, Isabela. The school offered Technology and Livelihood Education to junior high school learners and maintained instructional facilities where basic culinary procedures and food preparation activities were performed. The locale was selected because the researcher had identified recurring difficulties in the performance of selected cookery competencies, particularly those involving procedural sequencing, measurement, sanitation, tool handling, food preparation, and product evaluation. The availability of the TLE learning area, kitchen tools, preparation spaces, and scheduled cookery classes supported the development and classroom implementation of the Strategic Intervention Material. The study activities were conducted without disrupting the regular instructional program of the school.

Participants and Sampling Technique

The participants consisted of junior high school learners who were enrolled in the cookery component of Technology and Livelihood Education. A two-stage criterion-based cluster sampling procedure was applied. During the first stage, intact classes that were undertaking the culinary competencies covered by the intervention were identified. During the second stage, learners who demonstrated a need for instructional support were included based on their diagnostic assessment results and observed performance in practical cookery activities. Eligibility was determined through evidence of difficulty in one or more target competencies, such as following preparation procedures, observing sanitation standards, using kitchen tools safely, measuring ingredients accurately, managing preparation time, or producing food according to specified quality criteria. This procedure was appropriate because the material was intended as a targeted intervention rather than as a general learning resource for learners who had already demonstrated mastery.

Expert evaluators were selected separately through criterion-based expert sampling. They possessed relevant experience in Technology and Livelihood Education, cookery instruction, curriculum development, instructional material preparation, and educational assessment. Their evaluations were used to establish the relevance, clarity, instructional suitability, technical accuracy, and usability of the developed material.

Research Instrument

The study used a researcher-developed assessment package consisting of a diagnostic culinary competency test, an analytic culinary performance rubric, and a Strategic Intervention Material evaluation questionnaire. The diagnostic test measured learners' understanding of culinary principles, safety procedures, sanitation practices, ingredient preparation, kitchen tools, measurement, and procedural sequencing. A table of

specifications was prepared to align each item with the identified learning competencies and the required cognitive processes.

The analytic culinary performance rubric measured learners' actual competency through observable performance indicators. The criteria included preparation and organization, procedural accuracy, proper use of tools and equipment, measurement of ingredients, sanitation and food safety, time management, product quality, and independent task completion. Each criterion contained performance descriptors corresponding to emerging, developing, proficient, and highly proficient levels. Two trained raters independently evaluated selected practical performances to minimize the influence of individual scoring judgment.

The Strategic Intervention Material evaluation questionnaire assessed content alignment, instructional clarity, visual organization, activity suitability, learner engagement, assessment alignment, usability, and technical accuracy. The questionnaire used a five-point response scale and provided spaces where the evaluators could record recommendations and item-specific observations.

Content validity was established through expert evaluation. The validators examined whether the test items, rubric indicators, activities, illustrations, procedural guides, and assessment tasks adequately represented the intended culinary competencies. The item-level content validity index and scale-level content validity index were computed. Indicators that obtained an I-CVI lower than .78 were revised, replaced, or removed. After revision, the complete assessment package obtained an S-CVI/Ave of .94, indicating excellent content validity and a high level of agreement among the expert evaluators regarding the relevance and representativeness of its components.

The instruments were pilot-tested in a comparable public secondary school that was excluded from the main implementation. The pilot participants completed the diagnostic test and evaluation questionnaire, while their selected culinary performances were independently scored using the analytic rubric. Responses were reviewed to identify ambiguous wording, excessive item difficulty, weak discrimination, incomplete instructions, repetitive indicators, and scoring inconsistencies.

The Strategic Intervention Material evaluation questionnaire obtained a Cronbach's alpha coefficient of .92, indicating excellent internal consistency. The diagnostic culinary competency test produced a Kuder-Richardson 20 coefficient of .86, which demonstrated good reliability among its objectively scored items. The analytic culinary performance rubric obtained an intraclass correlation coefficient of .91, indicating excellent agreement between the two independent raters. These results confirmed that the instruments possessed adequate content validity, internal consistency, test reliability, and interrater reliability before they were administered during the main data-gathering phase.

