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Students' performance evaluation for secondary school in Mbulu district using mean and dispersion charts grade and fixed grading method

Abstract

This article focuses on comparing the evaluation of students' performance using the Mean and dispersion chart grade and fixed grading method. This quantitative study was conducted in Mbulu district council. The assessment of students' performance is one of the challenges that face assessors in secondary schools. This quantitative study investigated students' performance by comparing their performance using statistical quality control charts grade and fixed grading method. The study used secondary data collected from 240 sampled documents obtained from academic students' progressive reports from six ordinary secondary schools in the Mbulu District. The students' performance is analyzed by using statistical quality control charts grade and fixed grading method. The findings revealed that in the Mean and S chart grade method, a large number of students performed well than in the fixed grading method. The mean and S chart grade method was better than fixed grading in evaluating students' performance since it lowers the cut-off point of the individual students' performance. The finding has implications for evaluating students' performance because secondary school teachers can use mean and S chart grades to raise individual students' performance in each subject.

Keywords: mean and S chart, evaluation of students' performance and fixed grading

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Introduction

Tanzania is one of the several countries in the world that face challenges in their respective educational system. Poor students' performance in ordinary secondary schools is considered as one of the challenges. Focusing on Tanzania's education system is vital, as education has been acknowledged as a critical component for social and economic development of any nation.[1] A country that cannot raise its people's knowledge and abilities and use them successfully in the national economy is incapable to invest in education and thus cannot develop anything at all. Every developed country in the world has a pool of highly educated and competent workers. These human resources allow the country to gain benefits by effectively utilizing the natural resources of the country. Therefore, secondary education is essential part of the country's socio-economic growth.[2]

Examinations are used to assess the performance of students at all stages of education and in all professional contexts, and they focus on their successes in such examinations.[3] One strategy to ensure that students' academic performance is of high quality is to have them examined and monitored closely. As a result, we must develop scientific ways for evaluating students' performance to meet educational objectives. This study focuses comparing Mean and S control chart grade with fixed grading method in evaluating students' performance at ordinary secondary schools in Tanzanian context.

Mean and standard deviation control chart

According to Stamatis[4], the mean and standard deviation method are monitored using mean and standard deviation control charts based on samples taken from the process at a specific period. The measurement results of the sample at a given point in time form a subgroup. Once you have established the mean and standard deviation control limits, you can use these limits to control the mean and deal with future changes. If a point is not inside the control limits of these settings, it implies that the process change is outside these limits. When the control chart shows process is not statistically controlled, it is detected to be attributable. Woodall[5] explained that, mean and standard deviation chart which are also termed as control charts is a sort of statistical process monitoring system which is used simultaneously by taking account the mean and standard deviation of normally distributed variables during regular sampling in industrial processes. According to Montgomery[6], the interpretations of mean and standard deviation charts mean that if all points fall inside the lower and upper limits it implies that the process is statistically controlled and if all or some of the points fall out of the upper and lower bounds, the process is statistically out of control.

Fixed grading method

Guskey and Pollio[7] state that assessment is a set of signs, words, or figures that represent different degrees of success or competence. Grades are presented by letters A, B, C, D, and F; symbols or numbers such as 1, 2, 3, or 4, and descriptive terms such as Exemplary, Satisfactory, or Needs Improvement. These grades were created by the method of grading system. Regarding grades, Guskey and Pollio[7] declare that school examinations' grades were created to select students according to their talents, advance students from lower to higher levels and assure the availability of professionals in all fields for long-term development. For a long time, all examinations at the ordinary secondary level used five grades. These grades have been changed and new grades introduced in their place as shown in the Table 1 below:

Research that has been conducted on evaluation of students' performance

Beshah[8] conducted a study in Ethiopia on how to assess students' performance in higher education by utilizing quality control methods. To address the problems that students have in their performance, the study employed statistical process control. The scores from 20 students were selected randomly and the collected data were analyzed

and interpreted using mean and range charts. Statistical quality control (SQC) was used in this study to produce a new scoring technique that compares favorably to the previous way of determining score. However, the findings revealed that using SQC-based technique allowed teachers to award grades more objectively than before, and that students viewed the new technique as more motivating than the previous one.

