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Analysis of Results of Core Academic Subjects of Ghanaian Secondary Schools: Case Study of a Secondary School in Ghana

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Abstract
Educational authorities in Ghana have generally established that the performance of school leavers especially at the pre-university level offered a large room for improvement, due to so many factors. Hence, the introduction of the New Educational Reform in 1987 which led to the new system of Senior Secondary School with the first product in 1993. The study was to create awareness of whether Ghana's New Educational Reform, which has been in place since 1987, has led to improvement in performance of Senior Secondary Schools in Ghana in the area of the four core disciplines: Mathematics, Integrated Sciences, Social Studies, and English language. Two–way Analysis of Variance (ANOVA) without replication was derived to determine whether significant differences existed between grades, subjects and the years involved in the study to obtain some dimensions for determining the performance of students in the institution. Social Studies and the grades C, D and E gave the institution a glorious image while Mathematics, Integrated Science and English Language and grade F, gave the institution a poor image. However, majority of the grades A and B were associated with Core Mathematics. There was no significant difference in the trend of students' performance between years in the study period. We recommend that future research spanning a period from 2006 to 2014, which has different grading system, under the West African Senior School Certificate Examination (WASSCE) grading system, be done in a comparative manner. This might include students in two or three regions of Ghana. To make the research generalizable, random samples of schools and students must be considered.
Keywords: Percentage number of grades; interaction; replications; West African Senior School Certificate Examination (WASSCE) grading system.

1. Introduction

Before the influx of European into Ghana and other parts of Africa, the indigenous people had their own education where the home was the school and their place was the classroom (Kenyatta, 1963). He stressed that everybody played role of teacher and learned from each other based on one's skills. Teaching and learning were conducted within context, with an emphasis on a way of living in society. Important elements of this education was seen in built-in skills and values like hunting pottery, wrestling as well as virtues and vices of society like obedience and oracy (Kenyatta, 1963).

Today, people look at education in terms of what it will enable them to achieve. Many researchers in education also see it as a human right and that every individual should have access to it (Opolot & Enon, 1990). Bureaucrats argue that the present system is highly influenced by the western system, and produces theoretical elites. It is highly dominated by undue emphasis being placed on rote learning, memorization, and recall of factual knowledge at the expense of critical thinking, cognitive knowledge, reasoning and problem solving skills, and the ability to apply knowledge to new situations (Ugandan Government White Paper, 1992 as quoted by Caesar 1994). The graduates of this system have inadequate basic and practical skills and are viewed by critics to be job seekers, rather than job makers. Their contribution to the economic development of a country is reportedly minimal and insignificant (Caeser, 1994).

Institutional researchers and other campus administrators are probably very familiar with describing what their institutions produce in terms of outcomes. Students learning forms one distinct, but increasingly critical, corner of what most often are referred to as outcomes. The interest in outcomes has accelerated over this time, as accountability schemes now in place in most states, demand proof of institutional performance. This evidence is typically expressed in terms of retention rates, graduation rates, and placement rates – outcomes that typically are not direct measures of what students know or can accomplice. In contrast, competencies and the learning that they seek to measure operate at a much more granular level and require precise description and measurement of learning. Despite the advances and general interest in outcomes throughout higher education over the past decade, state indicators systems have only been able to approximate learning outcomes (Voorhees, 2001).

In order to gain knowledge about and understand the environment, one should explore and investigate problems that arise from ones association with the environment. There is no denying that the most important element in effective science education is the right use of investigation methods. These methods must be learned through practice. The teacher or some knowledgeable person should be available to guide the students in scientific investigations. Sometimes all that a student may need is a leading question that would direct his

attention to another point of view he has not thought of. The point stressed here is that the person guiding a student to conduct useful investigations should make use of (a) probing questions and (b) the discussion method to help the student sharpen his/her thoughts about what she/he is doing or what she/he intends to do. Help to students can take the form of providing material resources for their individual use (Tufuor and Fletcher, 2001).

Schooling and school examinations are hierarchical, ranging from elementary school examinations (primary) as the lowest to university school examinations as the highest. Although higher education contributes to increase in labor productivity and long term economic growth, focus on primary education has a more direct effect on poverty reduction (World Bank, 1986).This highlights the importance of Senior Secondary School Examinations.

