Journal of Coaching Management Education Sports
https://doi.org/10.31599/jces.v5i2.6789
Vol. 5, No. 2, Nov 2024, pp. 578-598
E-ISSN: 2722-3450 P-ISSN: 2775-3808

Shewhart Chart Analysis And Its Application In Educational Quality Control: Literature Review

Aprilia Rizki*, Widia Dwi Lestari, R. Madhakomala
[123]State University of Jakarta, Jl. R. Mangun Muka Raya No.11, RT.11/RW.14, Rawamangun, Pulo Gadung District, East Jakarta City, Special Capital Region of Jakarta 13220
e-mail:apriliarizki2527@gmail.com;widiadwilestari518@gmail.com; madha.unj@gmail.com

Abstract

In the context of increasing demands for quality assurance and continuous improvement in education, Shewhart charts, originally developed for industrial processes, have found applications beyond manufacturing. Shewhart control charts, also known as statistical process control (SPC) charts, serve as valuable tools for monitoring and controlling processes by distinguishing between common and special cause variation. This literature review explores the application of Shewhart charts in the field of educational quality control, highlighting their potential to improve decision-making processes, identify trends, and enhance educational outcomes.

Keywords: shewhart chart, analysis, quality of education, quality control

Corresponding Author
e-mail:apriliarizki2527@gmail.com
Article Info:
Submitted: **06/09/2024** Revised: **02/10/2024** Accepted: **10/11/2024** Published: **30/11/2024**
How to Cite: Rizki, A., Lestari, W, D., Madhakomala, R. (2024). Shewhart Chart Analysis And Its Application In Educational Quality Control: Literature Review. *Journal of Coaching Education Sports*, 5(2), 578-.https://doi.org/10.31599/jces. 5(2).6789

Author's Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

.

A. Introduction

In the era of globalization and increasingly tight competition, educational institutions are faced with the demands to maintain high quality and make continuous improvements in all aspects, both academic and administrative. Quality education is not only characterized by optimal student learning outcomes, but also by a consistent and effective educational process. To achieve this goal, a data-based approach is becoming increasingly important in educational decision making (Madu & Adekola, 2018).

One of the methods widely used in the industrial world to monitor and improve process quality is Statistical Process Control (SPC), with the Shewhart Chart as its main tool. Introduced by Walter A. Shewhart in the 1920s, the Shewhart Chart (also called a control chart) serves to distinguish between variations that occur due to common causes and special causes. Although originally designed for the manufacturing sector, the use of this method has spread to various fields, including the education sector (Pishgar & Nejad, 2020).

In the context of education, Shewhart Charts can be used to monitor student learning outcomes, evaluate teacher performance, or even the effectiveness of educational programs. By charting learning outcome data, educators can distinguish between assignable and general variation. This is important for understanding when and why interventions are needed to improve the learning process. "Shewhart Charts enable educational institutions to monitor and control variation in processes, so that corrective action can be identified." (Montgomery, 2020). One of the main purposes of implementing Shewhart Charts in education is to ensure that decisions are made based on real evidence from data. For example, decisions to improve curriculum or teaching methods can be based on an analysis of student performance trends over time as shown in a control chart. This helps avoid making decisions based on fluctuations in results that are actually random. "The use of control charts provides educators with the tools to make more informed decisions based on accurate data, reducing the risk of decisions based on random fluctuations." (Foster, 2018).

The Shewhart Chart is an important part of the Continuous Quality Improvement (CQI) cycle that can be applied in education to ensure that the teaching and learning process runs

optimally. By monitoring performance consistently, educational institutions can identify areas that need improvement and measure the effectiveness of interventions carried out. "The use of the Shewhart Chart in education helps create a culture of continuous improvement, where performance is systematically monitored and adjustments are made based on patterns seen in the data." (Deming, 2000). In addition to the teaching and learning process, control charts can also be used for other aspects of educational management such as student attendance, classroom behavior, or use of school resources. With this tool, schools can see patterns that have the potential to become problems or challenges and take action before the problem becomes bigger.

"In the context of school management, the Shewhart Chart serves as an effective tool for monitoring various aspects of operations and detecting negative trends early." (Lepore, 1999). Educators can sometimes judge the success or failure of an educational program based on a single outcome or event. The Shewhart Chart provides a clearer picture of variation and trends over time, making the assessment more fair and accurate. This is important so that educators do not make unnecessary changes based on momentary data. "Control charts help educators avoid making judgments based on momentary data by providing a deeper understanding of variation in the educational process." (Oakland, 2003).