Table 1 Fixed grading system in ordinary secondary education

Early grading system		New grading system	
Score	Grade	Score	Grade
81-100	A	75-100	A
61-80	B	65-74	B
41-60	C	45- 64	C
21-40	D	30-44	D
0-20	F	0 -29	F

Zacharia[9] conducted a study in Tanzania at Igunga district on evaluation of students' performance in ordinary secondary schools by adopting quality control approaches. The respondents of the study were 210 students chosen at random from their academic progress reports and the data were analyzed using statistical process control techniques. Nevertheless, the findings of the study show that secondary school students' performance was not statistically control, implying that there were addressable sources of variation in their performance that need to be identified and addressed.

Furthermore, most of the researchers have explained the concepts of evaluation of students' performance using different methods of evaluation process and some measures has been taken to solve the challenges that exist in evaluation of students' performance in many regions of the world and some part of Tanzania. Some studies with different authors for example Beshah8 and Zacharia9 and others have been conducted on evaluation of students' performance utilizing quality control methods in different areas of the world and in Tanzania. Akessa & Dhufera[10] studied the factors that influence student's academic performance. Ali et al.[11] developed the factors influencing students' performance at university level. Akinrefon & Balogun[12] discussed use of Shewart control chart technique in monitoring student performance. Patena & Dinglasan[13] studied students' performance on Mathematics departmental examination: basis for Math intervention program. However, no study that have been conducted on the comparison of Mean and S charts grade and fixed grading method in evaluating students' performance.

Conceptual framework for the study

The role of a conceptual framework is to display the relationship between the variables that are used in the study. As such, it connects different facts and directs the collection of relevant facts or evidence.[14] The conceptual framework of this study is centered on the overall goal of the study, which is to compare the evaluation of students' performance that uses statistical mean and S chart grade method against a fixed grading method. The conceptual framework for this study is presented in Figure 1.

Methodology

This is a quantitative study that employed the cross-sectional research design. The quantitative approach is important for broad investigation of secondary school students' performance since the performances are in numerical form. The study was conducted in Mbulu district, particularly at Mbulu Town Council in Manyara region in Tanzania. The map of Mbulu District Council is displayed in Figure 2 below:

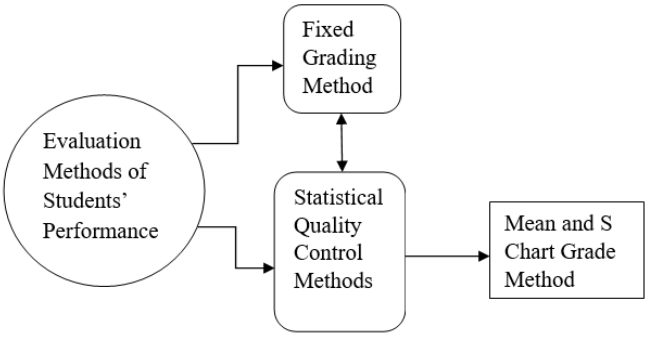

Figure 1 The relationship between response variables (Self- developed 2021).

Figure 2 Map of Mbulu district council.

The data for this study are secondary data which are collected from Mbulu district starting from 2nd week and end up in last week of September 2021 focusing on six subjects which are taught in ordinary secondary schools. These subjects are Kiswahili, History, Geography, English, Biology and Mathematics.

