STATISTICAL QUALITY CONTROL ANALYSIS OF LICENSURE EXAMINATION PERFORMANCE AMONG BTLED GRADUATES, 2023–2024

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ABSTRACT: *This retrospective, exploratory process-monitoring case study examined the stability and variability of the Licensure Examination for Teachers (LET) performance of Bachelor of Technology and Livelihood Education (BTLED) graduates from the University of Science and Technology of Southern Philippines across four examination periods in 2023–2024. Aggregate institutional records covering 171 examinees were analyzed using p-charts to distinguish common-cause from special-cause variation, Pareto analysis to prioritize concentrations of non-conformance, and an Ishikawa diagram to organize possible systemic contributors. Most component results remained within their calculated control limits, while the September 2024 general average was identified in the original analysis as a special-cause concern. The Major Subject had the highest overall non-conformance proportion (28.07%) and contributed 51% of subject-component non-conformance, indicating a persistent quality concern even where the process appeared statistically controlled. The diagnostic analysis pointed to interacting student, faculty, curriculum, assessment, instructional, resource, and institutional conditions. The findings show how Statistical Quality Control can complement conventional licensure-examination reporting by separating process stability from educational acceptability and by prioritizing areas for continuous quality improvement. Because the analysis involved only four examination periods with unequal cohort sizes, the control-chart findings should be interpreted as exploratory and verified using additional examination cycles.*

Keywords: Ishikawa Diagram; Licensure Examination; P-chart; Pareto Analysis; Process Stability; Quality Assurance; Statistical Quality Control; Teacher Education

INTRODUCTION

Licensure examination performance is an important external indicator of whether teacher education programs are preparing graduates to meet nationally defined professional standards. For institutions, however, a passing rate is not merely an annual score: it is the observable output of an educational system involving student preparation, curriculum alignment, instructional quality, assessment practices, review support, and institutional resources. When passing and non-conformance rates fluctuate across examination periods, administrators need evidence that distinguishes routine variation inherent in the system from unusual variation associated with specific cohorts or circumstances.

Most studies of licensure and academic performance have used descriptive comparisons, correlational models, or multiple regression to identify factors associated with success [3–5]. These approaches are valuable for explaining relationships among learner, teacher, curriculum, support, and environmental variables, but they generally treat examination results as isolated outcomes. They do not directly determine whether performance behaves as a stable process over time, whether an apparently improved or worsened result exceeds expected statistical variation, or whether a high but stable non-conformance level represents a chronic system problem.

Statistical Quality Control (SQC) provides a complementary process perspective. A p-chart is appropriate for proportion data such as pass/fail or conforming/non-conforming outcomes and uses a center line with sample-size-sensitive control limits to distinguish common-cause from special-cause variation [1,2]. Pareto analysis can then identify the “vital few” components accounting for most non-conformance, while an Ishikawa diagram can organize plausible causes across interacting system domains. Used together, these tools connect monitoring, prioritization, and diagnostic inquiry rather than relying only on aggregate averages.

Despite the growing use of predictive studies in education, longitudinal SQC applications to recent Philippine LET data remain limited, particularly for BTLED graduates and component-level performance. This study addresses that gap by treating LET non-conformance as a process outcome across the March and September examination periods of 2023 and 2024. It examines stability, identifies possible special-cause signals, prioritizes the components contributing most to non-conformance, and organizes potential systemic explanations. The contribution is therefore methodological and practical: it demonstrates how process-monitoring evidence can inform continuous quality improvement while recognizing that control-chart signals require educational interpretation and follow-up investigation.

CONCEPTUAL FRAMEWORK

The study used an Input–Process–Output (IPO) framework to connect the institutional evidence, analytical procedures, and quality-improvement decisions. Inputs comprised aggregate LET records for the four examination periods and the documented component-level non-conformance counts. The process combined p-chart monitoring, Pareto prioritization, and Ishikawa categorization. Outputs consisted of evidence on process stability, prioritized areas of concern, and testable hypotheses for curriculum, instruction, assessment, student support, and institutional interventions. The framework does not treat the Ishikawa categories as proven causes; rather, it positions them as diagnostic propositions that require verification through additional institutional and stakeholder evidence.

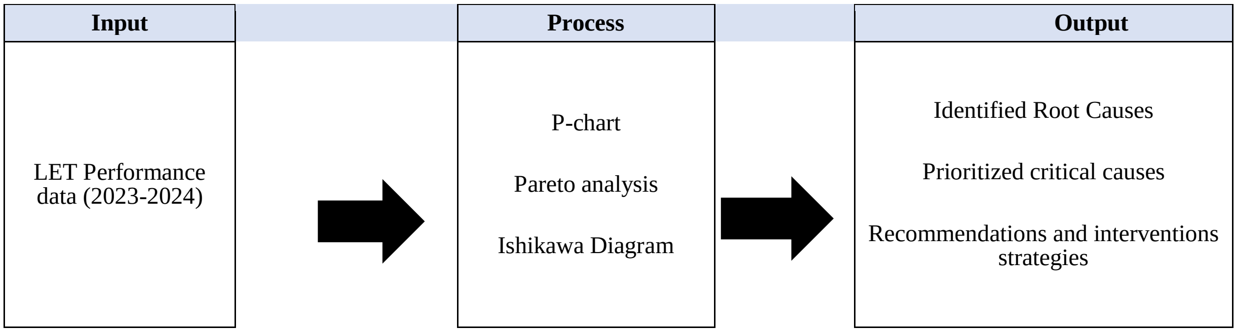

Figure 1. Conceptual Framework

Within this framework, the p-chart evaluates whether observed non-conformance proportions are consistent with expected process variation. Pareto analysis identifies where non-conformance is concentrated, thereby preventing improvement resources from being dispersed equally across components with unequal contributions. The Ishikawa diagram then provides a structured way to examine possible student, faculty, curriculum, teaching, assessment, resource, and institutional conditions associated with the prioritized concern.