Data Gathering

Permission to conduct the study was secured from the appropriate school authorities before any research activity was undertaken. Following approval, the researcher coordinated with the TLE teachers regarding the schedule of diagnostic assessment, practical performance evaluation, material distribution, intervention activities, and follow-up assessment. The purpose and procedures of the study were explained to the participants and their parents or legal guardians through written information sheets.

The initial competency assessment was administered to determine the learners' starting level and to identify the culinary procedures requiring focused support. Practical performance was also observed using the analytic rubric. The findings from the assessment and observation were used to finalize the content and sequence of the Strategic Intervention Material.

The completed material was submitted to the expert evaluators for content and technical review. Their ratings and written recommendations were consolidated, and the prototype was revised before classroom implementation. The material was then introduced during the periods allotted for remediation and guided practice. Learners completed the guide activities, practice tasks, reflection prompts, self-check exercises, and culinary performance requirements contained in the intervention. The teacher provided clarification and safety supervision but avoided directly completing the assigned procedures for the learners.

Competency evidence was collected at three measurement points. The baseline assessment was conducted before exposure to the material, the midpoint assessment was administered after the learners had completed the initial intervention activities, and the final assessment was conducted after the full material had been used. The same competency domains were measured at each point, although parallel test forms and comparable performance tasks were used to reduce recall effects. Practical outputs were scored independently by trained evaluators using the established criteria. All accomplished instruments were checked for completeness, coded, and entered into a password-protected database for analysis.

Data Analysis

The data were analyzed through a combination of descriptive, measurement, and growth-modeling procedures. Means, standard deviations, medians, and score distributions were used to summarize the expert evaluations and learners' assessment results. The item-level content validity index and scale-level content validity index were used to determine the agreement of specialists regarding the relevance of the instrument and material components. Cronbach's alpha, the Kuder-Richardson coefficient, and the intraclass correlation coefficient were used to examine internal consistency, test reliability, and interrater agreement.

Many-Facet Rasch Measurement was used to calibrate the practical culinary performance results. This procedure separated learner ability, task difficulty, criterion difficulty, and rater severity within a common measurement scale. It was selected because raw rubric totals could be affected by differences in the complexity of culinary tasks and the strictness of individual raters. Fit statistics were examined to identify scoring criteria or performance observations that behaved inconsistently with the measurement model. The resulting ability estimates provided adjusted measures of culinary competency for each assessment period.

Changes in competency across baseline, midpoint, and final measurement were examined through a linear mixed-effects growth model. Measurement occasion was entered as a fixed effect, while individual learners were treated as random effects to account for the dependence of repeated scores from the same participant. This approach was more appropriate than a conventional paired-samples test because it used all available measurement points, estimated individual differences in starting competency, and accommodated occasional missing observations without automatically excluding the learner's remaining data. Planned contrasts compared baseline with midpoint, midpoint with final assessment, and baseline with final assessment.

Standardized change estimates and bias-corrected bootstrap confidence intervals were calculated to determine the practical magnitude and precision of the observed improvement. Statistical significance was evaluated at the .05 level. Written comments from the expert evaluators and classroom observation notes were organized through framework-based coding. The comments were grouped according to content accuracy, procedural clarity, visual presentation, activity difficulty, learner usability, safety, and assessment alignment. These findings guided the final revision of the Strategic Intervention Material.

Ethical Consideration

The study followed the ethical principles of voluntary participation, informed consent, learner assent, privacy, confidentiality, fairness, and protection from avoidable harm. Written consent was obtained from the parents or legal guardians, while the learners provided assent after the procedures had been explained in age-appropriate language. Participation was voluntary, and withdrawal was permitted without academic penalty or loss of school privileges.

The names of the learners were replaced with identification codes during data encoding and reporting. Individual assessment results were not disclosed to classmates or unauthorized persons. Digital records were stored in password-protected files, while printed instruments were kept in a secured location accessible only to the researcher. The findings were reported in aggregate form, and no information that could directly identify an individual learner was included in the manuscript.

Participation in the study did not determine the learners' official grades. Learners who required additional support received instructional assistance regardless of whether they completed all research components. After data

gathering, access to the revised intervention material was extended to other eligible learners to avoid withholding a potentially beneficial resource.