All codes of conducts of a research work were observed in the whole processes of data collection and analysis. For instance, the details of the study are clearly explained to informants to seek their consent to participate consciously in the research. The data collection and analysis are quantitative in nature since 240 samples of students' performances are collected from six ordinary secondary schools in Mbulu district. The method used in this study to analyze data are the Mean and S control chart grade and fixed grading methods with the help of statistical tool known as Minitab statistical software. The analysis of collected data is described in sub section below:

Comparing mean and S chart grade method with fixed grading method in evaluation of students' performance

According to Montgomery[15], a mean chart is a control chart that can be used to measure changes in the mean value of the data, whereas a standard deviation chart is used to examine changes in the variability of the data gathered. It combines all average and standard deviation of each subject from the schools that are selected. The data gathered in this study are analyzed with the mean and standard deviation control chart using Minitab statistical software, and the manipulations of the data are done as described below:

Mean control limits are as follows:

LCL = $\overline{\overline{X}} = A_3\overline{S}$.

CL = $\overline{\overline{X}}$.

UCL = $\overline{\overline{X}} = A_3\overline{S}$.

Range control limits are given as:

LCL= $D_3\overline{S}$.

CL= $\overline{S}$.

Where A_3, D_3 and D_4 are constants which only depend on the subgroup of the sample size "n" since n is the subgroup number and was obtained from the table of constants. One and two sigma limits are used on both sides of the CL to construct students' grade. The mean and standard deviation control chart grade are presented graphically as shown below(Figure 3):

Mean and S control chart grade

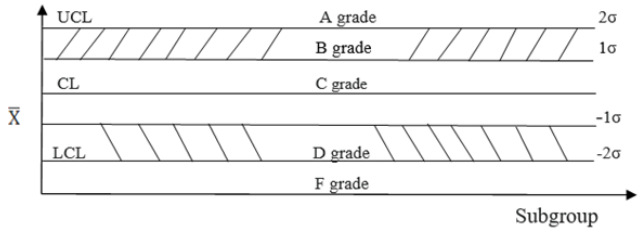

Figure 3 Individual control chart grade of a subject.

Where $\hat{\sigma} = S$

Results

The results of this study are based on the use and comparison of mean and S chart grade and fixed grading method in evaluation of students' performance in ordinary secondary schools in Mbulu district. The analysis of 240 samples of students' performance is conducted. The gathered information from each ordinary secondary school for each subject are analyzed and shown in sub section below:

Comparing students' performance between subjects by using mean and S chart grade with fixed grading

The data collected are analyzed and interpreted using mean and S charts. These charts are used because the study is carried out to measure students' performance of a large size of 240 students. The schools have different teachers, and the general teaching atmosphere from one school differs significantly from that of another. Hence, the sample of students is chosen to determine the average. A mean chart was used to regulate variations in a process average value while a standard deviation chart is used to control changes in the process variability.

The following are mean and standard deviation charts for the subjects. The analysis revealed that not all observations are inside the control limit, which indicates that students' performance varied from one subject to another and from one school to another.

Interpretation of mean and S charts of S_1-S_6 secondary schools for each subject

As per the analysis for mean control chart of Kiswahili subject in Figure 4, the central line was shown at overall mean of 40 sample means with $\overline{\overline{X}} = 57.69$, $UCL = 75.51$ and $LCL = 39.88$. According to the findings from the mean control chart grade of Kiswahili subject, grades intervals for Grade A become above 75.51, Grade B between 75.51 and 66.59, Grade C between 66.59 and 48.29, Grade D between 48.29 and 39.88, and Grade F below 39.88.

In the education system, the scores above UCL indicate those students with good performance or the students who scored Grade A and the observations falling below LCL indicate poor performance or Grade F. For example, in this mean chart two students' scores were above UCL which is not termed as the observations that fall outside the control limits, but they imply very good performance that is, the candidates who got Grade A. From the chart, it was also found that, 3 students acquired Grade A, 6 students got Grade B, 5 students got Grade D, 25 students got Grade C whereby 1 student got Grade F. This implies that students' performance in Kiswahili subject was almost average.

