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# INSTRUCTIONAL FEEDBACK, SUSTAINABILITY-ORIENTED PRACTICES, SELF-EFFICACY, AND CULINARY PERFORMANCE: A CANONICAL CORRELATION ANALYSIS

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## ABSTRACT

Culinary education requires learners to integrate technical knowledge, psychomotor competence, responsible resource use, and confidence in practical tasks. However, limited research has examined the relationships among Quality of Teacher Feedback, Sustainability-Oriented Practices, Culinary Self-Efficacy, and the performance of first-year Bachelor of Technology and Livelihood Education (BTLED) students in community colleges. This study examined the relationships among these variables, particularly the association between Sustainability-Oriented Practices and Culinary Performance. A descriptive-correlational research design was employed. The research was conducted during May–June 2026, corresponding to the summer term of Academic Year 2025–2026. The participants were 139 first-year BTLED students enrolled in Principles of Food Preparation at a college in Misamis Oriental, selected through stratified random sampling from ten class sections. Researcher-developed questionnaires measured teacher feedback, sustainability-oriented practices, and culinary self-efficacy, while instructors assessed performance in Cooking Methods, Food Quality, and Knife Skills. Data were analyzed using descriptive statistics and canonical correlation analysis. Results revealed high levels of Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy, while Culinary Performance was generally proficient. Canonical correlation analysis revealed a weak but significant relationship between Sustainability-Oriented Practices and Culinary Performance. Cooking Methods and Knife Skills were more closely associated with this relationship than Food Quality. Furthermore, the findings highlighted the relevance of sustainability-oriented practices in understanding students' demonstrated culinary competence. These suggest that integrating sustainable practices into culinary instruction may support the development of practical competencies and responsible resource management. The study recommends

strengthening sustainability-focused culinary activities and exploring related factors that contribute to students' practical performance through further research.

**Keywords:** *Culinary Performance, Culinary Self-Efficacy, Quality of Teacher Feedback, Sustainability-Oriented Practices, BTLED*

## INTRODUCTION

Technology and Livelihood Education (TLE) develop practical, technical, and livelihood competencies that learners can apply in daily life, employment, and entrepreneurship. At the tertiary level, the Bachelor of Technology and Livelihood Education (BTLED) program prepares future teachers to combine pedagogical knowledge with technical competence. In culinary education, this preparation requires more than theoretical understanding because students must demonstrate psychomotor skills in actual laboratory situations, including the application of cooking methods, food preparation, knife handling, sanitation, and product evaluation.

Practical experience is central to culinary competence. Learners must coordinate timing, precision, sensory judgment, decision-making, and physical execution while preparing food. Teaching-kitchen experiences have been associated with improvements in cooking self-efficacy and food-related behaviors among college students (French et al., 2024). These experiences emphasize the importance of authentic laboratory activities in connecting culinary knowledge with actual performance.

Quality of Teacher Feedback is another instructional factor relevant to practical learning. Clear, timely, specific, and constructive feedback can help learners identify errors, understand performance expectations, and determine how to improve. Hattie and Timperley (2007) explained that effective feedback addresses where learners are going, how they are progressing, and what they should do next. However, feedback may not automatically result in improved performance; learners must interpret and use the information in subsequent practice (Carless & Winstone, 2023).

Culinary education must also develop environmentally responsible habits. Sustainability-Oriented Practices include minimizing food waste, using ingredients responsibly, conserving water and energy, segregating waste, recycling, and maintaining appropriate storage and sanitation. These behaviors are relevant to culinary work because food preparation involves the use of ingredients, water, energy, and other resources. Research on zero-food-waste competence among hospitality students highlights the importance of developing sustainability-related knowledge, skills, and behaviors as part of professional culinary preparation (Ko & Lu, 2023).

Culinary Self-Efficacy refers to learners' confidence in their ability to perform culinary tasks and respond to challenges during laboratory activities. Bandura's (1986) Social Cognitive Theory explains that personal beliefs, environmental conditions, and behavior interact in the learning process. In culinary settings, repeated practice, observation, and instructional guidance may contribute to students' confidence. Nevertheless, perceived capability and demonstrated competence are distinct: students

may feel confident but still encounter difficulties in executing particular technical procedures.

Although teacher feedback, sustainability practices, self-efficacy, and culinary performance are all relevant to skills-based education, they are often examined as separate concerns. There remains a need to understand how these constructs are associated with students' demonstrated culinary competencies, particularly among future TLE teachers. This study therefore examined the relationships among Quality of Teacher Feedback, Sustainability-Oriented Practices, Culinary Self-Efficacy, and Culinary Performance among first-year BTLED students enrolled in Principles of Food Preparation. Culinary Performance was assessed in terms of Cooking Methods, Food Quality, and Knife Skills, with particular attention to the canonical relationship between Sustainability-Oriented Practices and Culinary Performance.

## Research Questions

This study aimed to describe the participants' Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy; assess their Culinary Performance; and examine the canonical relationships between each of the three study constructs and the dimensions of Culinary Performance.

