The Impact of Time on Learning Outcomes: Lessons from the Delivery of High School Mathematics Curriculum in Ghana

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ABSTRACT

A student’s productive learning time is proportional to the length of time they spend working during their lessons. However, it is important to remember that the issues with educational time are not just about optimizing “in-school time.” The study is prompted by the time spent in school and how it impacts students learning outcomes in core mathematics, considering two different year groups for the May/June 2013 West African Senior School Certificate Examination (WASSCE-standardized examination written by Anglophone countries of West Africa (Ghana, Nigeria, Sierra Leone, Liberia, and the Gambia). The study compares students’ learning outcomes in the May/June 2013 WASSCE. The study uses a descriptive survey design and conveniently collected data from 10 Senior High Schools (SHSs) in the Central Region of Ghana. The results of the study showed no statistically significant difference in core mathematics grades between students who spent four years and those who spent three years in SHS. Thus, time is not the sole determinant of a student's learning outcome, as has been suggested by some studies.

Keywords: core mathematics, learning outcome, time, WASSCE, SHS.

I. INTRODUCTION

It is important to remember that students and teachers place a high value on learning outcomes in every school. Studies (Abdulghani et al., 2014; Everaert et al., 2017; Ukpong & George, 2013; Zee & Koomen, 2016) have demonstrated that motivation and time spent studying are two of the most important factors that affect how well students do in school. Roybal et al. (2014) assert that grades are the most important indicator of students’ learning outcomes. Thus, if a student gets good grades, they are thought to have learned well, while getting bad grades is seen as a sign of poor learning. Despite this, good grades have also been linked to other factors such as students’ gender, IQ, study habits, study time, age, the number of children, birth order, geographical location, year of study, level of parental education, social status, and the availability of learning materials (See, for example, Cowan & Powell, 2014; Gall et al., 2003; Hsu & Kuan, 2013; McMillan, 2005). These factors that affect how well a student does in school can be environmental, institutional, personal, natural, or a mix. However, this paper looks at how the amount of time spent in school affects how well students learn mathematics at the SHS level in Ghana.

Since its inception, the structure, and rules of the SHS in the Ghanaian context have changed several times. Nonetheless, in 2007, the regular academic year at SHS was extended from three to four years without any modifications to the curricula. This plan was scrapped after three years, so there were no graduates in 2010, and two groups graduated in 2013. In 2013, the Four-Years was changed back to the Three-Years, which caused a lot of inconsistencies. Because of these changes, students in both the Three-Year and the Four-Year school systems wrote the WASSCE in May/June 2013.

There has been much debate over which group performed better, particularly in core mathematics, but no conclusive evidence has emerged thus far. Since the Three-Year Group and the Four-Year Group have distinct requirements regarding the amount of material they must study or the scope of topics they must cover, some may be persuaded that these arguments are flawed. The Ghana Education Service (GES) core mathematics syllabus for the Four-Year Group, issued in 2007, specified 34 topics to be taught over four years. The syllabus issued in 2010 for the Three-Year Group had 29 topics to be covered over three years (Curriculum Research and Development Division, CRDD, 2007, 2010). The curriculum indicated that each lesson or period should last forty minutes for both the Three-Year SHS and Four-Year SHS batches. Several issues and factors were considered when deciding how core mathematics should be taught and learned in senior high schools. However, the goal of both the Three-Year SHS program and the Four-Year SHS program was to help students learn more effectively. This paper aimed to determine if there was a difference between the core mathematics grades of the Four-Year and Three-Year SHS based on how long they had been in school. Consequently, it was hypothesized that the
II. TIME CONSIDERATIONS IN INSTRUCTION