According to the analysis of the S control chart in Figure 4, the $UCL = 24.80$, $CL = 10.94$, and $LCL = 0$ all points were inside the control limits. This indicates that the operation was statistically controlled. Furthermore, just 15 points out the of 40 were over the sample average standard deviation, 8 points were within the sample mean standard deviation, and 17 observations were under the sample average standard deviation. From fixed grading system, in the analysis of mean of Kiswahili subject, it was found that no student received Grade A, 1 student got Grade B, 22 students got Grade C, 16 students scored Grade D and 2 students scored Grade F. Likewise, the results found from two grading methods point out that, the mean and S control chart grade of Kiswahili subject has actual gain than the fixed grading method since it promotes students' performance.

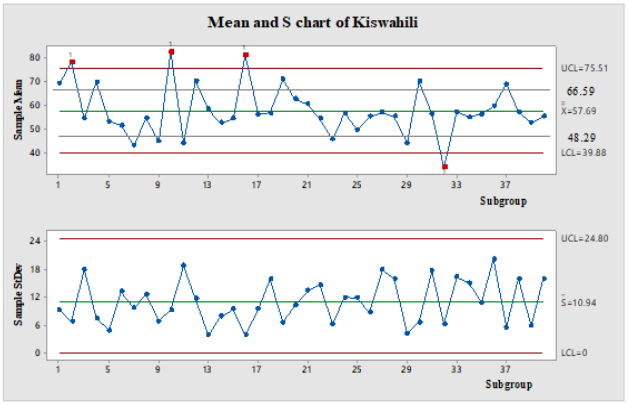

Figure 4 Control chart for mean and S chart of Kiswahili.

Figure 5 shows the mean control chart of History subject with the $UCL = 76.80$, $CL = 62.36$, and $LCL = 47.91$. The findings obtained through the mean control chart of History subject show that, the grades intervals for Grade A become above 76.80, Grade B between 76.80 and 69.58, Grade C between 69.58 and 55.13, Grade D between 55.13 and 47.91, and Grade F below 47.91.

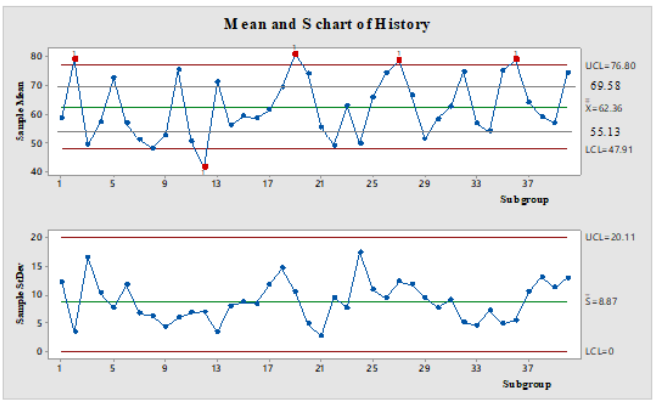

Figure 5 Charts for mean and S control chart of History.

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In the education system, the scores above UCL indicate those students with good performance or the students who scored Grade A and the scores falling below LCL indicate poor performance or Grade F. For example, in the mean control chart, the sample means for the 28th, 30th, and 31st samples were all above UCL. These were not regarded observations outside of statistical control, but they indicated good performance; i.e., students who scored Grade A. From the chart, it is also shown that, 4 students scored Grade A, 8 students got Grade B, 9 students got Grade D, 17 students scored Grade C whereby 1 student scored Grade F.

In addition, standard deviation control chart of History subject has the $UCL = 20.11$, $CL = 8.77$, and $LCL = 0$. The chart indicates that, the process was statistically under control where all points were within the control limits. At the same time, it was found that, out of 40 points only 16 points were above the sample mean standard deviation. In fixed grading system, the analysis of mean of History subject revealed that 1 student scored Grade A, 3 students got Grade B, 12 students acquired Grade C, 18 got Grade D and 4 students got Grade F.