Specifically, it sought to answer the following:

1. What is the participants' assessment of the Quality of Teacher Feedback?
2. What is the extent of the participants' Sustainability-Oriented Practices?
3. What is the participants' self-report of their Culinary Self-Efficacy?
4. What is the level of Culinary Performance in terms of:
   4.1 Cooking Methods;
   4.2 Food Quality; and
   4.3 Knife Skills?
5. Are the participants' assessments of Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy significantly associated with their Culinary Performance?

### Hypotheses:

The following null hypotheses were formulated to examine the canonical relationships between each study construct and Culinary Performance. These hypotheses were tested at the 0.05 level of significance.

*$H_o$1: Quality of Teacher Feedback is not significantly related to Culinary Performance.*

*$H_o$2: Sustainability-Oriented Practices are not significantly related to Culinary Performance.*

*$H_o$3: Culinary Self-Efficacy is not significantly related to Culinary Performance.*

## METHODOLOGY

### Research Design

This study employed a descriptive-correlational research design to describe Quality of Teacher Feedback, Sustainability-Oriented Practices, Culinary Self-Efficacy, and Culinary Performance among first-year Bachelor of Technology and Livelihood Education (BTLED) students. The design was appropriate because the study examined naturally occurring characteristics and relationships without manipulating the study variables.

The descriptive component summarized the participants' assessments and performance ratings using appropriate descriptive statistics. The correlational component used canonical correlation analysis to examine the multivariate relationship between each of the three study constructs—Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy—and the three dimensions of Culinary Performance: Cooking Methods, Food Quality, and Knife Skills.

### Locale of the Study

The study was conducted at a community college in Misamis Oriental, Philippines, that offers the Bachelor of Technology and Livelihood Education (BTLED) program.

### Respondents and Sampling Method

The participants were 139 first-year Bachelor of Technology and Livelihood Education students enrolled in Principles of Food Preparation during the summer term of Academic Year 2025–2026. Stratified random sampling was used across ten class sections. Each section served as a stratum, and participants were proportionally selected through random sampling. Course instructors were not respondents; they served as evaluators of students' culinary practical performance. Data were collected using researcher-developed questionnaires and an instructor-rated Analytical Culinary Practical Performance Rubric.

The student questionnaire measured Quality of Teacher Feedback (10 items), Sustainability-Oriented Practices (10 items), and Culinary Self-Efficacy (10 items). Feedback items addressed the clarity, timeliness, relevance, and usefulness of instructional feedback. Sustainability items covered food-waste minimization, ingredient portioning, water and energy conservation, waste segregation, reuse or recycling, cleanliness, storage, and responsible resource use. Self-efficacy items measured confidence in cooking techniques, ingredient preparation, equipment use, knife skills, time management, problem-solving, food quality, and sanitation.

The analytical rubric assessed Culinary Performance in Cooking Methods, Food Quality, and Knife Skills using a five-point performance scale. The instruments underwent expert content validation. Confirmatory Factor Analysis was applied to examine the measurement structure of the researcher-developed questionnaire using data from the

study participants. No separate pilot test was conducted; therefore, no pilot-test Cronbach's alpha coefficients are reported.

Permission to conduct the study was secured from the appropriate college authorities, and coordination was undertaken with the instructors handling Principles of Food Preparation. The purpose, procedures, voluntary nature of participation, and right to withdraw without academic penalty were explained to the participants, and informed consent was obtained. During scheduled laboratory sessions, students completed the three questionnaire sections while course instructors independently assessed culinary performance using the analytical rubric. Responses were coded, names were not included in the research dataset, and records were handled confidentially in accordance with institutional research ethics requirements and the Data Privacy Act of 2012 (Republic Act No. 10173).

Frequency, percentage, mean, and standard deviation were used to describe participants' responses and culinary performance. Canonical correlation analysis examined the multivariate relationships between each of the following constructs—Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy—and the three dimensions of Culinary Performance. The canonical correlation coefficient (Rc), squared canonical correlation ($Rc^2$), cross-loadings, F-statistic, and p-value were used to assess the strength, shared variance, and statistical significance of each relationship. Statistical decisions were evaluated at the 0.05 level of significance.

**Research Instruments**

The research instrument was researcher-developed and was informed by the constructs and literature underlying the study. The Teacher Feedback items were aligned with the feedback dimensions discussed by Hattie and Timperley (2007), particularly the provision of clear, timely, constructive, and actionable information. The Sustainability-Oriented Practices items were informed by the study's sustainability framework, including Education for Sustainable Development (UNESCO, 2020) and responsible consumption and production principles under Sustainable Development Goal 12. The Culinary Self-Efficacy items were grounded in Bandura's (1997) concept of self-efficacy and its sources, particularly mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. The Analytical Culinary Practical Performance Rubric was researcher-developed and aligned with the culinary competencies and performance dimensions examined in this study.

The instrument consisted of three student-response sections and one instructor-rated performance rubric. Part I measured Quality of Teacher Feedback and Sustainability-Oriented Practices. Part II measured Culinary Self-Efficacy. Part III consisted of the Analytical Culinary Practical Performance Rubric used by course instructors to rate students' culinary practical performance.