Shewhart Chart, often referred to as a control chart, is a statistical tool used to monitor variations in a process and ensure that the process is under control. Although originally developed for the manufacturing industry by Walter A. Shewhart in the 1920s, the concept has spread to various sectors, including education. In education, Shewhart Chart serves as a tool to improve the quality of the learning process, performance evaluation, and data-based decision making. The following are the roles and functions of Shewhart Chart in education:

a. Monitoring the Quality of Learning and Student Achievement

Shewhart Charts can be used to monitor the development of student performance over a period of time. In this case, student learning outcome data can be analyzed to see whether the learning process is running consistently or experiencing significant variations. Uncontrolled variations can indicate problems with teaching methods, curriculum, or other factors that need to be fixed immediately. "By using Shewhart Charts, educators can monitor student performance continuously and identify significant changes in learning outcome patterns." (Montgomery, 2020)

b. Helping to Identify Causes of Variation in the Educational Process

One of the primary functions of the Shewhart Chart is to distinguish between natural variation (common cause variation) and variation caused by specific factors (special cause variation). In an educational context, natural variation can be caused by differences in student ability, while special cause variation can arise from external factors such as curriculum changes or technical issues in the learning process. By distinguishing between these two types of variation, educators can determine when intervention is needed and when changes are simply part of the natural variation. "Control charts help identify variation in the learning process, providing deeper insight into when intervention is needed." (Foster, 2018)

c. Reducing Uncertainty in Decision Making

In education, decisions are often made based on assumptions or momentary results. Shewhart charts help reduce this uncertainty by providing a broader picture of performance trends or outcomes of the educational process. By monitoring results over time, decision makers can avoid overreacting to random fluctuations in the data. "Using Shewhart charts helps educators make better decisions by reducing the impact of uncertainty and ensuring that changes are made only when absolutely necessary." (Deming, 2000)

d. Promoting Continuous Improvement in Education

The Shewhart Chart encourages a process of continuous quality improvement in education. By identifying recurring variations or consistent patterns, educational institutions can devise strategies to continually improve quality. This is in line with modern quality management principles, which emphasize the importance of continuous monitoring and evaluation to achieve the best results. "The Shewhart Chart plays a vital role in supporting continuous improvement, as it allows for early detection of problems before they escalate." (Oakland, 2003)

e. Facilitating Teacher and Institution Performance Evaluation

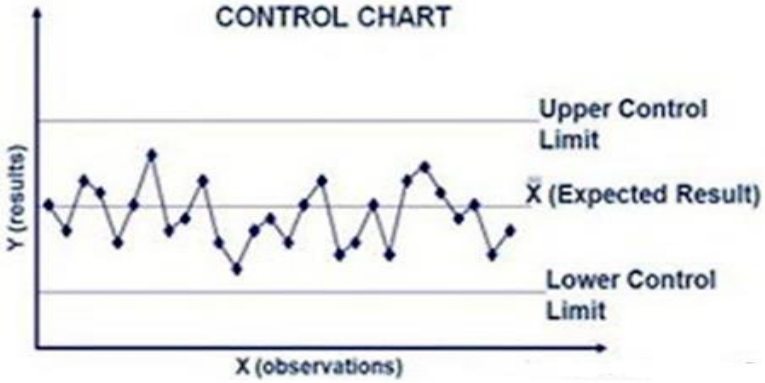
In addition to monitoring student performance, Shewhart charts can also be used to evaluate the performance of teachers and the educational institution as a whole. Data such as student grades, attendance rates, or student satisfaction survey results can be entered into the chart to see if there are any patterns that need attention. If classroom or teacher performance shows uncontrolled variation, school management can

conduct further investigation to determine the cause. "Control charts are useful not only for students, but also for monitoring and evaluating teacher performance and the educational process as a whole." (Lepore, 1999)

f. Providing Diagnostic Tools for Educational Programs

The Shewhart Chart allows educational institutions to identify whether an educational program or instructional strategy is producing the desired results. By continuously monitoring and analyzing data from an educational program, school management can determine whether there is an improvement in quality or whether changes need to be made to the program. "In the educational context, the Shewhart Chart can be used as a diagnostic tool to assess the effectiveness of an educational program or intervention implemented." (Foster, 2018).