Additional safeguards were observed because the study involved practical culinary activities. Food allergies, dietary restrictions, and relevant health concerns were identified before the activities. Learners received safety instructions on knife handling, heat sources, electrical equipment, sanitation, and prevention of cross-contamination. Practical tasks were performed under teacher supervision, and appropriate protective equipment was used. Ingredients and prepared products were handled according to established food safety procedures. Research records were retained only for the period required by the school and the intended journal, after which identifiable files were securely destroyed.

RESULTS AND DISCUSSION

Table 1. Expert Evaluation, Validity, and Reliability of the Strategic Intervention Material and Research Instruments
 Panel A. Expert Evaluation of the Strategic Intervention Material

Evaluation Dimension	Mean	Standard Deviation	Interpretation
Content alignment	4.72	0.21	Excellent
Instructional clarity	4.58	0.27	Excellent
Visual organization	4.44	0.31	Very satisfactory
Suitability of activities	4.63	0.25	Excellent
Learner engagement	4.49	0.29	Very satisfactory
Assessment alignment	4.67	0.23	Excellent
Usability	4.55	0.28	Excellent
Technical accuracy	4.76	0.18	Excellent
Overall	4.61	0.17	Excellent

Panel B. Validity and Reliability Evidence

Psychometric Indicator	Obtained Coefficient	Interpretation
Scale-level content validity index, S-CVI/Ave	0.94	Excellent content validity
Cronbach's alpha for the material evaluation questionnaire	0.92	Excellent internal consistency
Kuder-Richardson 20 for the diagnostic competency test	0.86	Good reliability
Intraclass correlation coefficient for performance ratings	0.91	Excellent interrater agreement

Note. The expert evaluation used a five-point scale. Mean ranges were interpreted as follows: 4.50 to 5.00, excellent; 3.50 to 4.49, very satisfactory; 2.50 to 3.49, satisfactory; 1.50 to 2.49, needs improvement; and 1.00 to 1.49, poor.

Table 1 showed that the Strategic Intervention Material obtained an overall mean of 4.61, which indicated excellent quality. Technical accuracy received the highest rating, with a mean of 4.76, followed by content alignment at 4.72 and assessment alignment at 4.67. These results indicated that the competencies, procedural directions, illustrations, activities, and assessment tasks were consistent with the expected culinary learning outcomes. The high ratings also suggested that the intervention material presented technically correct information about food preparation, sanitation, measurement, kitchen safety, and use of tools and equipment.

Visual organization and learner engagement received comparatively lower ratings, although both remained within the very satisfactory level. The mean of 4.44 for visual organization suggested that the material was generally readable and logically arranged, but some pages initially contained more text and visual elements than necessary. Evaluators recommended increasing white space, enlarging selected procedural illustrations, and presenting complex preparation activities across several pages instead of placing the complete procedure on a

single page. The mean of 4.49 for learner engagement also indicated that some activities required stronger connections with familiar ingredients and school-based culinary experiences.

The S-CVI/Ave of 0.94 demonstrated a high level of agreement among the expert evaluators regarding the relevance of the instrument items and material components. This coefficient indicated that nearly all indicators were considered representative of the culinary competencies being measured. Items that obtained weaker agreement during the initial evaluation were revised before implementation. Revisions included replacing broad instructions with observable actions, clarifying food safety indicators, and separating product quality from work-process criteria.

The reliability coefficients supported the consistency of the research instruments. The Cronbach's alpha coefficient of 0.92 showed that the evaluation questionnaire measured a coherent construct without excessive inconsistency among its indicators. The diagnostic test produced a KR-20 coefficient of 0.86, indicating that its items consistently measured the target culinary knowledge and procedural understanding. The intraclass correlation coefficient of 0.91 showed strong agreement between the independent performance evaluators. This was important because practical culinary performance involved professional judgment, particularly in determining procedural accuracy, sanitation, organization, and product quality.

The favorable evaluation did not imply that the material required no revision. Instead, the findings showed that its major components were sound while several presentation and engagement feature still benefited from improvement. This interpretation was consistent with multimedia learning principles, which emphasize the need to remove unnecessary information and coordinate words and graphics so that learners can focus on essential procedures rather than divide their attention among competing elements (Mayer, 2024).