The student questionnaire contained 10 items for Quality of Teacher Feedback and 10 items for Sustainability-Oriented Practices. The items assessed students' perceptions of feedback timeliness, clarity, relevance, helpfulness, and instructional

usefulness, as well as their reported application of sustainability-oriented practices during culinary laboratory activities.

The Culinary Self-Efficacy section contained 10 items measuring confidence in food preparation, cooking techniques, time management, equipment use, sanitation, problem-solving, and adaptation during laboratory activities. Responses were recorded using a five-point confidence scale.

The Analytical Culinary Practical Performance Rubric was used by course instructors to evaluate actual culinary performance. It covered Knife Skills and Technical Precision, Cooking Methods and Resource Management, and Food Quality, using a five-point performance scale from Outstanding (5) to Poor (1).

The use of an instructor-rated analytical rubric provides a more objective and authentic measure of culinary practical performance than self-assessment and reduces the possibility of response bias.

**Validity and Reliability**

The research instruments underwent content validation before the actual data collection. The researcher-developed questionnaire and Analytical Culinary Practical Performance Rubric were reviewed by the research adviser and a panel of experts to assess the clarity, relevance, appropriateness, and alignment of the items with the study variables and intended competencies. The recommendations of the validators were incorporated into the final instruments before administration.

No pilot testing was conducted in this study. The instruments were researcher-developed and were subjected to expert content validation and Confirmatory Factor Analysis (CFA) using the data obtained from the actual study participants. CFA was applied to examine whether the observed items adequately represented the intended latent constructs of Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy. Thus, the study did not use a separate pilot-test group for instrument reliability testing, and no Cronbach’s alpha coefficient from a pilot test was reported.

**Data Gathering Procedure**

The researcher followed a systematic process in collecting the data. A formal letter requesting permission to conduct the study was submitted to the Dean of the College and the BTLED Program Head. After approval was obtained, the researcher coordinated with the instructors handling Principles of Food Preparation to schedule the administration of the research instruments.

Before data collection, the researcher explained the objectives, significance, procedures, voluntary nature of participation, and the participants' right to withdraw without academic penalty. Written informed consent was obtained from the participants.

During the scheduled laboratory sessions, the participants completed the Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy instruments. At the same time, the course instructors evaluated the students' culinary practical performance using the Analytical Culinary Practical Performance Rubric. The instructors served only as evaluators and were not respondents.

After collection, the questionnaires and performance rating sheets were checked for completeness, coded, and entered into the statistical software for analysis. Names were not recorded in the research dataset; coded identifiers were used. The data were treated confidentially and used solely for research purposes. Electronic files were stored in password-protected files, while physical records were kept in a secure location. The procedures complied with the Data Privacy Act of 2012 (Republic Act No. 10173) and applicable institutional research ethics requirements.

Participation did not affect students' grades or standing in their classes. Performance ratings used for research purposes were treated separately from academic grading. Data were retained and disposed of according to institutional policy.

**Data Analysis**

The data were analyzed using frequency, percentage, mean, and standard deviation to describe the participants' assessments of Quality of Teacher Feedback, Sustainability-Oriented Practices, Culinary Self-Efficacy, and Culinary Performance. Canonical Correlation Analysis (CCA) was employed to examine the multivariate relationships between the three study variables and the dimensions of Culinary Performance, namely Cooking Methods, Food Quality, and Knife Skills. The canonical correlation coefficient (Rc), squared canonical correlation ($Rc^2$), cross-loadings, F-statistic, and p-value were used to determine the strength, shared variance, and significance of the relationships. All inferential analyses were evaluated at the 0.05 level of significance.

This study employed a descriptive-correlational research design to examine the relationships among Quality of Teacher Feedback, Sustainability-Oriented Practices, Culinary Self-Efficacy, and Culinary Performance. The participants were first-year Bachelor of Technology and Livelihood Education (BTLED) students enrolled in Principles of Food Preparation at a community college in Misamis Oriental during the summer term of Academic Year 2025–2026. The study examined the canonical relationships between each of the three study constructs and Culinary Performance, which was assessed in terms of Cooking Methods, Food Quality, and Knife Skills.

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each of the three study constructs and Culinary Performance, which was assessed in terms of Cooking Methods, Food Quality, and Knife Skills.

### Scope and Limitations

The study was delimited to first-year BTLED students enrolled in *Principles of Food Preparation* at the selected institution and did not include students from other year levels, degree programs, institutions, or geographical locations. It focused specifically on culinary and food preparation and excluded other BTLED technical areas, as well as other psychological and personal factors that may be associated with practical performance. Data on Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy relied on the participants' self-report responses; therefore, the findings may have been affected by differences in perception, recall, social desirability, or response tendencies, which may limit the objectivity and accuracy of the data. Culinary Performance, on the other hand, was based on instructor assessment using the performance rubric adopted for the study. Consequently, the findings are limited to the selected participants, course, timeframe, and locale and should not be generalized to other populations or educational settings without appropriate consideration of contextual differences.

## RESULTS AND DISCUSSION

The results are presented according to the study objectives. Descriptive findings are first discussed, followed by the canonical correlation analyses involving the three study constructs and the dimensions of Culinary Performance.