The approach distinguishes two questions that are often conflated in program evaluation: whether a process is statistically stable and whether its performance level is educationally acceptable. A component can remain within control limits while sustaining an unacceptably high center line; conversely, a single out-of-control point may reflect a temporary cohort-specific condition. Both situations require different institutional responses.

Accordingly, the framework supports evidence-based decision-making but does not establish causality from aggregate data alone. Control-chart and Pareto results identify patterns requiring attention, whereas the proposed root causes must be examined through curriculum mapping, assessment audits, faculty consultation, graduate feedback, and subsequent monitoring.

STATEMENT OF THE PROBLEM

This study assessed the stability, variability, and concentration of LET non-conformance among BTLED graduates of the University of Science and Technology of Southern Philippines from 2023 to 2024 using p-chart, Pareto, and Ishikawa analyses. Specifically, it addressed the following questions:

1. How stable was the LET performance of BTLED graduates across the four examination periods based on p-chart analysis?
2. Which examination periods exhibited special-cause variation or out-of-control performance?
3. Which LET component had the highest non-conformance level and therefore constituted a chronic performance concern?
4. Which components contributed most to total LET non-conformance based on Pareto analysis?
5. What plausible underlying conditions were organized through the Ishikawa root-cause analysis?

SIGNIFICANCE OF THE STUDY

The study contributes a process-oriented quality-assurance approach to LET monitoring. Instead of interpreting each examination period in isolation, it provides faculty and administrators with a basis for distinguishing routine variation, unusual signals, and persistently high non-conformance. This distinction can guide the timing and focus of curriculum review, assessment alignment, review programming, and student support.

For current and future BTLED students, the prioritized component results identify areas requiring sustained preparation rather than short-term remediation alone.

For BTLED faculty and program leaders, the p-chart, Pareto, and Ishikawa sequence offers a repeatable monitoring framework for evaluating whether interventions are followed by meaningful changes across subsequent examination cycles.

For educational researchers and policymakers, the study illustrates how SQC can complement predictor studies and program evaluation by treating licensure outcomes as longitudinal process evidence.

For the University, the analysis supports continuous quality improvement while avoiding the assumption that statistical control automatically indicates satisfactory performance.

REVIEW OF RELATED LITERATURE

Statistical Quality Control and Its Conceptual Basis in Education

Statistical Quality Control (SQC) comprises systematic statistical techniques designed to monitor, control, and improve process performance by distinguishing inherent variation from special-cause variation. At the core of SQC are control charts, such as the p-chart, which visualize performance outcomes over time to determine process stability and reveal signals of abnormal variation that require corrective action [1,2]. Control charts help practitioners distinguish random fluctuation — expected in any stable process — from meaningful shifts that warrant intervention. By identifying such variations, SQC promotes evidence-based decision-making rather than reliance on descriptive summaries or isolated mean comparisons.

In educational settings, where outcomes such as pass rates, completion rates, and academic performance behave as measurable processes, this theoretical framework allows evaluators to monitor trends longitudinally. Such monitoring fosters a shift from static evaluation toward continuous, data-driven improvement approaches [2,6]. Through statistical tools that detect subtle shifts over time, SQC aligns with quality assurance principles that demand consistent performance and empirical evaluation of improvements [1,2,6].

Application of Statistical Process Control in Higher Education Performance Evaluation

Although SQC originated in industrial contexts, its adoption within higher education has grown in recent years due to its ability to objectively assess institutional performance trends. A practical application of Statistical Process Control (SPC) demonstrated that control charts effectively captured variations in performance rates across academic programs that traditional descriptive methods overlooked [2,4]. By plotting data over time, SPC charts revealed statistically significant shifts in performance trends, enabling institutions to identify periods of “out-of-control” performance and investigate contributing factors.

Recent control-chart research has expanded process monitoring to fraction and non-normal data, strengthening the methodological basis for applying control charts to educational pass/fail outcomes [1,7]. These developments broaden the use of Statistical Process Control when data are proportional and sample sizes vary across periods.

In higher education, process-monitoring approaches can reveal shifts and recurring patterns that may be obscured by annual averages or isolated descriptive summaries [2,4]. This process view supports closer examination of instructional, curricular, and student-preparation conditions whenever performance changes are detected.

Quality Assurance in Higher Education Through Quantitative Monitoring

Quality assurance frameworks in higher education increasingly emphasize objective, longitudinal data monitoring over periodic snapshot evaluations. SPC methods support this paradigm by enabling evaluators to monitor outcome trends and detect deviations that exceed statistically expected limits. This approach aligns with best practices in institutional quality assurance, which advocate for continuous monitoring, accountability, and evidence-based improvement [2,4,6]. Through control charts, institutions can detect performance patterns that indicate deeper curricular or instructional issues rather than relying on annual averages that mask underlying variation.

Quantitative monitoring can also help administrators identify low-performing programmes or areas requiring improvement, producing more timely and actionable evidence than periodic rating systems alone [2,6].

Control Charts and Process Monitoring in Educational Performance

Control charts — including p-charts — are especially suited for monitoring proportion-based outcomes such as pass/fail or success/failure rates, because they map these discrete results over time with statistically derived control limits. When applied to educational outcomes like licensure examination pass rates, p-charts allow researchers and administrators to differentiate random variation from statistically significant shifts that may signal curricular misalignment, instructional deficiencies, or variations in student preparedness.

By establishing upper and lower control limits based on the binomial distribution of pass/fail outcomes, p-charts provide an empirical basis for assessing whether observed changes represent normal process fluctuation or meaningful deviations that require intervention. This methodology offers a more nuanced interpretation of outcome data than simple year-to-year comparisons or descriptive summaries [1,2,7].