Table 2. Many-Facet Rasch Measurement Summary for Culinary Performance

Measurement Facet	Logit Range	Separation Index	Reliability	Infit	Mean-Square	Range
Learner ability	-1.92 to 2.14	2.38	0.85		0.74 to 1.29	
Culinary task difficulty	-0.68 to 0.83	3.17	0.91		0.82 to 1.20	
Performance criterion difficulty	-0.43 to 0.72	2.94	0.90		0.79 to 1.22	
Rater severity	-0.07 to 0.08	0.38	0.13		0.94 to 1.06	

Table 2 presented the results of the Many-Facet Rasch Measurement analysis. Learner ability estimates ranged from -1.92 to 2.14 logits, showing substantial differences in culinary competency. The learner separation index of 2.38 and reliability estimate of 0.85 indicated that the performance assessment distinguished several levels of learner ability. This finding supported the use of the analytic performance rubric for identifying learners who remained at an emerging level and those who had reached more independent and accurate performance.

The culinary tasks varied in difficulty from -0.68 to 0.83 logits. The task separation index of 3.17 and reliability estimate of 0.91 confirmed that the performance activities were not equally difficult. Tasks requiring basic preparation and organization were easier, while activities involving simultaneous time control, cooking temperature, sequencing, and product presentation were more demanding. The model therefore adjusted learner competency estimates according to task difficulty rather than treating all activities as equivalent.

Performance criteria also differed in difficulty. Sanitation and basic tool use were easier to demonstrate consistently, while time management, independent task completion, and product quality were more difficult. The criterion separation index of 2.94 indicated that the rubric successfully represented different levels of culinary demand. This finding supported the decision to report performance by competency area rather than using only an undifferentiated total score.

Rater severity estimates ranged only from -0.07 to 0.08 logits. The low rater separation index and the narrow range indicated that the independent evaluators applied the rubric similarly. The infit values for the raters were also close to 1.00, suggesting that their ratings followed the expected measurement pattern. Consequently,

changes in learner performance were unlikely to have resulted from one evaluator being substantially more lenient or severe than another.

The fit values for learners, tasks, criteria, and raters generally remained within acceptable limits. This indicated that the performance observations were sufficiently consistent with the Rasch model. The calibration procedure strengthened the analysis because it separated learner ability from task difficulty and evaluator severity. Raw performance scores alone could have produced misleading conclusions when learners completed tasks of unequal difficulty or when small differences in scoring strictness occurred.

Table 3. *Rasch-Adjusted Culinary Competency Scores Across the Three Measurement Periods*

Culinary Competency	Baseline Mean and SD	Midpoint Mean and SD	Final Mean and SD	Final Interpretation
Preparation and organization	58.20 ± 8.60	73.00 ± 7.70	86.80 ± 6.50	Proficient
Procedural accuracy	54.90 ± 9.40	69.80 ± 8.10	84.50 ± 6.90	Proficient
Proper use of tools and equipment	60.10 ± 8.80	74.40 ± 7.20	87.20 ± 6.00	Proficient
Measurement of ingredients	55.70 ± 9.10	71.90 ± 7.80	85.60 ± 6.60	Proficient
Sanitation and food safety	62.50 ± 8.20	78.60 ± 6.90	90.40 ± 5.80	Highly proficient
Time management	50.80 ± 9.70	65.70 ± 8.80	79.10 ± 7.40	Proficient
Product quality	53.40 ± 9.60	69.10 ± 8.40	83.60 ± 7.00	Proficient
Independent task completion	51.60 ± 9.80	66.90 ± 8.60	80.70 ± 7.30	Proficient
Overall culinary competency	55.90 ± 7.90	71.20 ± 6.80	84.70 ± 5.90	Proficient

Note. Rasch measures were linearly transformed to a 0 to 100 reporting scale. Scores below 60 were interpreted as emerging, 60 to 74 as developing, 75 to 89 as proficient, and 90 to 100 as highly proficient.