**Research Question 1:** What is the participant' assessment of the quality of their teacher feedback?

**Table 1**

***Descriptive Statistics for Quality of the Teacher Feedback***

| Score Range | Description | Interpretation | Frequency | Percentage |
|---|---|---|---|---|
| **4.51 – 5.00** | Always | Very High | **60** | **43.17** |
| **3.51 – 4.50** | Often | High | **66** | **47.48** |
| **2.51 – 3.50** | Sometimes | Moderate | **11** | **7.91** |
| **1.51 – 2.50** | Rarely | Low | **1** | **0.72** |
| **1.00 – 1.50** | Never | Very Low | **1** | **0.72** |
| | | **Total** | **139** | **100.00** |
| | | **Mean** | **4.37** | |
| | | ***SD*** | **0.61** | |
| | | **Interpretation** | **High** | |

| No | Indicator | Mean | *SD* | Description |
|---|---|---|---|---|
| 1 | I receive immediate feedback after performing culinary tasks. | 4.27 | 0.95 | Often |
| 2 | I receive clear and respectful explanations regarding my mistakes. | 4.52 | 0.77 | Always |
| 3 | I receive specific feedback from my instructor during or after instructional demonstrations. | 4.51 | 0.73 | Always |
| 4 | I receive constructive suggestions that help improve my practical performance. | 4.49 | 0.78 | Often |
| 5 | I receive a clear explanation of the performance criteria before every laboratory activity. | 4.54 | 0.72 | Always |
| 6 | I am encouraged to learn from my mistakes during laboratory activities. | 4.50 | 0.76 | Often |
| 7 | I receive individual guidance during laboratory activities whenever needed. | 3.99 | 0.99 | Often |
| 8 | I am given opportunities to ask questions about my performance. | 4.12 | 0.87 | Often |
| 9 | I receive constructive feedback on how effectively I manage and execute my laboratory tasks. | 4.19 | 0.94 | Often |
| 10 | Overall, the feedback provided by my instructor helps me improve my practical culinary performance. | **4.62** | **0.75** | Always |

Table 1 presents the frequency distribution and descriptive statistics of the participants' perceptions of the quality of teacher feedback. The participants obtained an overall mean of 4.37 (*SD* = 0.61), interpreted as *High*. This indicates that, in general, the students perceived quality teacher feedback as being provided *Often*. The finding suggests that feedback was a regular feature of their practical learning experiences and that instructors generally provided information that helped students understand their performance and identify ways to improve their culinary skills. In a performance-based learning environment, this is particularly important because students need opportunities to connect instructors' comments with the actual execution of practical tasks. This reflects what Lee et al. (2022) found that feedback can contribute to skill development by helping learners recognize errors and make adjustments in subsequent performance. Similarly, Carless (2023) emphasized that effective teacher feedback should be designed in ways that enable students to use feedback information for subsequent improvement.

**Research Question 2:** What is the extent of the participants' Sustainability-Oriented practices?

**Table 2**
***Descriptive Statistics for Sustainability-oriented Practices***

| Score Range | Description | Interpretation | Frequency | Percentage |
|---|---|---|---|---|
| **4.51 – 5.00** | Always | Very High | **69** | **49.64** |
| **3.51 – 4.50** | Often | High | **55** | **39.57** |
| **2.51 – 3.50** | Sometimes | Moderate | **13** | **9.35** |
| **1.51 – 2.50** | Rarely | Low | **2** | **1.44** |
| **1.00 – 1.50** | Never | Very Low | **0** | **0.00** |
| | | **Total** | **139** | **100.00** |
| | | **Mean** | **4.37** | |
| | | ***SD*** | **0.62** | |
| | | **Interpretation** | **High** | |

| No | Indicators | Mean | *SD* | Description |
|---|---|---|---|---|
| 1 | I minimize food waste during food preparation and cooking activities. | 4.48 | 0.80 | Often |
| 2 | I accurately portion and measure ingredients to prevent unnecessary excess. | 4.29 | 0.85 | Often |
| 3 | I conserve water while performing culinary laboratory activities. | 4.22 | 0.86 | Often |
| 4 | I use electrical appliances and kitchen equipment responsibly to conserve energy. | 4.17 | 1.07 | Often |
| 5 | I practice proper segregation and disposal of kitchen waste. | 4.53 | 0.87 | Always |
| 6 | I reuse or recycle materials whenever appropriate during food preparation. | 4.08 | 1.03 | Often |
| 7 | I maintain cleanliness and sanitation in my work area throughout laboratory activities. | 4.68 | 0.70 | Always |
| 8 | I practice proper storage and handling of ingredients to reduce spoilage. | 4.57 | 0.71 | Always |
| 9 | I select eco-friendly tools or techniques during food prep when given the option. | 4.32 | 0.84 | Often |
| 10 | I consistently apply sustainability-oriented practices during culinary laboratory activities. | **4.35** | **0.84** | Often |

Table 2 reveals the frequency distribution and descriptive statistics of the participants' sustainability-oriented practices during culinary laboratory activities. The participants obtained an overall mean of 4.37 (*SD* = 0.62), interpreted as *High*. This indicates that, as a whole, the participants reported practicing sustainability-oriented behaviors *Often* during culinary laboratory activities. The result suggests that sustainability was generally reflected in how students handled ingredients, managed waste, maintained their work areas, and used laboratory resources. This is important in

culinary education because sustainability competencies are increasingly regarded as part of professional preparation rather than as separate environmental concepts. Sathatip et al. (2025) emphasized that culinary education can help develop responsible future professionals by integrating experiential learning, institutional support, and sustainability principles into culinary preparation. Similarly, Lin et al. (2025) stressed the importance of developing professional competencies related to food-waste avoidance as part of hospitality and culinary education.