The first Senior Secondary School Certificate Examination (SSSCE) in Ghana was held between 22nd November and 7th December 1993. Out of forty two thousand one hundred and twenty one (42,121) candidates, one thousand six hundred and fifty six (1,656) candidates representing 3.9% passed in all the 9 subjects offered in Ghana. This maiden performance was clearly upsetting (Abaidoo, 2004). According to the researcher, it is generally reported in Ghana at workshops of Mathematics, Science and English Language that students have difficulties in the three major Core subjects and that workshops were organized to find diagnosis and remediation. He observed that there was an improvement in the general performance of Junior Secondary School graduates in Mathematics in Cape Coast from the year 2000 to the year 2002 but declined slightly in 2003 and 2004 academic years. This gave the indication that there would be a decline in future performance.

One of the most important questions regarding school learning is how well students can transfer their learning to new situations. Educators throughout the world aspire to foster the development of problem solving skills and various higher mental processes in students. They believe and hope that the acquisition of higher mental processes will enable students to use their knowledge more effectively and efficiently long after school. Therefore, if school learning is to be beneficial to the individual as well as to society, school instruction should emphasize the development of higher levels of thinking in a wide variety of higher mental process objectives (Levin, 1986; Swartz and Perkins, 1990). Clerk and Peterson (1986) suggest that the more elaborate and sophisticated a teacher's conception of instructional goal pursued the greater the likelihood of the design and delivery of thoughtful lesson. Thus, according to these researchers it is expected that a lot is to be gained if students can be thought to be independent minded as well as improving the quality of the teacher or the instructor.

A significant factor influencing achievement is level of ability of children. Low ability students (low achievers) perform very poorly because they have virtually no idea of what they should do when they confront a problem and they often are unable to explain the strategies they use to reach a solution (Sternberg, 1986).

Low achievers evidence poorer planning and memory on school tasks, are less flexible in reorganizing the tasks, and could be said to be at lower language developmental level. Such deficient language development could be a critical factor in poor organization of skills (Vygotsky, 1978; Luria, 1976). By contract, those who performed well are those who possess well developed metacognitive skills because they are aware, can plan, and have good memory. Metacognition is an aspect of critical thinking that includes students' ability to develop a logical strategy during problem solving (Baron and Sternberg, 1987; Schoenfeld, 1987).

School characteristics such as school climate and culture, classroom climate and size are another factor that may influence students' achievement (McKnight and Crosswhite, 1987). Heyneman and Loxly (1983) also found that variance in student achievement explained by school characteristics amounted to 16 % across 17 developing countries. Mayer, Tajika and Stanley (1991) found that students in the United States performed below their cohorts in Japan on Mathematics achievement test (computational skills and problems solving).

Lengths of school year and instructional time have been found to relate to achievement. Amount of time students spend listening to teachers lecturing (active pedagogy and classroom processes) was positively related to achievement in Nigeria (Bockhead and Komenan, 1989) but Keeves and Mueller (1992) commented that the amount of time appears largely unrelated to achievement although some effects were observed in Science.

2. Statement of problem

Educational authorities in Ghana have generally established that the performance of school leavers especially at the pre-university level offered a large room for improvement, due to so many factors (Abaidoo, 2004). Hence, the introduction of the New Educational Reform in 1987 which led to the new system of Senior Secondary School with the first product in 1993. The findings of the study could be used to throw lights on the academic strength of schools over the study period, with respect to Core Subjects offered by all Secondary School students in Ghana.

3. Objective of the Study

The main objective of this study is to identify the modal grade in each core subject and also determine whether

there existed significant difference in performance between the subjects to determine the general performance in Senior Secondary School Certificate Examinations conducted by the West African Examinations Council.
Thus, the specific objectives are:

I. to describe and evaluate the performance patterns of Senior Secondary Schools in Ghana, and
II. to find out whether or not the awareness created by the new Educational Reform of 1987 has led to an improvement in the performance of senior secondary school students in Ghana, with respect to core subjects which all students in Ghana study**.**

4. Research Questions

The following are the pertinent questions used to direct the study:

I. What is the trend of students' academic performance from year to year?
II. What factors can be used to measure the academic image of the school?