The outcomes of the two grading techniques show that the mean and standard deviation control chart grade of History subject is more appropriate than the fixed grading system since it boosts students' performance.

Figure 6 indicates the mean control chart for Geography subject with the control limits as follows $UCL = 81.99$, $CL = 68.03$, and $LCL = 54.07$. From the findings obtained from mean control chart of Geography subject, it is revealed that, the grades intervals for Grade A become above 81.99, Grade B between 81.99 and 75.01, Grade C between 75.01 and 61.05, Grade D between 61.05 and 54.07, and Grade F below 54.07.

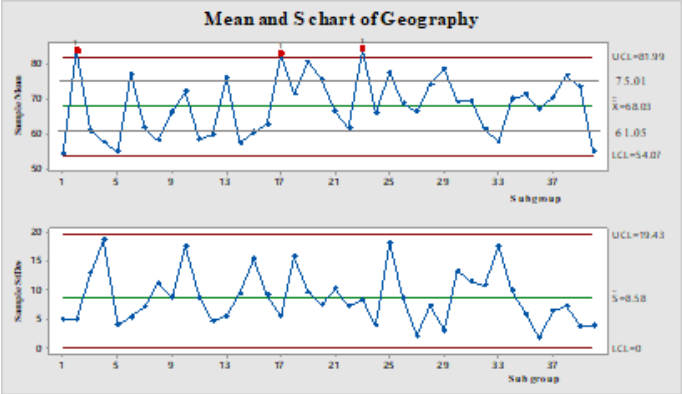

Figure 6 Charts for mean and S control chart of Geography.

In the education system, the scores outside UCL indicate those students with good performance; i.e., the students who scored Grade A and the observations falling below LCL indicate poor performance or Grade F. For example, in the mean control chart, the 16th and 28th sample averages were above UCL, which have not been regarded as the scores outside the control chart, but they are the points that indicate good performance. This implies that two students got Grade A because the region above the UCL represents the Grade A.

From the chart, it was also shown that, 3 students scored grade A, 7 students scored grade B, 10 students scored D, 20 students scored grade C whereby no student scored grade F, which implies that students' performance in Geography subject was nearly at average. The analysis of fixed grading system of mean of Geography subject revealed that no student scored grade A, 1 student got Grade B, 15 students obtained Grade C, 21 received Grade D and 3 students got Grade F. The findings from two grading method revealed that, the mean and S control chart grade in Geography subject is more helpful in evaluation than the fixed grading method since it increases students' performance.

Figure 7 presents mean control chart of Biology subject with the following control limits $UCL = 86.58$, $CL = 73.05$, and $LCL = 59.52$. The results obtained from mean control chart of Biology subject show that, the grades intervals for Grade A become above 86.58, Grade B between 86.58 and 79.82, Grade C between 79.82 and 66.29, Grade D between 66.29 and 59.52, and Grade F below 59.52.

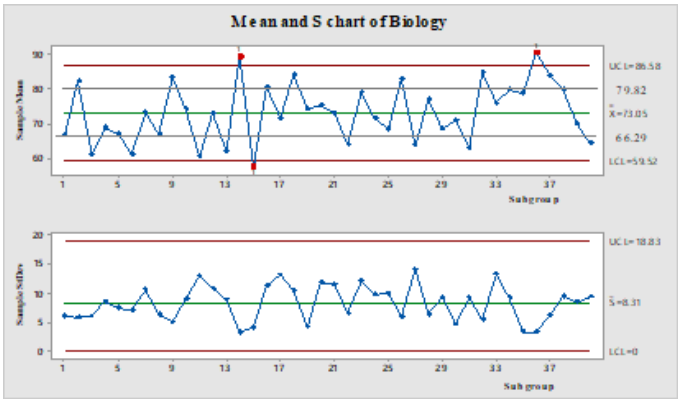

Figure 7 Charts for mean and S control chart of Biology

From the standard deviation control chart, the $UCL = 18.83$, $CL = 8.31$, and $LCL = 0$. The chart shows that the process was under statistical control where all points were within the control limits. In addition, from point 1-10, more points were below the sample mean standard deviation; from point 1-30 more points were above the sample mean standard deviation; and from 3-40 more points were below the sample mean standard deviation. This pattern of data points within the control limits indicates that there was a change in materials or some other causes of variation.