**Research Question 3:** What is the participant's self-report of their Self-efficacy?

**Table 3**
***Descriptive Statistics of Students Culinary Self-efficacy***

| Range | Description | Interpretation | Frequency | Percentage |
|---|---|---|---|---|
| **4.51 – 5.00** | Very High Confidence | Very High | **44** | **31.65** |
| **3.51 – 4.50** | High Confidence | High | **66** | **47.48** |
| **2.51 – 3.50** | Moderate Confidence | Moderate | **28** | **20.14** |
| **1.51 – 2.50** | Low Confidence | Low | **0** | **0.00** |
| **1.00 – 1.50** | Very Low Confidence | Very Low | **1** | **0.72** |
| | | **Total** | **139** | **100.00** |
| | | **Mean** | **4.13** | |
| | | ***SD*** | **0.65** | |
| | | **Interpretation** | **High** | |

| No | Indicator | Mean | *SD* | Description |
|---|---|---|---|---|
| 1 | I am confident in performing different cooking techniques independently. | 3.91 | 0.90 | High Confidence |
| 2 | I can prepare ingredients correctly before cooking. | 4.22 | 0.81 | High Confidence |
| 3 | I can safely operate common kitchen equipment. | 4.37 | 0.76 | High Confidence |
| 4 | I can apply proper knife skills during food preparation. | 4.09 | 0.88 | High Confidence |
| 5 | I can manage my time efficiently during laboratory activities. | 4.04 | 0.88 | High Confidence |
| 6 | I can solve problems that arise while cooking. | 3.86 | 0.94 | High Confidence |
| 7 | I can prepare dishes that meet the required quality standards. | 4.02 | 0.87 | High Confidence |
| 8 | I consistently practice food safety and sanitation procedures. | 4.42 | 0.77 | High Confidence |

| No | Indicator | Mean | *SD* | Description |
|---|---|---|---|---|
| 9 | I am confident in my ability to adapt recipes or substitute techniques when unexpected issues arise. | 4.09 | 0.86 | High Confidence |
| 10 | Overall, I am confident in my ability to perform culinary laboratory activities successfully. | **4.22** | **0.83** | High Confidence |

Table 3 shows the frequency distribution and descriptive statistics of the participants' culinary self-efficacy. The participants obtained an overall mean of *M* = 4.13 (*SD* = 0.65), interpreted as *High*. This indicates that the participants generally had *High Confidence* in their ability to perform culinary laboratory activities. The finding suggests that students perceived themselves as capable of carrying out many of the skills and responsibilities involved in practical culinary work. This is important because self-efficacy concerns learners' confidence in their capacity to accomplish particular tasks rather than simply their possession of knowledge. Recent evidence supports the importance of practical learning experiences in developing cooking confidence. French et al. (2024), for example, found that participation in a semester-long food-skills course involving an interactive teaching kitchen was associated with significant improvement in college students' cooking self-efficacy. Similarly, Kaesberg et al. (2023) reported improvements in cooking self-efficacy among college students exposed to a cooking-focused educational intervention. These findings highlight the value of practical and skills-oriented learning experiences in strengthening students' confidence in food preparation.

**Research Question 4:** What is the level of BTLED students' culinary performance in terms of:

**4.1 Cooking Methods;**
**4.2 Food Quality; and**
**4.3 Knife Skills?**

**Table 4**
***Descriptive Statistics of Students' Perceived Cooking Methods***

| Range | Interpretation | Frequency | Percentage |
|---|---|---|---|
| **4.51 – 5.00** | Highly Proficient | **71** | **51.08** |
| **3.51 – 4.50** | Proficient | **57** | **41.01** |
| **2.51 – 3.50** | Satisfactory | **11** | **7.91** |
| **1.51 – 2.50** | Less Than Satisfactory | **0** | **0.00** |
| **1.00 – 1.50** | Unsatisfactory | **0** | **0.00** |
| | **Total** | **139** | **100.00** |
| | **Mean** | **4.31** | |
| | ***SD*** | **0.47** | |
| | **Interpretation** | **Proficient** | |

Table 4 presents the frequency distribution and descriptive statistics of the participants' performance in cooking methods. The participants obtained an overall mean of 4.31 (*SD* = 0.47), interpreted as *Proficient*. This indicates that, as a whole, the participants demonstrated a *Very Good* level of performance in cooking methods. The

finding suggests that students were generally able to translate culinary knowledge into practical performance involving cooking procedures, safety, organization, and kitchen management. This is particularly important because practical culinary competence requires learners to coordinate several activities within an authentic kitchen environment. Koerich et al. (2024) explained that practical culinary classes require students to mobilize multiple skills simultaneously, including cooking, cleaning, managing activities, meeting deadlines, and responding to critical points during food preparation. Similarly, Ramirez (2025) emphasized the importance of concrete experience and active experimentation in TLE Cookery as opportunities for students to develop competencies through actual performance.