5. Limitations

The sample was based on convenient sampling and as such the finding may lack external validity. The study was taken from the old grading system A, B, C, D, E and F representing Excellent, Very Good, Good, Credit, Pass and Fail respectively and that the results of the study may not compare well with the new grading system A1, B2, B3, C4, C5, C6, D7, E8 and F9 representing Excellent, Very Good, Good, Credit, Credit, Credit, Pass, Pass and Fail respectively in terms of students performance.

6. Scope

The focus of the study was to analyze the general academic performance of the Ghanaian Secondary Schools with respect to Core Subjects offered only (Mathematics, Integrated Science, Social Studies, and English Language), using a case study. The study was conducted in Breman Asikuma Senior High School in the Central Region of Ghana– in the Odoben- Brakwa district. The data taken spans 1999 to 2005 (7 years) and did not include students' performance before 1999.

7. Research Methodology

Descriptive and quantitative survey research designs on records of a Senior Secondary School results of examinations conducted by the West African Examinations Council (WAEC) over a seven-year period, from 1999 to 2005 were used for the study. Data was analyzed using frequencies, percentages and Analyzes of variance (ANOVA). Results were presented on tables and charts.

8. Discussion of Results

8.1 Percentage Passes in various Core Subjects

A student having a pass in a subject means the student scoring either grade A, B, C, D, or E. Students population from the year 1999 to 2005 who wrote the external examinations stood at 220, 258, 256, 297, 367, 384, and 380 respectively (see Table 1).

Table 1: Percentage Passes in various Core Subjects (1999 – 2005)

	YEARS						
CORE SUBJECTS	1999	2000	2001	2002	2003	2004	2005
Mathematics	40	31.4	65.2	31.9	34.8	66.3	46.6
Integrated Science	26	21.3	43.8	40.4	51.4	51.8	81.7
Social Studies	82	76	34.8	54.8	75.2	86.3	93.8
English Language	44	41.1	78.1	49.1	28.6	52.1	50.3
Total Number of Students	**220**	**258**	**256**	**297**	**367**	**384**	**380**

Source: Field work

In the year 1999, Social Studies had 180 out of 220 students passing, which represented 82 % passes. That was the highest percentage passes for the year. It was followed by English Language with passes of 97 (44 %). Mathematics and Integrated Science trailed with passes of 88 (40 %) and 57 (26 %) respectively.

The number of students who wrote the external examination in the year 2000 was 258. Social Studies had the highest number of passes of 167 (76 %). English Language followed with passes of 106 (41.1 %). Mathematics and Integrated Science again trailed with passes of 81 (31.4 %) and 55 (21.3 %) respectively.

The year 2001 showed a pattern quite different from the two previous years' results with English Language and Mathematics leading with 78.1 % and 65.2 % passes respectively while Integrated Science and

Social Studies trailed with 43.8 % and 34.8 % respectively.

From the year 2002 to 2005 another picture was showed. Social Studies again was on top with 54.8 %, 75.2 %, 86.3 %, and 93.8 % respectively. The second, third and last positions were not taken by specific subjects over the last four years with respect to percentage passes.

8.2 Percentage Number of Grades Obtained in the Subjects for each Year in the Study Period

It is clearly seen from Table 2 (below) that, in 1999, grade F had the highest percentage of 55.5 % for English Language. It meant that, more than half of the total number of students who wrote the paper failed in the Subject. The next two highest percentages of 34.9 % and 7.3 % were scored for grades E and D respectively. Percentage for the grades A and B were 0.0 % and 0.0 % respectively. That was, no student had grade A or B in the subject (English Language) that year.

Table 2: Percentage Number of Grades Obtained in the Subjects for Each Year in the Study Period