Ishikawa Diagram (Fishbone) in Educational Performance Analysis

The Ishikawa or Fishbone Diagram is a root cause analysis tool widely used to identify and categorize potential factors contributing to a specific outcome [8]. In educational performance evaluation, Ishikawa diagrams facilitate the systematic exploration of factors affecting licensure examination outcomes. For instance, categories such as instructional quality, study habits, curriculum alignment, assessment design, and learning resources can be mapped as potential contributors to variations in LET pass rates. By visually organizing causes, educators and administrators can pinpoint actionable areas for intervention, prioritize remedial strategies, and foster collaborative problem-solving among faculty and stakeholders [8]. The integration of Ishikawa analysis with longitudinal SQC monitoring allows for a deeper understanding of process deviations detected in control charts, ensuring targeted and evidence-based improvements.

Pareto Analysis in Monitoring Educational Outcomes

Pareto Analysis, derived from the Pareto Principle, posits that a majority of problems often arise from a small subset of causes [2]. When applied to LET performance, Pareto charts enable administrators to identify the most frequent or impactful reasons for student underperformance, such as low scores in specific competencies or repeated examination failures in certain cohorts. By focusing on the “vital few” factors that contribute to the majority of performance issues, educational institutions can allocate resources efficiently, implement corrective measures effectively, and monitor improvements over subsequent examination periods [1,2]. The combination of Pareto analysis with p chart monitoring supports a practical, data-driven strategy for continuous quality improvement in teacher education programs.

Licensure Examination Outcomes in the Philippine Context

In the Philippines, the Licensure Examination for Teachers (LET) serves as the primary national benchmark for assessing the competence of teacher education graduates and the effectiveness of teacher preparation programs. While numerous Philippine studies have examined predictors of LET performance — including academic achievement, preparatory practices, and demographic factors — these studies typically rely on correlation and regression analyses rather than process monitoring frameworks [3-5]. For instance, research examining the relationship between academic achievement and LET outcomes has confirmed significant correlations but has not assessed longitudinal stability or process behavior across multiple examination periods [3-5]. Similarly, national studies of LET performance reveal variations across regions, degree programs, and examination components, underscoring the complexity of factors influencing licensure outcomes [3-5].

Research Gap: Limited Application of SQC to Licensure Examinations

Although control charts have been applied to educational performance, their use in recent Philippine licensure-examination monitoring remains uncommon. Existing work has largely emphasized predictors, cross-sectional comparisons, or single-period summaries [3–5]. Such evidence can identify variables associated with success, but it cannot by itself determine whether observed changes across examination periods represent expected common-cause variation, an assignable special cause, or a stable but chronically weak process. Program-specific evidence for BTLED Secondary graduates during the 2023–2024 examination cycles is particularly limited.

Addressing this gap is important because the institutional response depends on the type of variation observed. Special-cause signals call for investigation of period-specific conditions, whereas a stable process with an elevated non-conformance center line requires redesign of the underlying system. Combining p-chart monitoring with Pareto prioritization and Ishikawa analysis creates a practical sequence for identifying when, where, and through which domains improvement inquiry should begin.

Practical Implications of SQC in LET Performance Monitoring

Applied to LET data, SQC can provide program leaders with a monitoring structure that is more actionable than isolated annual percentages. The p-chart identifies the behavior of the process over time; Pareto analysis concentrates attention on the components responsible for the greatest share of non-conformance; and the Ishikawa framework directs follow-up inquiry toward curriculum, instruction, assessment, learner preparation, resources, and institutional support. Interventions can then be monitored in later examination periods to determine whether performance shifts and remains at an improved level.

Recent Philippine studies further demonstrate why LET performance should be interpreted as a system outcome rather than attributed to a single variable. Branzuela, San Diego, and Namoco found that learner conditions and parental guidance significantly contributed to Computer-Aided Designing students' academic performance during flexible learning, while the combined predictors explained substantial outcome variance [19]. Benedictos and Namoco showed that a structured gamification intervention improved academic performance and information, media, and technology literacy among TVL learners, illustrating that targeted pedagogical redesign can produce measurable learning gains [20]. These studies support the need to connect process signals to evidence-based instructional and learner-support interventions.

Teacher decision-making and graduate preparation also provide important explanatory context. Namoco and Zaharudin reported that teachers' assessment practices were shaped by pedagogical beliefs, perceived social norms, and behavioral intentions [21], suggesting that assessment alignment is partly an organizational and professional-practice issue rather than a technical matter alone. In a narrative inquiry, Capilitan and Namoco identified motivation, support, knowledge acquisition, proper preparation, and personal beliefs as recurring elements in technology education graduates' accounts of passing the LET [22]. Together, this literature clarifies the value of the present design: prior studies explain possible determinants and successful preparation experiences, whereas SQC examines how the aggregate institutional process behaves across examination cycles and where improvement efforts should be prioritized.

MATERIALS AND METHODS

Research Design

The study employed a retrospective, exploratory quantitative process-monitoring case-study design. It analyzed aggregate LET records for BTLED graduates from one state university across four examination periods: March 2023, September 2023, March 2024, and September 2024. The design was appropriate because the principal purpose was not to estimate individual-level causal effects but to examine whether institutional non-conformance proportions were statistically stable over time and to identify components requiring prioritized quality-improvement attention.

SQC was implemented through three complementary tools. The p-chart monitored the proportion of non-conforming outcomes across examination periods with unequal subgroup sizes. Pareto analysis ranked the LET components according to their contribution to total non-conformance. The Ishikawa diagram organized plausible conditions associated with the prioritized concern. Because only four examination periods were available, the control-chart findings were interpreted as exploratory signals rather than definitive evidence of long-term process stability.