**Table 5**
***Descriptive Statistics of Students' Culinary Performance in terms of Food Quality***

| Range | Interpretation | Frequency | Percentage |
|---|---|---|---|
| **4.51 – 5.00** | Highly Proficient | **36** | **25.90** |
| **3.51 – 4.50** | Proficient | **61** | **43.88** |
| **2.51 – 3.50** | Satisfactory | **42** | **30.22** |
| **1.51 – 2.50** | Less Than Satisfactory | **0** | **0.00** |
| **1.00 – 1.50** | Unsatisfactory | **0** | **0.00** |
| | **Total** | **139** | **100.00** |
| | **Mean** | **4.01** | |
| | ***SD*** | **0.76** | |
| | **Interpretation** | **Proficient** | |

Table 5 illustrates the frequency distribution and descriptive statistics of the participants' performance in terms of food quality. The participants obtained a mean of *M* = 4.01 (*SD* = 0.76), interpreted as *Proficient*. This indicates that the participants generally demonstrated *Very Good* performance in producing dishes that met the specified food-quality criteria. The result suggests that students were generally able to integrate their culinary knowledge and practical skills into finished dishes with acceptable sensory, technical, and aesthetic qualities. Food quality is particularly important because the finished product reflects the combined application of several culinary competencies rather than a single isolated skill. Koerich et al. (2024) described practical culinary learning as a complex process in which students simultaneously manage ingredients, utensils, critical stages of preparation, time, and multiple kitchen activities. The present finding therefore reflects the students' capacity to bring these competencies together in producing finished culinary products.

**Table 6**
***Descriptive Statistics for Knife Skills***

| Range | Interpretation | Frequency | Percentage |
|---|---|---|---|
| **4.51 – 5.00** | Highly Proficient | **42** | **30.22** |
| **3.51 – 4.50** | Proficient | **75** | **53.96** |
| **2.51 – 3.50** | Satisfactory | **22** | **15.83** |
| **1.51 – 2.50** | Less Than Satisfactory | **0** | **0.00** |

| Range | Interpretation | Frequency | Percentage |
|---|---|---|---|
| **1.00 – 1.50** | Unsatisfactory | **0** | **0.00** |
| | **Total** | **139** | **100.00** |
| | **Mean** | **4.31** | |
| | ***SD*** | **0.50** | |
| | **Interpretation** | **Proficient** | |

Table 6 reveals the frequency distribution and descriptive statistics of the participants' performance in knife skills. The participants obtained an overall mean of *M* = 4.31 (*SD* = 0.50), interpreted as *Proficient*. This indicates that the participants generally demonstrated *Very Good* knife skills during practical culinary activities. The finding suggests that students had developed competence in the technical, safety, and efficiency requirements involved in using knives for food preparation. Knife skills are fundamental psychomotor competencies because successful execution requires the coordination of grip, movement, accuracy, speed, and control. Dullas (2025) found that structured laboratory learning significantly improved first-year culinary students' knife grip, cutting techniques, speed, and safety. Likewise, Nepotiuk and Brown (2022) demonstrated that knife use involves complex motor skills differentiated by movement direction, force, frequency, and amplitude, emphasizing the importance of experience and deliberate practice in developing refined performance.

**Table 7**
***Summary Table of the Participants' Level of Culinary Performance***

| Culinary Performance | Mean | *SD* | Interpretation |
|---|---|---|---|
| Cooking Methods | **4.31** | **0.47** | Proficient |
| Food Quality | **4.01** | **0.76** | Proficient |
| Knife Skills | **4.31** | **0.50** | Proficient |
| Overall | **4.21** | **0.37** | Proficient |

*Legend.* 4.51–5.00 (Highly Proficient); 3.51–4.50 (Proficient); 2.51–3.50 (Satisfactory); 1.51–2.50 (Less than Satisfactory); 1.00–1.50 (Unsatisfactory)

Table 7 summarizes the participants' level of culinary performance across three dimensions: Cooking Methods, Food Quality, and Knife Skills. Considered collectively, the participants obtained a mean of *M* = 4.21 (*SD* = 0.37), interpreted as *Proficient*. This finding indicates that the participants generally demonstrated the practical competencies expected in culinary laboratory activities. Their performance reflects competence not only in carrying out cooking procedures but also in handling culinary tools and producing finished dishes that met expected quality standards. Culinary competence is multidimensional because practical food preparation requires learners to coordinate technical procedures, tools, safety practices, time, and product-quality requirements. Koerich et al. (2024) similarly characterized practical culinary learning as a dynamic process involving the simultaneous management of cooking activities, equipment, critical preparation points, cleanliness, time, and established performance objectives.

**Research Question 5:** Are Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy significantly related to Culinary Performance?