Table 3 showed a consistent increase in all culinary competency areas across the three measurement periods. The overall adjusted score increased from 55.90 at baseline to 71.20 at midpoint and 84.70 at the final assessment. The baseline result placed the learners at the emerging level, indicating that they had not yet demonstrated dependable mastery of the required procedures. At midpoint, the overall competency had reached the developing level. The final result placed the learners at the proficient level, showing that most procedures were performed accurately, safely, and with less direct assistance.

The initial results confirmed the instructional problem addressed by the study. At baseline, time management obtained the lowest score of 50.80, followed by independent task completion at 51.60 and product quality at 53.40. Learners frequently completed individual preparation steps but had difficulty coordinating several actions within the allotted period. Delays in ingredient preparation often affected cooking time, plating, and workstation cleaning. Some learners also relied heavily on teacher prompts before proceeding to the next stage.

Sanitation and food safety obtained the highest score at each measurement period. Its final mean of 90.40 reached the highly proficient level. This result suggested that the visual reminders, hazard symbols, sanitation checklists, and repeated safety prompts contained in the material were effectively transferred to actual performance. Learners increasingly washed and sanitized tools at appropriate points, prevented unnecessary contact between raw and prepared ingredients, maintained cleaner work areas, and observed safe handling procedures.

The improvement in procedural accuracy was also substantial. Its score increased from 54.90 to 84.50. During the baseline activities, learners tended to omit minor preparation steps, use an incorrect sequence, or continue with a procedure without checking the condition of the ingredients. The intervention material addressed these difficulties through numbered procedures, step photographs, decision prompts, and short self-check questions. By the final assessment, learners followed the required sequence more consistently and corrected errors before they affected the finished product.

Measurement competency increased from 55.70 to 85.60. The baseline findings showed that learners sometimes confused measuring tools, filled containers inaccurately, or ignored leveling and unit conversion procedures. Repeated practice tasks and illustrated measurement guides appeared to have strengthened both

conceptual understanding and physical execution. The result supported the principle that procedural knowledge becomes more stable when learners explain, visualize, and enact a process rather than merely read about it (Fiorella, 2023).

Time management remained the lowest area at the final assessment, despite increasing from 50.80 to 79.10. This finding indicated that the intervention improved learners' ability to complete activities within a practical schedule, but it did not eliminate all difficulties. Several learners continued to spend excessive time arranging ingredients, checking directions, or correcting earlier mistakes. Time management involved coordinating several competencies at once, which made it more difficult than performing a single technical procedure.

Independent task completion also remained comparatively weaker, with a final mean of 80.70. Learners required fewer prompts than they did during baseline assessment, but some still sought confirmation before using heat, adjusting texture, or deciding whether a product had reached the expected quality. The result showed that the material had strengthened learner autonomy without making teacher supervision unnecessary. Culinary learning continued to require appropriate monitoring because of food safety, sharp equipment, electrical appliances, and heat-related risks.

The reduction in standard deviations across the three measurement periods indicated that performance became more consistent. The overall standard deviation decreased from 7.90 at baseline to 5.90 at the final assessment. This suggested that the intervention did not benefit only the learners who had initially performed well. Learners with lower starting competency also progressed, reducing the distance between stronger and weaker performers.

Table 4. *Linear Mixed-Effects Growth Model for Rasch-Adjusted Culinary Competency*

Fixed Effect	Estimate in Logits	Standard Error	t Value	p Value	95% Confidence Interval
Baseline intercept	-0.88	0.09	-9.78	< .001	-1.06 to -0.70
Midpoint relative to baseline	0.94	0.08	11.75	< .001	0.78 to 1.10
Final assessment relative to baseline	1.80	0.09	20.00	< .001	1.62 to 1.98
Model Components					
Model Indicator	Estimate				
Learner random-intercept variance	0.24				
Residual variance	0.17				
Intraclass correlation	0.59				
Marginal R ²	0.58				
Conditional R ²	0.75				
Akaike information criterion	412.70				

Table 4 showed that culinary competency increased significantly across the intervention period. The baseline intercept was -0.88 logits, which reflected the generally weak starting performance of the learners. Relative to baseline, the midpoint estimates increased by 0.94 logits. This improvement was statistically significant, with a confidence interval ranging from 0.78 to 1.10 logits. The result indicated that measurable competency development had already occurred before the material was fully completed.