There are two ways to talk about time: “gross” and “net.” The time allotted for school and time per subject, usually called “allocated time,” is a rough measure of how much time a student spends in school (Scheerens, 2013). In comparison, what autonomous schools understood about lost time and extra time is a measure in defining “net time,” which is often called “exposed time” in this case (Scheerens, 2013). Stallings and Mohlman (1981) put the time for organization and keeping order at 15%, but Lam (1996), who looked at Dutch primary schools, put it at 7%. The students’ productive learning time can be summed up as a percentage of the time they spend working during the lessons. The problems with education time are not just about making the most of “in-school time.” In developing countries like Ghana, policies have been in place for decades to make the school year, school week, or school day longer (Glewwe, 2002). More time is expected to have a favorable influence on student learning outcomes; however, this effect is not linear and shows declining returns as more time is invested. Thus, beyond a certain threshold, the further time has diminishing returns (Cattaneo et al., 2017).

Also, since we need more time or effort to improve student performance, the extra time should be well spent, meaning that more instructional content should be covered, and curriculum requirements should be just right (Scheerens, 2013). When comparing treatments for different time periods and exposures, empirical studies that look at the effect of time on student performance should ensure that enough content is covered, and that the quality of instruction is high (Scheerens, 2013). It can also be said that the quality of education and the length of time it takes to teach are like two sides of the same coin. The quality of education will make up for the long teaching hours (Scheerens, 2013). Finland’s impressive performance on international examinations like the TIMSS and PISA demonstrates this (Grek, 2009). One could say that the quality of education in Ghana is so low that fewer lesson hours would not help. As time is tied to the skills and motivation of the students, there are even more possibilities and changes. Expanded or enhanced time programs have different effects on students with different skills and socioeconomic backgrounds (Scheerens, 2013).

One of the best policy decisions that can be made to improve education is to allocate reasonable time for school and instruction. The basic idea behind schooling and teaching is that students should be “exposed” to a simple and reasonable time. Nonetheless, there are many factors to consider when trying to pin down time’s precise impact on students’ learning outcomes. Every classroom where a curriculum is taught or administered needs to maximize student time on task. This time needs to be planned out and used well for teaching and learning activities. School time is mostly used for teaching, learning, and testing (Benavot, 2012; Yair, 2000). Because of this, every educational system has a strict schedule or timetable that teachers and students must follow. Teachers and students are expected to be on time to teach and learn within the allotted time. School heads and district directors need to help with administration for this time to be used and managed well. Any time lost in an educational setting adds to time deficits, making learning challenging. Consequently, time should be used wisely in any education system.

One thing in the Ghanian context is that is there is no strong connection between the school calendar (the times set aside) and planning at the district and school levels. It is clear how the curriculum is covered at different times and how well it is covered. Associating time with tasks needs a team effort that encourages schools to use every minute of their teaching time efficiently and effectively (Kyriacou, 2010). This cannot be done if the state agencies responsible do not have a plan for making good use of teaching time and putting students and teachers on the best schedules. Thus, teaching time cannot be changed anyhow. Curriculum delivery is based on an integrated framework that considers human and physical capital (Fink, 2013). It calls for a framework in which all stakeholders know how curriculum policy affects other departments’ work and how other departments’ policies affect how the curriculum is delivered (Todd & Mason, 2005). Thus, the system must work together to avoid duplicating efforts or wasting resources.

Increasing the amount of time Ghanaian students spend in school is and has always been a popular idea among people who make decisions about education. Practically, the school year cannot be made longer because it would cost a lot, and people would have to be involved. As school years get longer, the benefits of more school days might not be as great (Marcotte & Hansen, 2010). This could make it challenging for students to learn and likely to demotivate them. Even though the problem has not improved in the past and faces a lot of resistance, the political climate is usually good until public school systems run into money problems. Administrators and policymakers looking to take advantage of this window should avoid making changes that would have a negative impact on programs that have been successful in boosting student learning outcomes. Those in favor of extending the school year have been relatively silent on the issue of whether accountability systems are compatible with extended school years.