Year	Grade	Mathematics	Integrated Science	Social Studies	English Language
1999	A	0.5	0.0	0.0	0.0
	B	6.0	0.5	2.8	0.0
	C	4.1	3.2	9.6	2.3
	D	8.3	3.7	22.9	7.3
	E	22.1	18.8	47.2	34.9
	F	59.0	73.9	17.4	55.5
2000	A	0.0	0.0	0.0	0.0
	B	4.7	0.0	3.1	0.0
	C	3.5	1.2	9.7	0.4
	D	6.2	2.7	22.5	6.2
	E	17.1	17.8	40.7	34.6
	F	68.6	78.3	24.0	58.8
2001	A	2.0	1.2	0.0	0.4
	B	4.3	3.6	3.2	3.2
	C	4.7	3.2	15.4	8.0
	D	7.1	6.3	26.9	10.8
	E	17.4	30.0	33.6	46.0
	F	64.4	55.7	20.9	31.6
2002	A	1.7	0.0	0.0	0.0
	B	2.4	1.7	1.0	0.7
	C	2.7	5.1	3.4	2.7
	D	6.4	9.8	9.5	5.1
	E	18.6	23.1	40.7	39.3
	F	68.1	60.3	45.4	52.2
2003	A	3.6	0.5	0.0	0.0
	B	7.1	6.3	4.1	0.0
	C	3.6	4.6	13.7	0.3
	D	4.9	7.7	20.3	1.6
	E	15.8	32.5	37.3	27.0
	F	65.0	48.4	24.7	71.0
2004	A	6.6	1.6	0.0	0.0
	B	11.4	6.1	9.3	1.9
	C	9.3	6.9	18.9	1.3
	D	9.8	8.8	23.5	9.9
	E	30.3	29.0	35.5	39.55
	F	32.4	47.6	12.8	47.5
2005	A	2.9	0.5	0.0	0.0
	B	3.7	6.3	9.9	0.3
	C	3.9	6.8	21.4	2.3
	D	9.1	15.4	27.9	6.3
	E	26.9	53.0	34.7	41.3
	F	53.5	18.0	6.0	49.9

Source: Field work

Mathematics had 0.5 %, 6.0 %, 4.1 %, 8.3 %, 22.1 % and 59.0 % for the grades A, B, C, D, E and F respectively. Here too, more than half of the total number of students who wrote the paper failed in the Subject (Mathematics). However, percentage for the grades A and B (0.5 % and 6.0 respectively) showed that some students had those grades in 1999.

Integrated Science had 0.0 %, 0.5 %, 3.2 %, 3.7 %, 18.8 %, and 73.9 % for the grades A, B, C, D, E and F respectively. Percentage for the grade A being zero percent (0.0 %) means that no student had grade A. However, 0.5 % for B means very few students had grade B; while close to three quarters (3/4) of the total number of students who wrote the paper failed in Integrated Science in the year 1999. The failure rate was worst in this subject that year.

In Social Studies, grade D rather had the highest percentage of 47.2 %. Far less than half of the total number of students (17.5 %) who wrote the paper failed in the Subject. Percentage for the grade A being 0.0 % for Social Studies means that no student had grade A; and 2.8 % for B means some students had grade B.

Similar picture was seen for the rest of the study period except the following:

- In the year 2000, no student had grade A (0.0 %) in Mathematics.
- Integrated Science had grade A in the years 2001, 2003, 2004, and 2005 of (1.2 %), (0.5 %), (1.6 %), and (0.5 %) respectively.
- English Language had grade B in the years 2001, 2002, 2004, and 2005 of (3.2 %), (0.7 %), (1.9 %), and (0.3 %) respectively.
- Social Studies had its highest and lowest percentage failure of 45.4 % and 6.0 % in the years 2002 and 2005 respectively.

From grade A to F, the percentage number of grades scored was in ascending order with value of F being out of proportion to that of any other grade. Social Studies had a different trend with grade E having the highest percentage score followed by grades D, F, C, B and C in that order.

8.3 Overall Percentage Number of Grades Obtained in the Subjects (1999-2005)

Table 3 (below) shows that, over the study period, the total number of final year students used for the study was two thousand one hundred and sixty two (2,162). Out of this total, percentage of students that scored a particular grade over the study period represents the overall percentage number of grade obtained in that subject.

Table 3: Overall Percentage Number of Grades Obtained in the Subjects (1999-2005)

	Mathematics	Integrated Science	Social Studies	English Language
A	2.92	0.65	0.00	0.00
B	5.84	3.91	5.26	0.98
C	4.55	4.89	14.1	2.28
D	7.79	8.14	22.0	6.51
E	21.4	30.9	38.2	37.1
F	57.5	51.5	20.4	53.1
Total	2,162(100%)	2,162 (100%)	2,162 (100%)	2,162 (100%)

Source: Field work

Mathematics had the highest overall percentage scores in grade F (57.5 %) followed by grade E (21.4 %) with the least of 2.92 % in grade A. Also, Integrated Science had its highest overall percentage score in grade F (51.5 %) followed by grade E (30.9 %) with the least of 0.65 % in grade A. Similarly, English Language had its highest overall percentage score in grade F, followed by grade E. However, Social Studies differed from that trend. Its highest overall percentage score of 38.2 % was obtained in grade E, followed by D (22.0 %) with the least of 0.00 %in grade A.