In education system, the scores over UCL indicate those students with good performance; i.e., the students who scored Grade A and the scores falling under LCL indicate poor performance or Grade F. For example, in the mean chart, the 17th and 40th sample means were over the UCL. This indicates good performance; i.e., two candidates received Grade A because the region just above UCL represents Grade A region, while the sample means 2nd, 26th, and 33rd were below the LCL, indicate poor performance. The chart also shows that, 2 students got Grade A, 7 students got Grade B, 8 students received Grade D, 22 students got Grade C and 1 student obtained Grade F.

The analysis of fixed grading system of mean of Biology subject revealed that no student scored Grade A, 1 student scored grade B, 14 students got grade C, 20 got Grade D and 5 students scored grade F. From the outcomes of the two grading techniques, the results revealed that the mean and standard deviation control chart grade in Biology was more essential than the fixed grading method because it boosts students' performance.

Figure 8 represents mean control chart for the $UCL = 87.23$, $CL = 73.49$, and $LCL = 59.75$. The results obtained from mean control chart of English subject show that, the grade intervals for Grade A become above 87.23, Grade B between 87.23 and 80.49, Grade C between 80.49 and 66.75, Grade D between 66.75 and 59.75, and Grade F below 59.75. From the standard deviation control chart, the $UCL = 19.12$, $CL = 8.44$, and $LCL = 0$. The graph depicts

that the process was under control, with all points falling within the control limits. Moreover, it was revealed that nearly all sample observations were inside the sample average standard deviation.

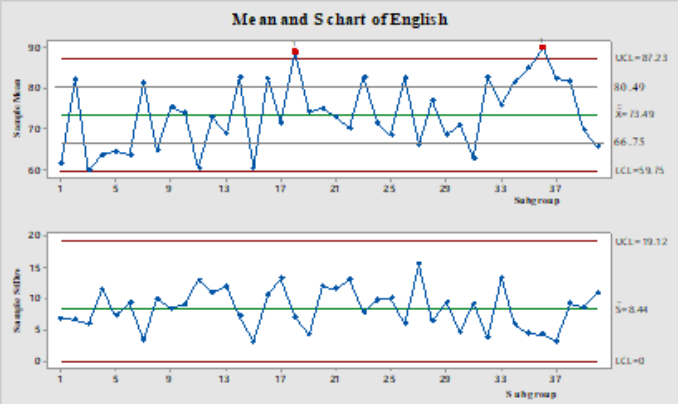

Figure 8 Charts for mean and S control chart of English.

In education system, the scores observed over UCL indicate those students with excellent performance; i.e., the students who scored grade A and the scores falling below LCL imply poor performance or grade F. For example, no sample means were over UCL in the mean control chart. This indicates that no students received Grade A in English subject. Conversely, students who got under LCL had poor performance. The chart also shows that, 2 students got Grade A, 11 students got Grade B, 10 students got Grade D, and 17 students got Grade C whereby no student scored Grade F. This implies that students' performance in English subject was almost moderate. From the fixed grading system, the analysis of mean of English subject implied that no student got Grade A, 2 students got Grade B, 22 students got Grade C, 15 students obtained Grade D and 1 student scored Grade F.

The findings from the two grading methods revealed that the mean and standard deviation control chart grade in Biology subject was more essential than the fixed grading approach since it increases the students' performance.