III. METHODOLOGY

The study employed a descriptive survey design. Convenient sampling was used to select and collect data from 10 SHSs in the Central Region of Ghana. The data collection instrument was the May/June 2013 WASSCE results of the 10 SHSs. The researchers engaged the selected schools for the purpose of the study and its relevance. The core mathematics grades of Four-Year and Three-Year SHS students were pulled out from the whole data set and compared. An independent sample t-test was used in testing the hypothesis.
IV. RESULTS

The research hypothesis that guided this study was that: “the learning outcomes in core mathematics between the Four-Year and the Three-Year SHS are not statistically significant.” The result of the study showed that out of the 10 SHSs sampled, 9 SHSs had a higher pass rate in favor of the Four-Year SHS group of students. Consequently, it was reasonable to determine whether the pass rate difference was statistically significant. The data extracted from the 10 SHSs are presented in Table I. The hypothesis test results, using an independent samples t-test statistic, are displayed in Tables II and III.

\[ Eta \ square = \frac{t^2}{t^2 + \frac{(N1+N2-2)}{2}} = \frac{(-0.369)^2}{(-0.369)^2 + (18)} = 0.007 \] (1)

The results of the two student groups were compared using an independent samples t-test to determine whether there were statistically significant differences. The analysis showed that there was no statistically significant difference between the results of Four-Year:

\[ M = 69.35, SD = 30.06 \]

and Three-Year:

\[ M = 64.41, SD = 29.73 \]

\[ t (18) = -0.37 \]

\[ p = 0.72 \text{ (two-tailed)} \]

The differences between the means were also small:

\[ \text{mean difference} = -4.93, 95\% CI = -33.02 \text{ to } 23.16, etasquared = 0.007 \]

### TABLE I: FREQUENCIES AND PERCENTAGES OF PASSES OF 2013 MAY/JUNE WASSCE RESULTS

| Name of School | Year Group | Frequency | % Passed |
|----------------|------------|-----------|----------|
| School A       | 3 Years    | 100       | 91.60    |
|                | 4 Years    | 100       | 92.50    |
| Total          |            | 200       | 92.00    |
| School B       | 3 Years    | 100       | 92.00    |
|                | 4 Years    | 100       | 93.00    |
| Total          |            | 200       | 92.50    |
| School C       | 3 Years    | 100       | 92.00    |
|                | 4 Years    | 100       | 93.00    |
| Total          |            | 200       | 92.50    |
| School D       | 3 Years    | 100       | 92.00    |
|                | 4 Years    | 100       | 93.00    |
| Total          |            | 200       | 92.50    |
| School E       | 3 Years    | 100       | 92.00    |
|                | 4 Years    | 100       | 93.00    |
| Total          |            | 200       | 92.50    |
| School F       | 3 Years    | 100       | 92.00    |
|                | 4 Years    | 100       | 93.00    |
| Total          |            | 200       | 92.50    |
| School G       | 3 Years    | 100       | 92.00    |
|                | 4 Years    | 100       | 93.00    |
| Total          |            | 200       | 92.50    |
| School H       | 3 Years    | 100       | 92.00    |
|                | 4 Years    | 100       | 93.00    |
| Total          |            | 200       | 92.50    |
| Total          |            | 200       | 92.50    |

### TABLE II: MEAN AND STANDARD DEVIATION SCORES OF THREE AND FOUR-YEAR GROUPS

| Year Group | Number of schools | Mean | Std. Deviation | Std. Error Mean |
|------------|-------------------|------|----------------|-----------------|
| Shs H      | 10                | 64.410 | 29.7302       | 9.40241         |
| Shs H      | 10                | 69.3470 | 30.06066     | 9.50602         |

### TABLE III: INDEPENDENT SAMPLE T-TEST

| Levene’s Test for Equality of Variances | t-test for Equality of Means |
|----------------------------------------|-----------------------------|
| F | Sig. | T | Df | Sig. (2-tailed) | Mean Diff. | Std. Error diff. | 95% Confidence Interval of the Difference |

| Pass Rate of Students | Equal variances assumed | 0.001 | 0.972 | -0.369 | 18.00 | 0.716 | 4.93 | 13.37 | -33.02 | 23.16 |
|                      | Equal variances not assumed | 0.001 | 0.972 | -0.369 | 18.00 | 0.716 | 4.93 | 13.37 | -33.02 | 23.16 |

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We cannot prove the null hypothesis as false, so we conclude that there was no statistically significant difference between the core mathematics grades of Four-Year and Three-Year SHS students considering time was a factor.