The highest overall percentage scores of 57.5 %, 51.5 % and 53.1 % were obtained in grade F for Mathematics, Integrated Science and English Language respectfully. This implies that more than half of the students who wrote the WAEC examinations in the core subject areas fail in Mathematics, Integrated Science and English Language. This indicates a poor performance by the final year students in the Senior Secondary School in terms of Core Subjects.

Over the study period, Mathematics had the highest overall percentage scores in grade A (2.92 %), followed by Integrated Science (0.65 %). This shows that, in terms of quality grades obtained, Mathematics and Integrated Science were on top. If grade B is considered as another good grade, then the highest sum (of grades A and B) of 8.76 % was scored in Mathematics. It was followed by Social Studies with 5.26 %, whilst English Language trailed with a sum of 0.98 %. This still shows that Mathematics had the highest quality grades and that English Language had the least quality grades obtained.

If grade E was considered as another poor grade beside F, then the highest sum (of grades E and F) of 90.2 % was scored in English Language, followed by Integrated Science with 82.4 % , whilst Social Studies trailed with a sum of 58.6 % of students with poor grades. This means that most of the students perform poorly

in Social Studies, Mathematics, Integrated Science and English Language in ascending order such that the latter (English Language) was worst performing subject for students over the study period.

If we consider each grade from grade A to grade F individually, the following were observed:

- For grade A, the highest percentage of 2.92 % was obtained in Mathematics whilst the least of 0.00 % was obtained in Social Studies and English Language.
- For grade B, the highest percentage of 5.84 % was obtained in Mathematics whilst the least was obtained in English Language.
- With grade C, the highest percentage of 14.1 % was obtained in Social Studies and English Language trailed with 2.28 %.
- Also for grade D, the highest percentage of 22.0 % was obtained in Social Studies and English Language trailed with 6.51 %.
- With grade E too, the highest percentage of 38.2.0 % was obtained in Social Studies but here Mathematics trailed with 21.4 %.
- In grade F, the highest percentage of 57.5 % was obtained in Mathematics whilst the least of 20.4 % was obtained in Social Studies.

It was clearly seen that Mathematics was on top under grades A, B and F; and trailed under grade E, whilst Social Studies got on top under grades C, D and E and trailed under grade A. Hence, preliminary investigation with single grades (A, B, C, D, E and F) showed that Mathematics was the worst subject over the study period followed by English Language; and Social Studies was the most favorite subject. However, Mathematics was the subject in which students had the highest quality grade of A or B.

If the average of the grades F and E ($(\frac{F+E}{2})$) was considered, English Language was the worst subject with average percentage failure of 45.1 % over the study period, followed by Integrated Science with average percentage failure of 41.2 %; and Social Studies was the most favorite subject with average failure of 29.3 %. Again, Mathematics was the subject in which students had the highest number of quality grades of 4.38 %, if the average of the grades A and B ($(\frac{A+B}{2})$) was considered.

8.4 Analysis of Variance (ANOVA)

Two-way analysis of variance without replication (at $\propto = 0.05$) was performed on table 1, the Percentage Passes in various subjects (1999 – 2005). The results were such that there was statistically significant difference in the subjects (F of 4.011 > F_{crit} of 3.160 with P-value of 0.024), while the years within the study period did not experience any significant difference (F of 1.41 < F_{crit} of 2.66 with P-value of 0.266).

The Fisher Least Significant Difference (LSD) method was used to find the pairs of subjects which brought about the significant difference in the subjects (see Table 4). The results were as follows: there was no statistically significant difference between Mathematics and Integrated Science; Mathematics and English Language; and Integrated Science and English Language. However, there was statistically significant difference between Mathematics and Social Studies; Integrated Science and Social Studies; and English Language and Social Studies. The statistical interpretation here was that Mathematics, Integrated Science and English Language form a factor of results and Social Studies was a singleton which also forms another factor of results; and that pattern was the same every year throughout the study period, with respect to percentage passes in the various Core Subjects.