Data Collection

Secondary, aggregate records were obtained from the Office of the Dean of the College of Science and Technology Education. The dataset contained the number of examinees and non-conforming outcomes for the general average and the General Education, Professional Education, and Major Subject components in each of the four examination periods. The analysis used the complete set of records made available for the defined 2023–2024 period; no personally identifying information was included in the analytical file.

Research Instrument

The principal analytical instrument was the p-chart, an attribute control chart designed to monitor a proportion when subgroup sizes may vary [1,7]. For examination period i, the non-conformance proportion was computed as $p_i = d_i/n_i$, where d_i was the number of non-conforming outcomes and n_i was the number of examinees. The pooled center line was $\bar{p} = \Sigma d_i/\Sigma n_i$. Period-specific three-sigma limits were calculated as $UCL_i = \bar{p} + 3\sqrt{[\bar{p}(1-\bar{p})/n_i]}$ and $LCL_i = \max\{0, \bar{p} - 3\sqrt{[\bar{p}(1-\bar{p})/n_i]}\}$. A point outside the limits was interpreted as a possible special-cause signal requiring investigation.

Control limits were calculated separately for each component because the pooled non-conformance level differed across the General Average, General Education, Professional Education, and Major Subject outcomes. Statistical control was interpreted separately from educational acceptability: a high center line can indicate a chronic concern even when every period lies within its control limits.

$$\mathrm{UCL} = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

$$\mathrm{LCL} = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

The plotted proportions were examined for points beyond the period-specific limits. Given the short series, the analysis did not apply extended run rules that require a longer sequence of subgroups.

Data Analysis

Analysis proceeded in three stages. First, p-charts were constructed for the General Average and each LET component to estimate the pooled non-conformance level and period-specific control limits. Second, component non-conformance counts were ranked through Pareto analysis to determine the relative percentage and cumulative contribution of each subject area. Third, an Ishikawa diagram was used to organize potential contributors under student, faculty, curriculum, teaching-strategy, assessment-system, learning-resource, and institutional-environment categories.

The p-chart and Pareto analyses were descriptive process-monitoring procedures based on aggregate records. The Ishikawa categories were interpreted as diagnostic hypotheses rather than statistically verified causes. Their confirmation would require additional evidence such as curriculum mapping, assessment review, faculty and graduate interviews, and multivariable analysis. The two illustrative participant statements reproduced in the original Results section should therefore be supported in the final submission by a documented qualitative data-collection and analysis procedure.

Unequal subgroup sizes were accommodated through period-specific control limits. Nevertheless, the small September 2024 cohort and the availability of only four examination periods increase uncertainty; accordingly, apparent special-cause signals and trend interpretations should be examined alongside cohort records and verified using additional LET cycles.

Ethical Considerations

The study used de-identified, aggregate institutional LET data and applied data-minimization, confidentiality, restricted-access, and secure-storage practices consistent with ethical secondary-data analysis [9,10]. The report presents no names, student identifiers, or individual scores. Before journal submission, the manuscript should state the institutional authorization and ethics-review or exemption details for the secondary records and for any qualitative statements used in the Ishikawa interpretation

RESULTS

This section presents the analysis of LET performance using Statistical Quality Control tools, particularly the p-chart, Pareto analysis, and Ishikawa interpretation. The data contains four examination periods: March 2023, September 2023, March 2024, and September 2024. In this analysis, non-conformance refers to examinees or subject outcomes that did not meet the expected standard, while the proportion represents the rate of non-conformance relative to the number of takers.

Table 1. Non-Conformance By Let Component

Component	Total Takers	Total Defects	Overall Proportion
General Average	171	31	18.13%
General Education	171	19	11.11%
Professional Education	171	28	16.37%
Major Subject	171	48	28.07%

Table 1 shows that the major subject recorded the highest number of non-conformances with 48 defects out of 171 takers, equivalent to an overall non-conformance proportion of 28.07%. This was followed by the general average with 31 non-conformances or 18.13%, professional education with 28 non-conformances or 16.37%, and general education with 19 non-conformances or 11.11%. The pattern suggests that the major subject is the primary area of concern in the LET performance of the group. While non-conformance is present in all components, the largest concentration occurs in the major subject, indicating that content specialization and mastery of discipline-specific competencies require the greatest intervention

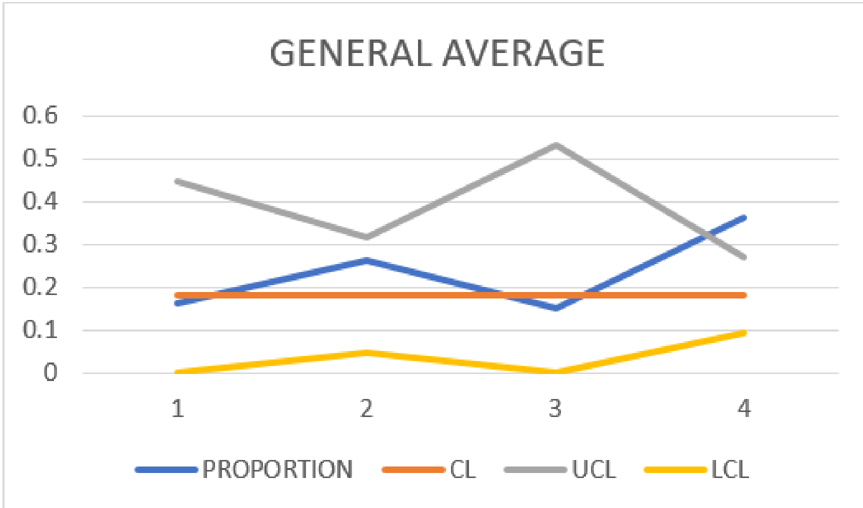

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Figure 2. P-Chart For General Average