V. DISCUSSION

In testing the hypothesis, the results show no statistically significant difference between the learning outcomes measured by grades of the Four-Year and those of the Three-Year SHS students. The study’s results suggest that going to school for four years would not significantly affect how well you do in school compared to going to school for three years. There are a few possible reasons why attending school for four years does not affect performance. One reason could be that students who went to school for four years did not pay attention in the first year. If you take the results at face value, you can say that being in school for four years may not affect how well students do, even though they get more instructional time the longer they are in school. A longer schooling period gives students more time in the classroom, which could lead to more learning outcomes. Unfortunately, they might not want to learn as much outside of school if they spend more time in school. Even though three years of schooling get less time in school compared to four years, they may learn more outside of school, so their grades do not change. This may be the case because the individual may be forced to make good use of the limited time they have for instruction because they know it is limited. Also, school officials may devise ways to make up for a short time in the Three-Year system. However, this may not be the case for the Four-Year group for four years is thought to be enough time. We may not have seen a link between learning outcome and time spent in school because of how time spent in school affects school-related inputs to education production. Students may want to go to school for three years, but teachers may want to go for four years to have more time to teach. If teachers only have three years to teach, they may not be as productive.

Individuals might tend to wait until the last minute when they have more time, which could be the case with the Four-Year System. Teachers and students in the Four-Year System may be less motivated because they have more time on their hands. On the other hand, since students and teachers in the Three-Year System feel like they do not have much time, they may be more proactive and smarter in their interactions. The grades of the Four-Year and Three-Year Systems did not significantly differ. This could be because the information learned in the first year may have been forgotten after four years. During the WASSCE, students are tested on things from the first year to the last. This means that the individuals who go to school for three years are more likely to remember what they have learned than those who go for four years.

Palm Beach Study Time Learning Theory says that the amount of time you spend studying is a good way to predict and control how you learn. It shows how the amount of time students spend studying affects how much they learn. The theorist makes it clear that how well you do in school depends on how long it takes you to finish a task. According to the study’s results, there is a significant difference between SHS 3 and SHS 4 students in the Central Region of Ghana who took the May/June 2013 WASSCE in terms of how long they were in school and how well they did in school. The study’s results do not support what Ukpong and George (2013) asserted, which is that there is a significant difference in how well students do in school between those who study for 30 minutes and those who study for an hour. Ukpong and George (2013) assert that students’ success in school depends on how well they study and do in other areas. If students want to get good grades and graduate, they must read their books carefully and understand them. This will take more time, which goes against what this study demonstrated.

In the same way, the present study does not support Bandura and Schunk’s (1981) claim that students who do well in their chosen field spend more time studying. The study also does not support Singh et al. (2002) conclusion that a grade is a key indicator of this kind of learning. When a student gets good grades, it may mean they took the time to study correctly. On the other hand, low grades are often seen as a sign that the student did not put in enough time to learn, but the results of this study show that this is not the case.

VI. CONCLUSION

Ghana’s move to a four-year SHS in 2007 provided students with additional schooling time, hence the possibility of improving learning outcomes. However, this study found that in core mathematics, there was no significant difference between the learning outcomes of students who spent four years and those who spent three years schooling. Thus, there are other reasons students may not do well in school, which is not always the time. In light of all the accounts and arguments made so far, and with the statistical evidence, it can be said that the length of school time does not affect how well students do in school. Other factors must also be considered. But time management and how well students use their time greatly affect how well they do in mathematics.

CONFLICT OF INTEREST

The authors have no conflict of interest.

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