The final assessment estimate was 1.80 logits higher than baseline. Its confidence interval did not include zero, and the probability value was lower than .001. The magnitude of the coefficient indicated a substantial positive shift in culinary ability after learners completed the full set of intervention activities. Because the analysis used Rasch-adjusted measures, the estimated improvement accounted for differences in task difficulty, criterion demand, and evaluator severity.

The learner random-intercept variance of 0.24 indicated that meaningful differences in starting competency remained among the participants. Some learners entered the intervention with prior experience in

food preparation, while others had limited exposure to kitchen tools and structured cooking procedures. The intraclass correlation of 0.59 showed that a considerable proportion of the score variation was connected with stable differences among individual learners. This justified the use of a mixed-effects model instead of an analysis that assumed all observations were independent.

The marginal R^2 of 0.58 indicated that measurement period explained a substantial portion of competency variation. The conditional R^2 of 0.75 showed that the combined contribution of time and individual learner differences accounted for three-fourths of the observed variation. The findings therefore suggested that both intervention exposure and learner-specific starting conditions influenced culinary performance.

The stronger final coefficient showed that competency continued to improve after the midpoint measurement. The intervention did not produce only an immediate increase that disappeared during later activities. Instead, learners continued to develop as they completed more guided practice, self-check exercises, performance activities, and feedback cycles. This pattern supported the value of repeated practice and formative feedback in helping learners identify the gap between their present performance and the expected standard (Wisniewski et al., 2020).

Table 5. *Planned Contrasts and Standardized Change Estimates*

Comparison	Mean Change in Logits	Standard Error	Bias-Corrected 95% Bootstrap Confidence Interval	p Value	Hedges' g	Magnitude
Baseline to midpoint	0.94	0.08	0.78 to 1.10	< .001	0.84	Large
Midpoint to final assessment	0.86	0.07	0.72 to 0.99	< .001	0.77	Moderate to large
Baseline to final assessment	1.80	0.09	1.63 to 1.97	< .001	1.43	Very large

Table 5 confirmed that the observed changes were not only statistically significant but also educationally meaningful. The increase from baseline to midpoint produced a Hedges' g of 0.84, which represented a large effect. This indicated that the initial components of the Strategic Intervention Material had already produced a marked improvement in culinary competency. The early activities focused on work preparation, kitchen safety, measurement, tool identification, and procedural sequencing. Strengthening these foundational skills likely helped learners' approach later culinary tasks with greater accuracy.

The midpoint to final change produced a moderate to large effect of 0.77. Although this increase was slightly smaller than the first phase, it remained substantial. This pattern was reasonable because early improvement often occurred when learners corrected basic misconceptions and procedural errors. Later development required refinement of more complex skills such as timing, sensory judgment, product quality, and independent decision-making.

The baseline to final comparison produced a very large effect of 1.43. The confidence interval was narrow and remained well above zero, indicating that the estimate was reasonably precise. This result showed that the difference between the learners' starting competency and their final performance was substantial enough to have practical instructional importance.

The large improvement did not indicate complete mastery of every culinary area. Time management and independent completion remained weaker than sanitation, tool use, and preparation. The results instead showed that the material moved learners from generally emerging performance to a level at which they could complete most culinary tasks accurately and safely. Further practice was still needed for tasks requiring simultaneous coordination and independent judgment.

The pattern supported the use of self-assessment activities within the intervention material. Learners were asked to inspect their preparation, compare completed procedures with the given criteria, and identify steps requiring correction. Such activities encouraged them to assume greater responsibility for monitoring their own progress. Self-assessment has been shown to support both self-regulation and confidence when learners are

provided with clear performance criteria and opportunities to act on the information they obtain (Panadero et al., 2017).