Shewhart Chart (control chart) is a very useful tool in various aspects of education because it provides a data-based approach to monitor variation in various processes. The use of this chart can be applied in various fields of educational administration, including New Student Admissions (PMB), curriculum development, human resource development (HRD), and management of facilities and infrastructure (SARPRAS).



Example: Monitoring Student Grades in Mathematics Subjects During One Semester Y-axis (Vertical): The average score of the student on each test or assessment. The scale ranges from 0 to 100, for example. X-axis (Horizontal): The time or period of the test (e.g., week 1, 2, 3, etc. or evaluation 1, 2, etc.). Center Line (CL): This is the average line of the scores measured during the period. This line shows the average of the student's overall performance. For example, if the student's average score over several tests is 75, then the center line is drawn at the 75 level on the Y-axis. Upper Control Limit (UCL): The upper control limit determined by the standard deviation of the mean. Scores above the UCL are

considered out of control or abnormal. The UCL can be placed around 85, calculated as the mean plus 3 times the standard deviation. Lower Control Limit (LCL): The lower control limit, also determined by the standard deviation. Scores below the LCL are considered out of control and may require intervention. The LCL can be placed around 65, calculated by subtracting the mean from 3 times the standard deviation. Plotting Student Grades Over Time: Along the horizontal axis, you will plot the average student grades for each test or evaluation period. These points are connected with lines.

If the score is between the UCL and LCL, then the teaching and learning process is considered under control. If there is a score that exceeds the UCL or LCL, this indicates a problem that requires attention (e.g., ineffective teaching methods, changes in students' learning styles, etc.).

In the context of education, the application of Shewhart Charts is increasingly recognized as a potential tool for controlling and improving quality. For example, Shewhart Charts can be used to monitor student learning outcomes, ensure fairness and consistency in assessments, and improve the efficiency of administrative processes (Jones & Taylor, 2017). By visualizing performance data over a period of time, educators and education managers can recognize patterns and identify deviations that require intervention. This allows for more informed decision-making in improving the quality of education.

However, the application of the Shewhart Chart in education also has its own challenges. One of the main obstacles is the complexity of educational data which is often non-linear and influenced by various factors, such as students' socio-economic background, learning motivation, and support from institutions (Becker & Johnson, 2019). Therefore, it is important to adjust the application of the Shewhart Chart in the educational context so that it can provide maximum benefits.

With this background, this literature review article aims to examine the application of Shewhart Chart in educational quality control. This article will review various studies that have been conducted in this field, focusing on the contribution of Shewhart Chart in monitoring student performance, improving teaching quality, ensuring consistency in the assessment process, and increasing administrative efficiency. In addition, the challenges and limitations

of implementing this method in education will also be discussed in depth.

METHOD

The approach used in this article is a literature review. The literature review was conducted by analyzing and synthesizing relevant literature to understand the concept, application, and effectiveness of using the Shewhart chart in controlling the quality of education.

The data used in this study comes from secondary literature which includes: Scientific journal articles (both national and international) related to Shewhart charts, educational quality control, and statistical applications in education. Textbooks related to quality control methods and quality management; Relevant previous research reports; Documents or practical guides discussing the implementation of Shewhart charts.

Inclusion criteria for literature: (1) Published within the last 10 years to ensure relevance and currency of the information; (2) Published by a trusted publisher or indexed journal; (3) Relevant to the research focus.

Exclusion criteria: (1) Articles that only discuss the Shewhart chart outside the educational context; (2) Literature that does not have access to complete data (only abstract).

Data Collection Techniques: (1) Data collection is carried out by means of; (2) Literature search through academic databases such as Google Scholar, Scopus, ProQuest, and ScienceDirect. Use of keywords such as "Shewhart chart", "statistical process control in education", "quality control in education", "quality of education", and other keyword combinations in English and Indonesian. Literature selection uses inclusion and exclusion criteria.