Table 2. P-Chart For The General Average

Period	Takers	Non-Conformance	p	CL	UCL	LCL	Interpretation
March 2023	68	11	16.18%	18.13%	44.64%	0.00%	Within control limits
September 2023	19	5	26.32%	18.13%	31.66%	4.60%	Within control limits
March 2024	73	11	15.07%	18.13%	52.98%	0.00%	Within control limits
September 2024	11	4	36.36%	18.13%	26.97%	9.29%	Above UCL - special-cause concern

For the general average, the overall center line was 18.13%. The March 2023 result showed a non-conformance proportion of 16.18%, while September 2023 increased to 26.32%. March 2024 declined to 15.07%, indicating a temporary improvement. However, September 2024 increased sharply to 36.36%, exceeding its upper control limit of 26.97%. This indicates a special-cause variation and suggests that the September 2024 general average performance was not operating under the same stable pattern as the earlier periods. However, it is important to consider that the September 2024 examination period had a relatively small sample size (n = 11), which may have amplified the proportion of non-conformance. In p-chart analysis, smaller sample sizes tend to produce more volatile proportions and wider control limits, which can exaggerate apparent deviations. Therefore, the observed special-cause variation should be interpreted with caution, as it may partly reflect sample size sensitivity rather than a true process shift

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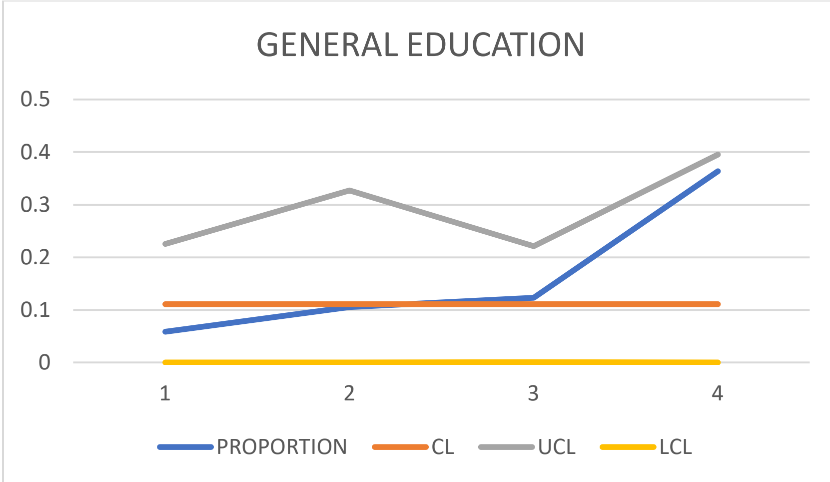


FIGURE 3. P-CHART FOR GENERAL EDUCATION

TABLE 3. P-CHART INTERPRETATION: GENERAL EDUCATION

Period	Takers	Non-Conformance	p	CL	UCL	LCL	Interpretation
March 2023	68	4	5.88%	11.11%	22.54%	0.00%	Within control limits
September 2023	19	2	10.53%	11.11%	32.74%	0.00%	Within control limits
March 2024	73	9	12.33%	11.11%	22.15%	0.08%	Within control limits
September 2024	11	4	36.36%	11.11%	39.54%	0.00%	Within control limits

For general education, the overall center line was 11.11%. The non-conformance proportions were 5.88% in March 2023, 10.53% in September 2023, 12.33% in March 2024, and 36.36% in September 2024. Based on the control limits, all points remained within the control limits, although September 2024 was relatively close to the upper control limit of 39.54%. This means that general education was statistically controlled, but the rising pattern still deserves attention. The increase in the last period suggests that general education should not be ignored, especially if the institution aims to sustain consistent performance across all LET components.

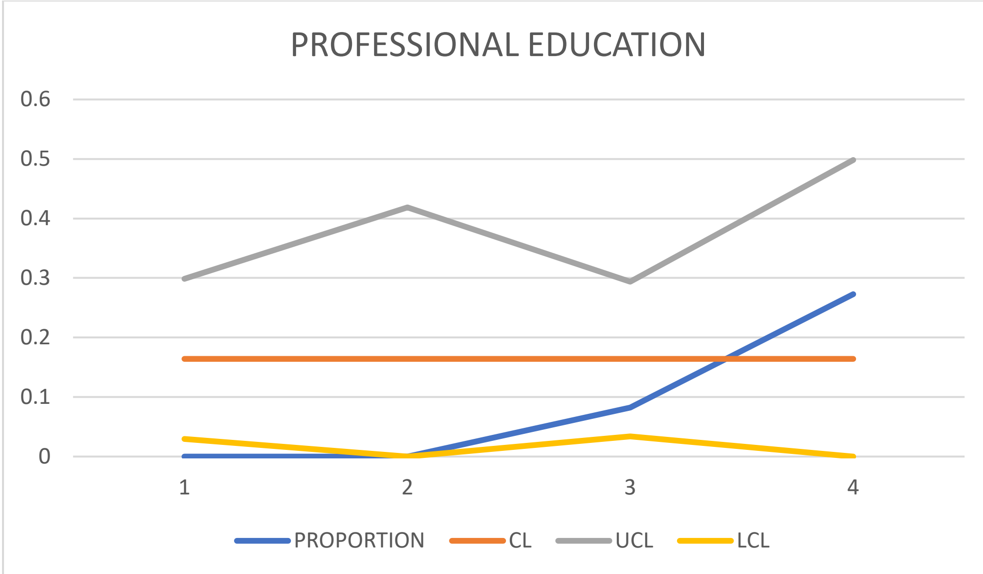


Figure 4. P-Chart For Professional Education

Table 4. P-Chart Interpretation: Professional Education

Period	Takers	Non-Conformance	p	CL	UCL	LCL	Interpretation
March 2023	68	0	0.00%	16.37%	29.84%	2.91%	Below LCL - favorable special-cause variation
September 2023	19	0	0.00%	16.37%	41.84%	0.00%	Within control limits
March 2024	73	6	8.22%	16.37%	29.37%	3.38%	Within control limits
September 2024	11	3	27.27%	16.37%	49.85%	0.00%	Within control limits