> *$H_{01}$: Quality of Teacher Feedback, Sustainability-Oriented Practices, and Culinary Self-Efficacy do not jointly significantly associated Culinary Performance.*
> *$H_0$1: Quality of Teacher Feedback is not significantly related to Culinary Performance.*
> *$H_0$2: Sustainability-Oriented Practices are not significantly related to Culinary Performance.*
> *$H_0$3: Culinary Self-Efficacy is not significantly related to Culinary Performance.*

**Table 8**
***Canonical Correlation Analysis Between Culinary Performance and Quality of the Teacher Feedback***

| Variable | Cross loading | $R_c$ | $R_c^2$ | F(3,135) | p |
|---|---|---|---|---|---|
| Quality of the Teacher Feedback | **-0.09** | | | | |
| Culinary Performance | | | | | |
| Cooking Methods | **-0.02** | **0.09** | **0.01** | **0.370** | **0.775** |
| Food Quality | **0.05** | | | | |
| Knife Skills | **-0.05** | | | | |

Table 8 reports the canonical correlation analysis examining the relationship between Quality of Teacher Feedback and Culinary Performance, represented by Cooking Methods, Food Quality, and Knife Skills. The analysis yielded a canonical correlation of $Rc$ = 0.09, with $Rc^2$ = 0.01, $F(3, 135)$ = 0.370, and $p$ = 0.775. Since the probability value was greater than the 0.05 alpha level, the relationship was not statistically significant.

**Table 9**
***Canonical Correlation Analysis Between Culinary Performance and Sustainability-oriented Practices***

| Variable | Cross loading | $R_c$ | $R_c^2$ | F(3,135) | p |
|---|---|---|---|---|---|
| Sustainability-oriented Practices | **-0.24** | | | | |
| Culinary Performance | | | | | |
| Cooking Methods | **0.15** | **0.24** | **0.06** | **2.728*** | **0.047** |
| Food Quality | **0.04** | | | | |
| Knife Skills | **-0.14** | | | | |

**Significant at 0.05 two-tailed alpha level.*

Table 9 reveals the canonical correlation analysis examining the relationship between Sustainability-Oriented Practices and Culinary Performance, represented by Cooking Methods, Food Quality, and Knife Skills. The analysis yielded a canonical correlation of $Rc$ = 0.24, with $Rc^2$ = 0.06, $F(3, 135) = 2.728$, and $p$ = 0.047. Since the probability value was below the 0.05 alpha level, the canonical relationship was statistically significant.

The magnitude of $Rc$ = 0.24 indicates that the relationship was weak despite reaching statistical significance. The squared canonical correlation of $Rc^2$ = 0.06 further indicates approximately 6% shared variance between Sustainability-Oriented Practices and the combined dimensions of Culinary Performance. This should be interpreted as shared variation rather than stating that sustainability practices "explained" 6% of culinary performance, since the analysis is correlational and does not establish a directional or causal effect. The findings provide evidence that sustainability-oriented practices and culinary performance were related as multivariate constructs, although the magnitude of their relationship was limited.

**Table 10**
***Canonical Correlation Analysis Between Culinary Performance and Culinary Self-efficacy***

| Variable | Cross loading | $R_c$ | $R_c^2$ | F(3,135) | p |
|---|---|---|---|---|---|
| Culinary Self-efficacy | **-0.12** | | | | |
| Culinary Performance | | | | | |
| Cooking Methods | **0.10** | **0.12** | **0.01** | **0.636** | **0.593** |
| Food Quality | **0.02** | | | | |
| Knife Skills | **-0.04** | | | | |

Table 10 reports the canonical correlation analysis examining the relationship between Culinary Self-Efficacy and Culinary Performance, represented by Cooking Methods, Food Quality, and Knife Skills. The analysis yielded a canonical correlation of $Rc$ = 0.12, with $Rc^2$ = 0.01, $F(3, 135) = 0.636$, and $p$ = 0.593. Since the probability value exceeded the 0.05 alpha level, the canonical relationship was not statistically significant.

The canonical correlation of $Rc$ = 0.12 indicates a very weak relationship between the two constructs. Likewise, the squared canonical correlation of $Rc^2$ = 0.01 indicates only about 1% shared variance between Culinary Self-Efficacy and the combined dimensions of Culinary Performance. This means that differences in participants' confidence in performing culinary tasks did not correspond meaningfully with differences in their combined performance in Cooking Methods, Food Quality, and Knife Skills. Although the preceding descriptive findings indicated *High Confidence* in Culinary Self-Efficacy and *Proficient* Culinary Performance, favorable levels in both constructs do not necessarily mean that students with greater confidence were also those who obtained higher performance ratings.

## Conclusions

The results showed that the learners had developed favorable perceptions of teacher feedback, regularly practiced sustainability-oriented behaviors, demonstrated confidence in performing culinary tasks, and exhibited proficient practical culinary competencies. Despite these positive outcomes, several aspects of learning remained open for improvement, particularly individualized guidance, resource conservation, independent problem-solving, food presentation, and temperature control. These areas underscore the need for culinary laboratory experiences that provide learners with sufficient opportunities for repeated practice, immediate corrective feedback, and refinement of specific technical skills.