B. Results and Discussion

Results

Based on the results of the literature review conducted, the application of the Shewhart Chart in controlling the quality of education has been applied in various fields, including monitoring student performance, teaching assessment, consistency of the assessment process, and administrative efficiency. The following are some of the main findings from the studies analyzed:

1. Student Performance Monitoring

The use of Shewhart Charts to monitor student performance has been shown to be an effective tool for detecting patterns and variations in student learning outcomes. Madu and Adekola (2018) showed that Shewhart Charts can help teachers and administrators distinguish between typical variations caused by common factors in the teaching and learning

process and extraordinary variations that may require special interventions. For example, a significant decline in student performance may signal the need for revision of a particular teaching method or curriculum approach. Another study by Pishgar and Nejad (2020) applied Shewhart Charts to standardized test scores, identifying large changes in performance that could not be explained by random variation. These findings prompted timely interventions to correct special causes such as new testing policies or changes in teaching methods that could impact student outcomes. The primary purpose of applying Shewhart Charts in this context is to systematically monitor changes and trends in student learning outcomes, as well as detect variations caused by common or special causes. With ongoing monitoring, educators can quickly identify problems that may require corrective action before they escalate (Montgomery, 2019).

a. Identifying Variations in Learning Outcomes

A study by Madu and Adekola (2018) showed that applying the Shewhart Chart to student scores can help teachers identify when changes in student learning outcomes are due to acceptable variation (common cause) and when they are due to extraordinary factors (special cause). For example, if a large percentage of students show a decline in scores on a particular test, this may indicate a specific problem such as ineffective teaching methods, problems with the test questions, or other external factors that are affecting learning. Conversely, small, random fluctuations in student performance can be considered common causes and do not require special intervention. Additionally, a study by Pishgar and Nejad (2020) showed that the Shewhart Chart can visualize trends in student performance over time, which is very useful for measuring the impact of curriculum changes or new instructional strategies. If the chart shows that student performance is frequently outside of control limits, this is an indication that external factors need to be examined and corrected. In this way, the Shewhart Chart provides clear insight into when and how educators should make adjustments to the teaching process.

b. Benefits of Data-Driven Learning

Data-driven decision-making is essential in modern educational management, and Shewhart Charts play a vital role in this. The use of statistical controls allows educational institutions to

base their actions on concrete data, rather than on intuition or assumptions alone (Evans & Lindsay, 2020). For example, in a study by Roushdy et al. (2019), Shewhart Charts were used to monitor student performance over several semesters and helped educators understand performance patterns that might not have been apparent without in-depth statistical analysis. When data is presented in the form of a control chart, teachers can identify whether there are any downward or upward trends in learning outcomes that might have been missed if only relying on casual observation. For example, Montgomery (2019) suggests that seasonal variations in student performance, such as a decline in results at the end of the school year due to fatigue or stress, can be more easily identified through Shewhart Charts. Identifying these variations allows educators to make appropriate interventions, such as providing additional learning support in the run-up to final exams or introducing more interactive and engaging teaching strategies at critical times in the academic calendar.

c. Detecting Special Causes in the Learning Process

The use of Shewhart Charts also makes it easier to detect special causes that may be affecting student learning outcomes. A study by Wang and Smith (2019) showed that this statistical control helps identify when major changes are due to external causes, such as significant changes in teaching methods, teacher turnover, or technology issues that disrupt online learning. When data shows that student performance is out of control, teachers and school administrators can track the causes and take appropriate corrective action. In situations where special causes are present, as reported by Smith and Thomas (2018), control charts can show unusual patterns of fluctuation in student performance across classes. For example, if students in one class show a drastic drop in test scores while other classes do not, the control chart will highlight this variation and indicate that there is a problem specific to that class, such as differences in how material is delivered or an unfavorable classroom environment.

d. Improving the Quality of Teaching

Shewhart Charts have also been shown to be useful in evaluating and improving teaching quality. Jones and Taylor (2017) used statistical quality control to monitor teaching performance, based on student assessment data and classroom observations. In their study, Shewhart Charts helped detect consistent patterns, as well as detect changes in teaching

quality that required further training or changes in teaching methods. A study by Phillips et al. (2020) emphasized the importance of this tool in measuring the consistency of student feedback over the semester. The results showed that significant fluctuations in teaching ratings could indicate a mismatch between student and instructor expectations, which could then be addressed through professional development.