The p-chart for Professional Education shows the variation in the proportion of non-conformance across the four Licensure Examination for Teachers (LET) periods, with a center line (CL) of 16.37% and varying control limits based on sample size. In March 2023, the non-conformance rate was 0.00%, which fell below the lower control limit of 2.91%, indicating a favorable special-cause variation and suggesting that the absence of defects was influenced by unusual or assignable factors rather than normal process behavior. In September 2023, the non-conformance rate remained at 0.00%; however, since the lower control limit was computed at 0.00%, the result fell within the control limits and was attributed to common-cause variation, likely influenced by the smaller number of examinees. For March 2024 and September 2024, the non-conformance rates were 8.22% and 27.27%, respectively, and both values remained within the established control limits, indicating that the variations observed during these periods were due to normal process fluctuations. Despite being within control, the increasing trend in non-conformance from earlier to later periods reflects inconsistency in performance, as the process shifted from extremely low defect rates to relatively higher values. This pattern suggests that while the Professional Education component did not exhibit adverse out-of-control conditions, it has not yet achieved stability, and the observed variations may be influenced by differences in instructional delivery, assessment alignment, or student preparedness, thereby necessitating continuous monitoring and targeted interventions.

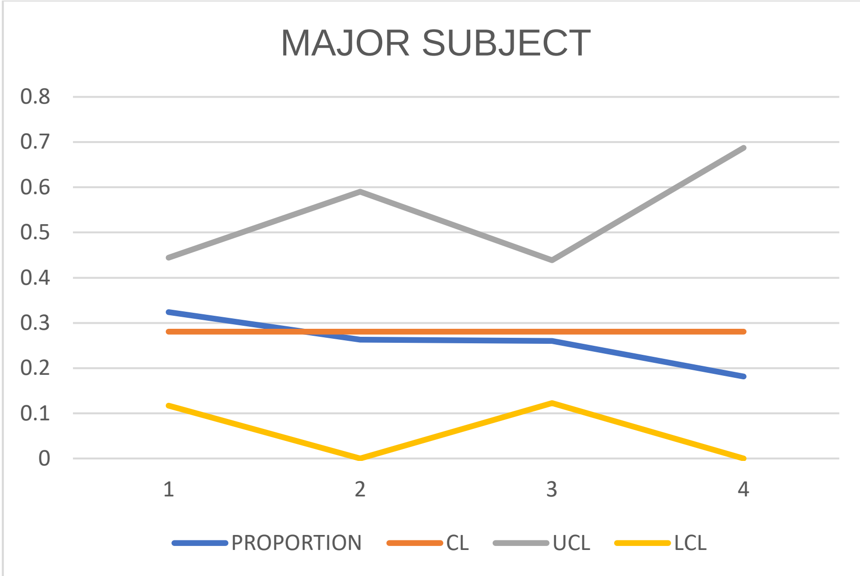


FIGURE 5. P-CHART FOR MAJOR SUBJECT

TABLE 5. P-CHART INTERPRETATION: MAJOR SUBJECT

Period	Takers	Non-Conformance	p	CL	UCL	LCL	Interpretation
March 2023	68	22	32.35%	28.07%	44.42%	11.72%	Within control limits
September 2023	19	5	26.32%	28.07%	59.00%	0.00%	Within control limits
March 2024	73	19	26.03%	28.07%	43.85%	12.29%	Within control limits
September 2024	11	2	18.18%	28.07%	68.71%	0.00%	Within control limits

For the major subject, the center line was highest among all components at 28.07%. March 2023 recorded a non-conformance proportion of 32.35%, September 2023 recorded 26.32%, March 2024 recorded 26.03%, and September 2024 recorded 18.18%. All points were within the encoded control limits, indicating statistical control. However, being within control does not mean the condition is acceptable. The center line itself is high, meaning that the process is consistently producing a relatively large proportion of non-conformance. This is the most important finding: the major subject may not show extreme special-cause fluctuation, but it represents a chronic performance problem that must be addressed through sustained instructional and curricular intervention.

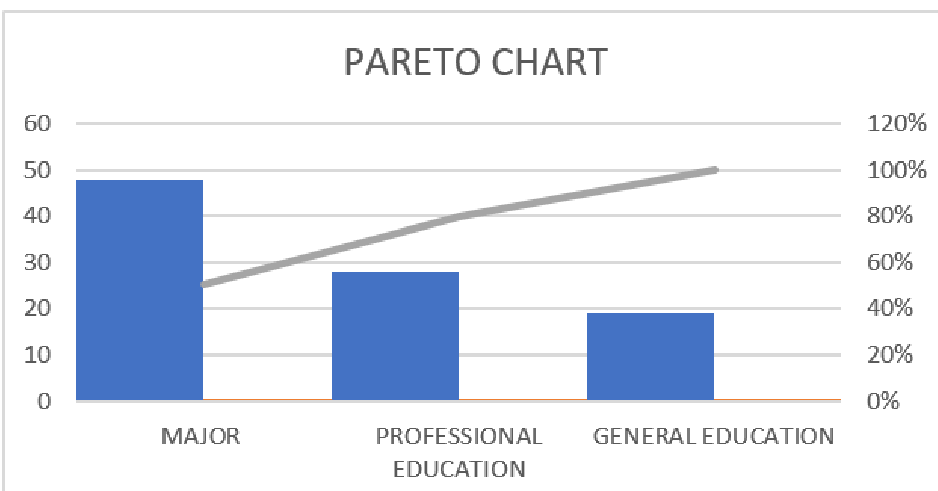


FIGURE 6. PARETO CHART

TABLE 6. CUMULATIVE PARETO CHART

DEFECT TYPE	TOTAL DEFECT	TOTAL PERCENTAGE	CUMULATIVE
MAJOR SUBJECT	48	51%	51%
PROFESSIONAL EDUCATION	28	29%	80%
GENERAL EDUCATION	19	20%	100%

The Pareto chart shows that the Major Subject is the biggest contributor to LET non-conformance, with 48 defects or 51% of the total defects. This means that more than half of the performance problem comes from the Major Subject area.