Figure 9 represents the mean control chart of Mathematics subject with the $UCL = 59.62$, $CL = 47.13$, and $LCL = 34.63$. According to the results obtained from mean control chart of Mathematics subject, the grades intervals for A become above 59.62, B between 59.62 and 53.38, C between 53.38 and 40.88, D between 40.88 and 34.63, and F below 34.63. From the standard deviation control chart, the $UCL = 17$, $CL = 7.67$, and $LCL = 0$. The graph indicates that the process was statistically controlled, with all observations falling inside the control limits. Likewise, it was observed that approximately all data points were inside the sample average deviation.

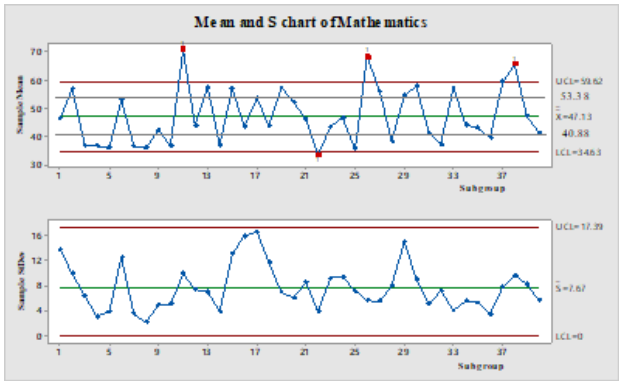

Figure 9 Charts for mean and S control chart of Mathematics.

In education system, the scores above UCL indicate the students that have high performance. For instance, in the mean chart, there were no sample means that were over UCL. This indicates that no student scored Grade A in English subject. Likewise, the scores below LCL indicate the students with low performance. If some sample averages were under LCL, they are not termed as observations that were outside the control chart but observations indicating poor performance represent Grade F. The mean and S control chart of Mathematics subject revealed that, 3 students scored Grade A, 9 students scored Grade B, 16 students scored Grade C, where 1 student scored Grade F. As per the results of the two grading systems, the mean and standard deviation control chart grade of Mathematics subject is more vital than the fixed grading method because it optimizes the students' performance.

According to Guskey & Pollio,[7] the fixed grading methods intervals for Grade A were above 74, Grade B between 65 and 74, Grade C between 45 and 64, Grade D between 30 and 44, and Grade F between 0 and 29. When the fixed grade intervals and the mean and S control chart grade were compared result show that, the students' grade have dropped in fixed grading method. This indicates that the mean and S control grade increases the students' performance simply by lowering the cut-off points.

Conclusions and recommendations

This paper presents findings focused on the comparison of Mean and S chart grade and fixed grading methods in the evaluation of students' performance in ordinary secondary schools in Tanzanian context. In comparing students' performance between subjects by using mean and S chart over fixed grading method, the analysis of the students' performance by using mean and S chart grade and fixed grading method, reveal that the fixed grade intervals were lower than the mean and S chart grade method in raising students' performance. This implies that the mean and S chart grade increases students' performance as compared to the fixed grading method. This is because the mean and S chart monitored the mean and variability of the process. A statistical quality control chart grade is a graphical supervisor of students' performance that recognizes the importance of grade point in students' performance. According to the results of the study, more students were not performing well in their studies due to presence of variability in the process of learning. Thus, the researcher suggests the following to increase students in ordinary secondary schools. The ministry of education should propose a regulation that encourages teachers to adopt mean and S chart grade rather than a fixed grading method when evaluating students' performance. In addition, the government should use the mean and S chart lower control limit (LCL) as a minimum academic benchmark for each subject at each level when judging whether a student passes a subject in the national education standard throughout time.

This research also advocates that further research to be conducted, focusing on the application of mean and S chart grade and fixed grading techniques on evaluation of students' performance at different levels of education, such as pre-primary, primary, advanced, and university. In the same way, the similar study can be replicated in either other regions or the whole country at large.

Acknowledgments

None.

Conflicts of interest

The authors declare the there are no conflicts of interests.

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