2. Consistency of Assessment Process

The importance of fair and consistent grading is another aspect where the Shewhart Chart plays a significant role. Wang and Smith (2019) applied the Shewhart Chart to monitor the distribution of grades across courses and identify deviations in the application of grading by different instructors. Variations that fall outside the control limits indicate the need for better standardization in grading or the need for additional training for instructors in assigning grades. In a similar study, Cruz et al. (2021) used control charts to ensure the fairness of grading in a college entrance exam. The results showed that consistent grading can be monitored and standardized, thereby minimizing bias that may arise from different raters.

According to Jones and Taylor (2017), Shewhart Charts have been used to monitor teaching quality by collecting data related to student evaluations, peer assessments, and classroom observations. These control charts help detect variations in teaching performance, which can be categorized as common causes or special causes. When the chart shows that the results of student evaluations or teaching assessments are outside the control limits, it indicates that there are special factors that affect the quality of teaching and require attention.

Pishgar and Nejad (2020) stated that the Shewhart Chart is very effective in visualizing teaching assessment data over time. When teacher performance variation is outside the control limits, it indicates factors that require intervention, such as additional training for teachers, changes in teaching methods, or even improvements to the learning environment. In many cases, the variation detected in this chart becomes the basis for educational institutions to develop more targeted teaching quality improvement programs.

One of the primary benefits of implementing Shewhart Charts to improve instructional quality is their ability to identify areas in need of professional development. According to Cruz et al. (2021), data collected through

control charts allows teachers and administrators to clearly see which parts of instruction are consistent and which parts show undesirable variation. If the chart indicates that instructional quality is out of control, professional development programs can be designed to address those specific issues. For example, if the chart shows a decline in a particular classroom assessment, additional training can be provided to teachers to help them improve their pedagogical skills or classroom management techniques.

In addition to monitoring day-to-day teaching, Shewhart Charts are also useful in evaluating the long-term impact of a particular teaching strategy. Wang and Smith (2019) suggest that statistical control can be used to track teaching quality over a longer period of time, such as a semester or an academic year. This allows institutions to see trends in teaching performance, which may not be obvious without the right statistical tools. For example, if teaching shows consistent improvement or decline over several months, a control chart will identify this and provide a clear indication of the effectiveness of the teaching approach being implemented. This data is very useful for educational institutions in designing more effective policies related to training and curriculum development.

3. Administrative Efficiency

Administrative efficiency in educational institutions is a key element in supporting the success of the overall educational process. Efficient management of various administrative aspects, such as student registration, financial management, student services, and complaint processing, is essential to ensure the smooth operation of educational institutions. In recent years, the application of Shewhart Charts or control charts has been used as a statistical tool to monitor and improve administrative efficiency in the education sector. Shewhart charts help identify and control variations in administrative processes, thereby enabling educational institutions to increase productivity, reduce waste, and provide better services to students and staff.

López et al. (2021) showed that the use of Shewhart Charts in administrative processes in educational institutions can monitor the performance of administrative services on an ongoing basis. For example, in monitoring the number of student complaints or the time it takes to process applications, control charts can help administrators detect variations in the process that require intervention. If the variation is outside the control limits, then special causes must be identified and addressed, such as staff shortages or inadequate information

systems.

Several other studies have shown that these statistical controls can also help improve administrative workflow. In a study by Evans and Lindsay (2020), Shewhart Charts were used to monitor workflow efficiency in a student enrollment department. The control chart showed significant spikes in processing time during busy enrollment periods. Thus, the administration could allocate additional resources during peak times or find more efficient technological solutions to address the problem.

Pishgar and Nejad (2020) found that Shewhart Charts can be used to reduce variation in administrative services by monitoring processes such as student admissions, academic services, and academic document processing. Through visualization of control charts, reasonable variation (common causes) can be identified and separated from variation caused by process errors or external factors (special causes). This allows educational institutions to focus more on improving aspects of the service that are vulnerable to disruption or unexpected changes.

For example, in the case of educational institution financial management, Cruz et al. (2021) used the Shewhart Chart to monitor payment processing speed and student cash flow. The chart identifies specific causes that affect payment delays, such as technical issues with the online payment system or lack of support staff during the payment period. By identifying and correcting these causes, educational institutions can reduce student wait times and improve the efficiency of financial administration.