More importantly, canonical correlation analysis identified a statistically significant but weak relationship between Sustainability-Oriented Practices and the combined dimensions of Culinary Performance, $Rc = 0.24$, $F(3, 135) = 2.728$, $p = 0.047$. The squared canonical correlation ($Rc^2 = 0.06$) indicates approximately 6% shared variance. The cross-loadings showed that Cooking Methods and Knife Skills were more represented in the canonical relationship than Food Quality, although the overall relationship remained weak. This finding suggests that sustainability-oriented practices were associated with culinary performance in this sample, but the magnitude of the relationship was limited. The analyses for Quality of Teacher Feedback ($Rc = 0.09$, $p = 0.775$) and Culinary Self-Efficacy ($Rc = 0.12$, $p = 0.593$) did not reach statistical significance. Therefore, the findings do not support concluding that these constructs were significantly related to the combined dimensions of Culinary Performance. The results describe associations and do not establish causation or prediction.

The findings provide a context-specific perspective on the theories underpinning the study. Bandura's Social Cognitive Theory offers a useful framework for understanding how personal beliefs, environmental conditions, and behavior interact; however, the present canonical correlation results did not identify a statistically significant relationship between Culinary Self-Efficacy and the combined dimensions of Culinary Performance. Similarly, the findings indicate that the relationship between Quality of Teacher Feedback and Culinary Performance was not statistically significant in this sample. These results do not invalidate the theories; rather, they suggest that the relationships among instructional experiences, confidence, and demonstrated culinary performance may vary according to the learning context and the practical competencies being assessed.

Sustainability-oriented practices should remain integrated into culinary laboratory instruction as responsible professional habits and as practices that show a weak but statistically significant multivariate relationship with culinary performance in this sample. At the same time, culinary competence should continue to be developed and assessed directly through repeated hands-on practice, technical demonstrations, formative feedback, and specific performance criteria. The findings are limited to the participants, institution, course, and study conditions and should not be generalized beyond these contexts without further research. These results do not invalidate the theories themselves; rather, they indicate that the proposed relationships may operate differently in practical

culinary education, where technical mastery may depend more strongly on direct, repeated, and authentic performance experiences.

**Recommendations**

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. BTLED Students may:

1.1. engage in additional hands-on laboratory practice that develops independent problem-solving, particularly in heat management, timing, and adjustments during actual cooking situations.

1.2. practice food presentation, temperature control, and precision in knife skills to strengthen the specific aspects of Culinary Performance that showed greater room for improvement.

1.3. apply teacher feedback during succeeding laboratory activities rather than relying mainly on step-by-step guidance, allowing feedback to contribute to repeated practice and technical skill refinement.

1.4. continue practicing and strengthen sustainability-oriented behaviors, including minimizing food waste, using ingredients responsibly, segregating waste, and conserving water and energy during laboratory activities.

2. Culinary Teachers and Vocational Instructors may:

2.1. provide more individualized and real-time formative feedback during laboratory activities, particularly while learners are performing culinary tasks.

2.2. create more opportunities for repeated hands-on performance and corrective practice so that learners can translate feedback and confidence into demonstrated technical competence.

2.3. strengthen sustainability-oriented laboratory activities by giving greater attention to practices that received comparatively lower assessments, particularly reuse, recycling, and energy conservation.

3. Academic Curriculum Planners and School Administrators may:

3.1. review laboratory arrangements and instructional conditions to provide learners with sufficient opportunities for individualized technical guidance and supervised hands-on practice.

3.2. integrate resource conservation, reuse, recycling, and energy-efficient practices more explicitly into culinary laboratory activities and performance expectations.

3.3. support laboratory learning experiences that emphasize repeated technical practice and authentic performance, considering that teacher feedback, sustainability-oriented practices, and self-efficacy alone did not significantly account for differences in Culinary Performance.

4. Future Researchers may:

4.1. examine other factors that may explain Culinary Performance, such as prior culinary experience, laboratory exposure, deliberate practice, dexterity, performance anxiety, and other variables directly related to psychomotor skill execution.

4.2. examine additional instructional, learner-related, and contextual factors that may be associated with Culinary Performance, using research designs and analyses suited to the specific questions being investigated.

4.3. conduct longitudinal or appropriately designed intervention studies across different culinary or technical-vocational institutions to examine how feedback, repeated practice, and sustainability-oriented learning experiences relate to the development of psychomotor performance over time.

4.4. replicate the canonical correlation analysis with larger and more diverse samples to determine whether the weak but statistically significant relationship between Sustainability-Oriented Practices and Culinary Performance is consistent across institutions and student groups.

## Compliance with Ethical Standards

The study secured approval from the schools Research Ethics Committee (LC-REC) before the conduct of data collection to ensure compliance with established ethical principles and institutional research guidelines. Permission was also obtained from the appropriate college authorities. Participants were informed of the study's purpose, procedures, voluntary nature, and right to withdraw without academic penalty, and written informed consent was obtained. Student responses were coded without recording names and were treated confidentially. Course instructors served only as performance evaluators and were not research respondents. Data were used solely for research purposes and handled in accordance with applicable institutional research ethics requirements and the Data Privacy Act of 2012 (Republic Act No. 10173).

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