Professional Education is the second major contributor, with 28 defects or 29%, while General Education has the lowest contribution, with 19 defects or 20%. When the Major Subject and Professional Education are combined, they account for about 80% of the total non-conformance, making them the priority areas for improvement.

The result supports the Pareto principle, which means that the largest portion of the problem comes from a few key areas. Therefore, interventions should focus first on the Major Subject, followed by Professional Education, because improving these areas will likely produce the greatest reduction in LET performance problems.

Pareto Analysis

The Pareto chart illustrates the distribution of non-conformance across the three LET components and highlights the relative contribution of each to the overall performance problem. Based on the results, the major subject recorded the highest number of defects with 48 cases, accounting for 51% of the total non-conformance, followed by professional education with 28 defects or 29%, and general education with 19 defects or 20%. The cumulative percentages further reveal that the major subject alone constitutes more than half of the total defects, and when combined with professional education, these two components account for approximately 80% of the overall non-conformance. This pattern confirms the Pareto principle, which suggests that a majority of problems are often caused by a limited number of factors. The graphical representation supports this finding, as the steep increase in the cumulative line after the major subject indicates its dominant contribution to the issue. From a quality improvement perspective, this implies that intervention efforts should not be distributed equally across all components but should instead prioritize the major subject, followed by professional education, as addressing these areas would yield the greatest impact in reducing overall non-conformance. While general education also contributes to the problem, its relatively smaller share suggests that it may be considered a secondary priority.

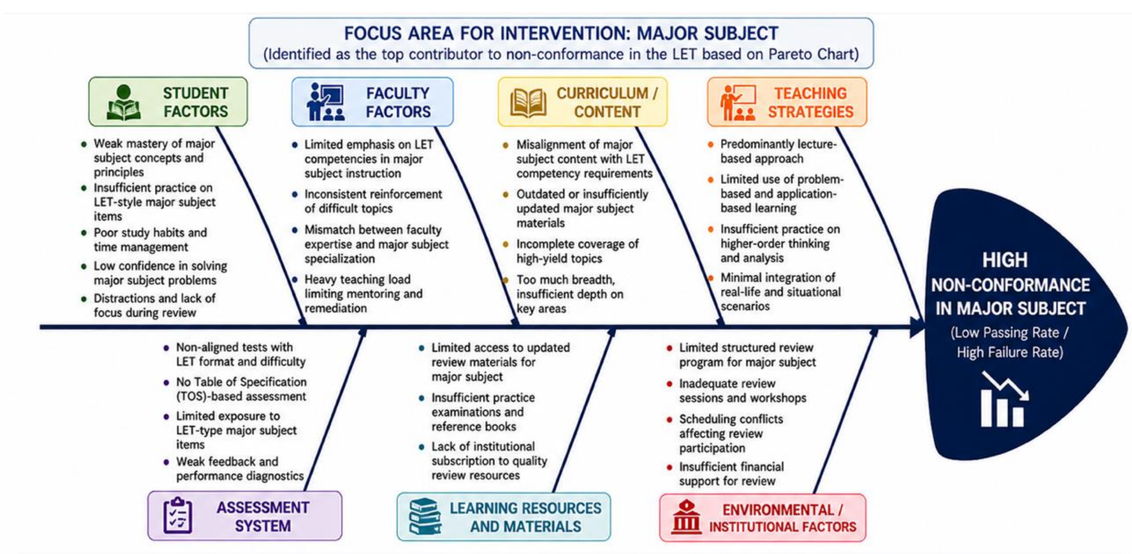
1. The Major subject is the main source of LET non-conformance because it accounts for 51% of the total problem, and although the p-chart shows that the process is statistically controlled, the high center line of 28.07% indicates a persistent or chronic performance issue.

2. The problem is not caused by random fluctuations but by systemic factors such as possible curriculum misalignment, instructional delivery issues, weak teaching strategies, assessment gaps, limited student mastery, and insufficient academic support systems.

> *“There were competencies in the major subject that I only understood during the review. It made me realize that some lessons should have been emphasized more while we were still taking the course.” (P2)*

> ***Most of the time, our learning was focused on lectures and reporting. We had fewer activities that trained us to answer analytical or situational questions like those in the LET.” (P5)***

3. Although the Ishikawa Analysis focused on the Major Subject, the observed issues in General Education and Professional Education suggest that LET performance problems affect the whole program; therefore, institution-



wide and data-driven interventions are needed.

FIGURE 7. ISHIKAWA DIAGRAM

DISCUSSION

The Ishikawa analysis focused on the major subject, which accounted for 51% of total non-conformance based on Pareto results, indicating that it is the most critical contributor to LET performance variability. The p-chart further revealed that although the process is statistically controlled, the consistently high center line (28.07%) indicates a chronic performance issue rather than random fluctuation. This pattern suggests that the underlying causes are systemic and persistent, consistent with the principle that stable processes with high defect rates reflect inherent system-level problems [1,2,6].