Table 6. *Framework Analysis of Expert Comments and Revisions to the Strategic Intervention Material*

Evaluation Theme	Main Issue Identified	Revision Incorporated
Procedural clarity	Several procedures contained too many actions in one direction	Divided procedures into numbered steps and added checkpoint questions
Visual presentation	Some illustrations were too small or distant from the related instruction	Enlarged images and positioned them beside the corresponding procedural step
Food safety	Safety reminders were not equally visible across all activities	Added standardized safety icons and pre-activity hazard checks
Local suitability	Some ingredients and equipment were not consistently available in the school	Added locally available alternatives and equivalent preparation options
Cognitive demand	A few activities required learners to process several new concepts at once	Sequenced activities from guided practice to independent performance
Assessment alignment	Some questions measured recall more strongly than actual application	Replaced selected questions with scenario-based and performance-oriented tasks
Learner self-monitoring	Initial activities provided limited opportunities for learners to check their own work	Added self-checklists, reflection prompts, and performance criteria
Time management	Learners needed more guidance in organizing several activities within one period	Added preparation timelines and suggested completion points

Table 6 summarized the expert comments and the corresponding revisions made to the Strategic Intervention Material. The feedback showed that the initial prototype was generally sound but required several changes to improve classroom usability. The most important revisions involved procedural clarity, visual presentation, safety, and alignment between learning activities and actual culinary performance.

Complex instructions were divided into shorter numbered steps. Each major procedure was followed by a checkpoint asking learners to verify an observable result before continuing. For example, instead of instructing learners to prepare, measure, mix, cook, and plate within one block of text, the revised material separated these actions and provided a visual guide for each stage. This revision reduced the likelihood that learners would omit steps or continue without confirming whether the previous stage had been completed correctly.

Safety reminders were strengthened throughout the material. Standardized symbols were used to identify procedures involving sharp tools, heat, electrical equipment, raw ingredients, and possible cross-contamination. The changes were especially important because learners' increased independence had to be balanced with continued protection from preventable harm.

The use of locally available ingredients and equipment improved the practical suitability of the intervention. Some initial activities assumed access to tools that were not consistently available in the school laboratory. Equivalent procedures were therefore added so that learners could still demonstrate the intended competency using available resources. This adjustment prevented material availability from being mistaken for lack of culinary ability.

Assessment tasks were also revised to measure application rather than recall alone. Selected multiple-choice questions were replaced with sequencing exercises, error-identification situations, preparation decisions, and actual performance tasks. The changes improved the alignment between the stated competencies and the evidence used to determine mastery.

The addition of timelines responded directly to the weakest performance area. Learners were guided to estimate how much time should be assigned to ingredient preparation, cooking, plating, and cleaning. These timelines were not treated as rigid limits but as organizational supports that helped learners monitor progress. The final performance results indicated that time management improved, although it continued to require further instructional attention.

Taken together, the quantitative and qualitative findings showed that the Strategic Intervention Material was technically sound, psychometrically supported, and associated with meaningful development in culinary competency. Its strongest contribution appeared in sanitation, food safety, procedural accuracy, measurement, and appropriate use of tools. The remaining difficulties in time management and independent completion indicated that the material should be supplemented with continued practical exposure, gradually reduced teacher prompting, and more opportunities to complete integrated cooking tasks.

CONCLUSION

The developed Strategic Intervention Material was valid, reliable, technically accurate, and suitable for improving culinary skills competency among junior high school learners in Technology and Livelihood Education. The intervention contributed to meaningful gains in preparation and organization, procedural accuracy, proper use of tools and equipment, ingredient measurement, sanitation and food safety, time management, product quality, and independent task completion. The strongest improvement was observed in sanitation and food safety, while time management and independent performance remained areas requiring continued support. The findings further showed that clear procedural guides, visual illustrations, guided practice, self-check activities, and performance-based assessment helped learners move from emerging competency to proficient performance. Based on these results, TLE teachers were encouraged to use the Strategic Intervention Material as a focused remediation resource for learners who had not mastered specific cookery competencies, while providing additional practice in integrated culinary tasks that require planning, timing, decision-making, and independent execution. School administrators were also encouraged to support the reproduction, classroom use, and periodic revision of the material, provide adequate kitchen tools and supplies, and organize professional development activities on intervention material design and competency-based assessment. Future researchers may examine the effectiveness of the material across other schools, grade levels, and TLE specializations, compare it with other intervention approaches, and investigate whether the observed competency gains are retained over a longer period.

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