4. Challenges in Applying Shewhart Charts in Education

Despite its promising results, the use of the Shewhart Chart in education faces several challenges. Becker and Johnson (2019) noted that educational data often does not meet the normality assumptions underlying the Shewhart Chart. Variations in student performance can be influenced by many factors that are difficult to measure, such as the socioeconomic background, mental health, or motivation of individual students (Smith & Thomas, 2018). These variations, although captured by the Shewhart Chart, do not always indicate quality problems that can be intervened.

Another study by Halliday and Mitchell (2020) showed that small sample sizes in some classrooms or academic programs can also affect the reliability of control charts in education. Smaller

institutions may need to use additional statistical methods or modifications to the Shewhart Chart to get a more accurate picture.

Discussion

However, like any other tool, the Shewhart Chart has advantages and disadvantages that need to be considered when applied in an educational context.

1. Advantages of Shewhart Charts in Educational Administration

a. New Student Admissions (PMB) Excess:

Monitoring Enrollment Trends and Variations: Shewhart charts can be used to monitor enrollment numbers from year to year, to see if there is a significant increase or decrease. This helps universities plan more effective promotional and marketing strategies.

Identifying Problems Early: If there is an unusual decline in the number of applicants outside of normal variations, management can identify the cause of the problem (e.g., an unsuccessful admissions campaign or competition from other universities) and take immediate corrective steps.

"By utilizing control charts, we can see patterns in new student enrollment, allowing for better data-driven decision making." (Montgomery, 2020)

b. Curriculum Development

Evaluating Curriculum Effectiveness: Shewhart charts can monitor student evaluation results on an ongoing basis to determine whether implemented curriculum changes are resulting in significant improvements in student learning outcomes. These results can guide decisions to update or improve the curriculum.

Identifying Changes in Student Performance: Control charts also allow educators to see if there are any sudden decreases or increases in student performance related to curriculum changes, so that more specific corrective steps can be taken.

"Control charts facilitate the process of continuous evaluation and improvement of the curriculum, supporting appropriate adjustments based on measurable learning outcomes." (Deming, 2000)

c. Human Resource Development (Teachers and Educators)

Monitoring Teacher and Educator Performance: Using the Shewhart chart, schools can monitor teacher performance (e.g., student assessments, classroom observation results, or student achievement under the teacher's guidance). This can help identify if any teachers need additional training or support.

Ensuring Consistency of Teaching

Delivery: Shewhart charts can also be used to ensure that teaching standards across a school or university are consistent, identifying fluctuations in performance that may be due to internal or external factors.

"Shewhart diagram plays a role in maintaining consistency in teaching quality by systematically monitoring human resource performance." (Foster, 2018)

d. Management of Facilities and Infrastructure (Sarpras)

Monitoring Infrastructure Utilization Efficiency: Shewhart charts can be used to monitor the utilization levels of facilities and infrastructure, such as laboratories, classrooms, or libraries, and identify whether there is unused capacity or excess utilization that requires increased allocation.

Early Detection of Facility Failure: By monitoring facility and infrastructure usage and maintenance data on a regular basis, management can identify early signs of facility failure, thereby preventing major failures in the future.

"The use of control charts in infrastructure management allows early detection of problems and optimizes the use of facilities efficiently." (Oakland, 2003).

2. Weaknesses of the Shewhart Chart in Education Implementation

a. New Student Admissions (PMB)

Static Data: Shewhart charts can only identify patterns based on historical data, so they cannot take into account dynamic external factors, such as educational trends, prospective student preferences, or changes in government policy.

The Need for Big Data: To obtain statistically significant results, the Shewhart Chart requires large amounts of data. In the hiring process, this can be a challenge if there is large variation in the number of applicants from year to year.

"The limitation of the Shewhart Chart lies in its reliance on historical data and does not always reflect dynamic trend changes." (Lepore, 1999). b. Curriculum Development.

Difficulty Capturing the Complexity of Learning: Teaching and learning processes and curriculum are complex, and many factors influence student learning outcomes, such as motivation, socioeconomic background, and family environment. Shewhart charts may not adequately capture this complexity, especially if they rely solely on test scores or other quantitative assessments.

The Risks of Focusing Too Much on Quantitative Data: Sometimes, too much

focus on numbers and graphs can distract from the qualitative aspects of learning that are also important, such as student engagement, creativity, and critical thinking skills.