Table 4: Least Significant Difference (LSD) Test on Pairs on Core Subjects

No Significant Difference between pairs	**Significant Difference exists between pairs**
Mathematics and Integrated Science	Mathematics and Social Studies
Mathematics and English Language	Integrated Science and Social Studies
Integrated Science and English Language	English Language and Social Studies

Factor 1: Mathematics, Integrated Science and English Language
Factor 2: Social Studies

Also two-way analysis of variance without replication (at $\propto = 0.05$) was performed on table 2, which was a table on Percentage Number of Grades obtained in the subjects for each year in the study period. The results were as follows: There was no significant difference between the mean of values of the subjects (F of 0.0429 < F_{crit} of 1.5686 with P- value of 1); while there was significant difference between the mean of values in the grades (F of 73.422 > F_{crit} of 2.2813 with P- value of 8.41E-37). The Fisher Least Significant Difference (LSD) method was used to find the pairs of grades which brought about the significant difference in the grade

(Table 5). The results were as follows: there was no statistically significant difference between the following pairs of grades: A and B; A and C; A and D; B and C; B and D; and C and D; while there existed statistically significant difference between the following pairs of grades: A and E; A and F; B and E; B and F; C and E; C and F; D and E; and E and F. The statistical interpretation here was that the grades A, B, C and D form a factor of results and each of the grades E and F forms another factor of results; and that the pattern was the same in all the four Core Subjects.

Table 5: Least Significant Difference (LSD) Test On Pairs of Grades

No Significant Difference between pairs	**Significant Difference exists between pairs**
A and B	A and E
A and C	A and F
A and D	B and E
B and C	B and F
B and D	C and E
C and D	C and F
	D and E
	E and F

Factor 1: A, B, C, and D
Factor 2: E
Factor 3: F

Again, two-way analysis of variance without replication (at $\propto$ = 0. 05) was performed on table 3, which was a table on overall Percentage Number of Grades obtained in the Subjects. The results obtained were exactly the same as that performed on Table 2. There was no significant difference between the mean of values of the subjects (F of 6.38E-07 < F_{crit} of 3.28738 with P- value of 1); while there existed significant difference in the grades (F of 14.8279 > F_{crit} of 2.9013 with P- value of 2.4E-05). The Fisher Least Significant Difference (LSD) method was used to find the pairs of grades which caused the significant difference in the grades. The results were the same as that obtained on Table 2. The results were as follows: Here too, the statistical interpretation was that the grades A, B, C and D form a factor of results and each of the grades E and F forms another factor of results; and that the pattern was the same in all the four Core Subjects.

Two-way analysis of variance without replication (at $\propto$ = 0. 01 and 0.10) was performed on tables 1, 2 and 3, and the results obtained showed no difference in pattern.

9. Conclusion

It was established that students performed best in Social Studies but not in Mathematics, Integrated Science and English Language. However, in terms of quality passes, Mathematics was relatively on top. This pattern of results was seen almost every year throughout the study period.

It was also observed that the grades A, B, C and D formed a factor of results and each of the grades E and F also formed another factor of results and that the pattern was the same in all the four Core Subjects.

Again, it was clear that more than fifty percent (50 %) of the candidates obtained grade F. This indicated poor performance on the part of the students in terms of grades obtained in the four Core Subjects over the study period. Again, more than fifty percent (50 %) of the remaining candidates who did not obtain grade F, obtained grade E. This showed that majority of the candidates (more than 75 %) obtained grade E or F, and that, very few candidates had grade A, B, C or D.

10. Recommendation

Educational management should find out causes of students' difficulties leading to the generally-poor-performance outlook of the school in those in similar situation for the four Core Subjects, so that subsequent teaching can be directed at removing the causes. Also, the Parents-Teachers Association (PTA), Counsel of Heads of Assisted Secondary Schools (CHASS), Circuit Supervisors, Counsel of directors, Counsel of Chiefs ('Nana num') and other educational stakeholders should come out boldly to find solutions to tackle such educational problems which is very common in many schools in Ghana.

Future research on academic performance of students using same method must be done with data from 2006 to 2014. That would show students' performance on West Africa Senior Secondary School Certificate Examination (WASSSCE) which has a different grading system from the Senior Secondary School Certificate Examination (SSSCE).

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