From a curriculum perspective, the high level of non-conformance suggests a potential misalignment between course content and LET competency requirements, as reflected in consistently elevated defect rates across all examination periods. This supports the concept of constructive alignment, which emphasizes that mismatches between intended learning outcomes, teaching activities, and assessments can significantly hinder student performance [3,15,16].

In terms of faculty-related factors, the lack of substantial improvement across examination periods implies that instructional delivery may not fully address licensure-level competencies. Studies have shown that instructional quality and alignment of teaching expertise with subject matter significantly influence student learning outcomes and examination performance [11,12].

Teaching strategies also appear to contribute to performance variation. The stable yet elevated non-conformance suggests that existing instructional approaches may not sufficiently develop higher-order thinking and application skills required in licensure examinations. Research indicates that active learning strategies are more effective than traditional lecture-based methods in improving student performance and conceptual understanding [11,12].

Similarly, assessment practices may not be fully aligned with licensure-type examinations, limiting students' exposure to LET-style problem-solving tasks. Effective assessment design, particularly formative assessment aligned with learning outcomes, plays a critical role in enhancing student performance and self-regulated learning [13-16].

Supporting factors include student-related variables, where the observed defect rate implies insufficient mastery of discipline-specific competencies. This aligns with findings that academic performance is strongly influenced by students' self-regulated learning strategies and engagement [13,17,18]. Additionally, environmental conditions may contribute, as the sustained level of non-conformance suggests that existing academic support systems, such as structured review programs and access to learning resources, may be insufficient to significantly improve outcomes. Institutional support mechanisms have been identified as critical factors in enhancing academic success in higher education [5,6].

The data indicate that the performance issue in the major subject is not due to isolated variation but reflects a systemic condition requiring integrated, data-driven interventions across curriculum design, instructional practices, assessment alignment, and academic support systems.

While the Ishikawa analysis focused on the major subject due to its dominant contribution to non-conformance, variations observed in other components such as general education and professional education also indicate that performance issues are not isolated within a single domain. For instance, the increasing trend in general education and the variability in professional education, as reflected in the p-chart results, suggest that similar systemic factors may influence performance across multiple components. This reinforces the need for institution-wide interventions that address not only the major subject but also broader instructional, curricular, and assessment-related conditions affecting overall LET performance.

SUMMARY OF FINDINGS

This study investigated the stability and variability of the Licensure Examination for Teachers (LET) performance of Bachelor of Technology and Livelihood Education (BTLED) secondary graduates from the University of Science and Technology of Southern Philippines (USTP) from 2023 to 2024 using Statistical Quality Control (SQC) techniques. The study employed the p-chart to assess process stability, Pareto analysis to identify the major contributors to non-conformance, and the Ishikawa diagram to determine the underlying causes of performance variation, all anchored within the Input–Process–Output (IPO) framework. The findings revealed that most LET components exhibited common-cause variation, indicating generally stable processes, although a special-cause variation was observed in the general average during the September 2024 examination period, suggesting the influence of unusual factors. Among the components, the major subject recorded the highest level of non-conformance and was identified as a chronic performance issue due to its consistently high proportion despite being within control limits. Pareto analysis further showed that the major subject accounted for 51% of the total defects, followed by professional education and general education, indicating that the majority of performance issues were concentrated in a few critical areas. The Ishikawa analysis revealed that performance variability was caused by interconnected factors across student, faculty, curriculum, teaching strategies, assessment systems, and learning environment domains. Overall, the study concluded that LET performance is influenced by both process-related variations and systemic issues, and that the integration of SQC tools provides a comprehensive and data-driven approach for monitoring performance, identifying critical problem areas, and implementing targeted interventions to improve the effectiveness of teacher education programs.

LIMITATIONS

One limitation of this study is the variation in sample size across examination periods, particularly the small number of examinees in certain periods such as September 2024. This may affect the stability and interpretation of p-chart results, as smaller samples can lead to exaggerated proportions and wider control limits. Consequently, findings related to these periods should be interpreted with caution

CONCLUSION

This study concluded that the LET performance of BTLED graduates was generally stable; however, it was not consistently satisfactory due to the presence of both special-cause variation and chronic performance issues. The major subject emerged as the most critical area of concern, contributing the highest proportion of non-conformance despite operating within statistical control limits, indicating a persistent and systemic problem. The results further showed that LET performance variability was influenced by interconnected factors across student preparedness, instructional practices, curriculum alignment, assessment systems, and institutional support. Therefore, improving LET outcomes requires not only monitoring process stability but also addressing underlying systemic issues through continuous quality improvement and data-driven decision-making.

RECOMMENDATIONS

Curriculum Alignment Policy. Ensure that all major subject courses are explicitly aligned with LET competencies through periodic curriculum review and standardized learning outcomes.

Continuous Performance Monitoring (SQC Integration). Institutionalize the use of Statistical Quality Control tools (e.g., p-charts) to monitor LET performance trends, detect variations, and support data-driven decision-making.

Structured LET Review Program. Implement a mandatory, competency-based review program focusing on high-risk areas (major subject and professional education), including diagnostic tests, targeted remediation, and LET simulations.

Standardized Assessment Policy (TOS-Based). Require all faculty to use Table of Specification (TOS)-based assessments to ensure alignment between instruction, learning outcomes, and licensure expectations.

Faculty Development Policy. Strengthen faculty training programs to ensure subject specialization and promote the use of licensure-oriented and student-centered teaching strategies.

Student Academic Support System. Establish structured support mechanisms such as tutoring, mentoring, early identification of at-risk students, and access to updated LET review materials.

Integrated Quality Assurance Framework. Adopt a unified, data-driven quality assurance policy integrating SQC, Pareto, and Ishikawa analyses to guide continuous improvement and enhance LET performance outcomes.

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