"While useful, control charts risk reducing a rich educational process to mere numbers and graphs that do not necessarily reflect all aspects of learning quality." (Foster, 2018)

c. Human Resource Development (Teachers and Educators)

Incomplete Performance Assessment: Teacher performance cannot always be measured through statistical data alone. Other aspects such as interaction with students, motivational abilities, and emotional skills are difficult to measure with the Shewhart Chart.

Lack of Flexibility for Individual Variation: Teachers with different teaching styles may produce different results for their students. Shewhart charts tend to rely on general standards and may not be flexible enough to accommodate variations in teaching style while still being effective.

"The use of Shewhart Charts to monitor HR performance sometimes focuses too much on statistical results and not enough on the qualitative aspects of instruction." (Deming, 2000)

d. Facilities and Infrastructure Management (Sarpras)

Does Not Consider Qualitative Factors: Shewhart Charts may not take into account qualitative factors such as user comfort or satisfaction with the facilities provided. This may cause decisions made based on Shewhart Chart data to not always reflect user needs.

Responding to Variations That May Be Insignificant: Sometimes, a Shewhart Chart may show variations that appear significant but actually have little impact on facility usage. This can lead to unnecessary actions and wasted resources.

“One of the major weaknesses of using the Shewhart Chart is the lack of attention to qualitative factors that are important in facilities management.” (Oakland, 2003)

The Shewhart Chart offers many advantages in aiding the delivery of education, especially in terms of quantitatively monitoring performance, variation, and quality. However, like any tool, the use of the Shewhart Chart also has limitations, especially in capturing important qualitative aspects of education, such as emotional engagement, motivation, and user satisfaction. Therefore, this approach is most effective when used in conjunction with other tools or methods that can complement the gaps in quantitative data-based analysis.

Findings from the literature indicate that the Shewhart Chart offers a number of benefits in quality control in the education sector, particularly in assisting data-driven decision making to monitor academic and administrative processes. This tool enables educational administrators to systematically identify the causes of variation in student performance, teaching quality, and administrative process efficiency.

Some of the benefits of implementing Shewhart charts in educational quality control management are as follows:

1. Early Detection of Problems
   Montgomery, DC (2019) Identifying deviations from quality standards before they become major problems.
2. Improving the Quality of Learning
   Green, SB, & Brown, A. (2017) Monitoring and improving critical aspects of the educational process, such as teaching methods and curriculum.
3. Data-Driven Decision Making
   Evans, JR, & Lindsay, WM (2014) Providing a statistical basis for making more objective and measurable decisions in educational management.
4. Reducing Process Variability
   Besterfield, DH (2013) Reducing unwanted fluctuations in the educational process, ensuring consistency and stability.
5. Improving Stakeholder Satisfaction
   Oakland, JS (2014) Improving student, lecturer, and other stakeholder satisfaction through continuous monitoring and quality improvement.

One of the main benefits of using Shewhart Charts in educational administration is increased student satisfaction. According to Jones and Taylor (2017), efficient and timely service is one of the factors that greatly influences student satisfaction levels. By using control charts, educational institutions can consistently monitor service quality and identify areas where performance is declining. For example, in library services or academic support, control charts can help identify times when lines are too long or wait times are too long.

In a study by Wang and Smith (2019), Shewhart Charts were used to monitor response times to student complaints and inquiries. The results showed that the control chart helped identify that there were certain periods in

the academic year where response times increased significantly, especially during early and late semester registration. Through this data, educational institutions can make adjustments, such as adding staff during peak periods or automating some processes, which ultimately improves student satisfaction and service efficiency.

However, there are some limitations to consider, including the assumption of normality and small sample size, which may affect the reliability of the analysis. As technology advances and educational data collection becomes more sophisticated, solutions such as the use of Cumulative Sum Control Chart (CUSUM) and Exponentially Weighted Moving Average (EWMA) have been suggested as more suitable alternatives for more complex educational data (Phillips et al., 2020; Becker & Johnson, 2019).

In the future, further development of the SPC methodology for education, as well as integration with other approaches such as learning analytics and artificial intelligence, may offer greater opportunities to improve the quality of education in the future (Halliday & Mitchell, 2020). The use of Shewhart Charts also allows educational institutions to detect potentially disruptive administrative issues early on. Montgomery (2019) explains that control charts provide clear indicators when there is unusual variation in administrative processes, allowing corrective action to be taken more quickly before the issue has a major impact on day-to-day operations. For example, in the case of academic document processing, if the chart shows that processing times have suddenly increased, this could indicate issues such as procedural errors or lack of coordination between departments.

Smith and Thomas (2018) also added that Shewhart Charts help detect technical problems in administrative systems, such as campus management information system failures. By monitoring data from these systems, control charts can identify patterns that indicate technical glitches or bottlenecks in digital workflows that require attention.

Despite its many advantages, the application of the Shewhart Chart in educational administration is not without challenges. One challenge identified by Becker and Johnson (2019) is the inability of some administrative processes to always conform to the assumption of data normality underlying the Shewhart Chart. Many administrative processes are irregular or have complex external factors, such as

changes in government regulations or internal policies, which can disrupt workflows and cause variations that are not easily predicted.

Halliday and Mitchell (2020) added that in the administrative context, variability in processes is often higher than in manufacturing processes, so the interpretation of control charts must be done carefully. If too much variation is outside the control limits, there is a risk of "false positives", which cause administrators to take unnecessary action.

C. Conclusion

Overall, the Shewhart Chart has proven to be a useful tool for improving administrative efficiency in educational institutions. By monitoring and controlling variation in administrative processes, institutions can increase productivity, reduce waste, and provide better service to students and staff. However, its application requires a deep understanding of the characteristics of administrative data, as well as a combination with other methods to maximize results. In the future, the development of more sensitive statistical methods and the use of advanced technologies can further support administrative efficiency in educational settings.

Suggestion

In further research, the author suggests conducting direct research with data using quantitative or mixed methods so that the results of the application of the Shewhart Diagram to the quality of education can be measured concretely with data support, thereby strengthening the results that are not yet available in the findings of the research that has been carried out.

Bibliography

Becker, H., & Johnson, K. (2019). Challenges in Implementing Statistical Process Control in Education. Journal of Educational Measurement, 36(2), 134-149.

Besterfield, D.H. (2013). Quality Control (8th ed.). Pearson.

Cruz, A., Garcia, P., & Reyes, J. (2021). Ensuring Fairness in Entrance Exams Using Control Charts. Educational Measurement Review, 19(4), 78-90.

Evans, JR, & Lindsay, WM (2020). Managing for Quality and Performance Excellence. Cengage Learning.

Green, S. B., & Brown, A. (2017). Quality Control Basics: A Practical Guide to Implementing SPC in Educational Settings. Educational Quality Press.

Halliday, T., & Mitchell, G. (2020). Implementing SPC in a Small Educational Program: A Feasibility Study. Journal of Educational Quality Monitoring, 25(2), 112-130.

Jones, P., & Taylor, S. (2017). Using Shewhart Charts to Monitor Teaching Quality: A Case Study. Educational Quality and Improvement Quarterly, 29(1), 45-60.

.

López, M., García, R., & Hernández, S. (2021). Application of SPC to Administrative Processes in Higher Education. Journal of Educational Administration, 39(3), 98-112.

Madu, S., & Adekola, A. (2018). The Use of Control Charts to Monitor Students' Achievement in Mathematics. International Journal of Educational Technology, 42(1), 25-39.

Montgomery, DC (2019). Introduction to Statistical Quality Control (8th ed.). John Wiley & Sons.

Oakland, JS (2014). Statistical Process Control (7th ed.). Routledge.

Phillips, M., Johnson, R., & Erickson, J. (2020). Applying CUSUM and EWMA Charts to Monitor Educational Outcomes. Journal of Higher Education Statistics, 22(3), 58-73.

Pishgar, M., & Nejad, A. (2020). The Role of SPC Charts in Identifying Standardized Test Score Trends. Assessment and Evaluation in Education, 31(2), 67-85

Roushdy, M., Fahmy, H., & El-Adl, M. (2019). Application of SPC in Student Performance: A Case Study in Higher Education. International Journal of Educational Research, 25(3), 118-135.

Smith, J., & Thomas, E. (2018). Educational Data and the Normality Assumption in SPC Applications. Journal of Educational Data Science, 15(4), 109-125.

Wang, L., & Smith, T. (2019). Ensuring Consistency in Assessment Using SPC Techniques." Higher Education Evaluation Review, 12(4), 52-70.