Teacher Instructional Time, Student-Engaged Time and Numerical Ability as Predictors of Student Achievement in Senior Secondary School Chemistry

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Abstract
The study investigated the extent to which teacher-instructional time, student-engaged time and student numerical ability can predict achievement in Senior Secondary School Chemistry. An expo-facto descriptive survey design was adopted for this study. 90 Senior Secondary School (II) students were randomly drawn from six Senior Secondary Schools. Numerical Ability Test, Chemistry Achievement Test and Stalling’s model of time-on-task were the instruments used to collect data for the study. The data obtained were analysed using a stepwise multiple regression analysis. The result showed that teacher instructional time, student-engaged time and numerical ability when taken together accounted for 63.9% of the total variance (R= 0.639, p<0.05). Also, student numerical ability and student-engaged time contributed significantly to the prediction. Hence, it was concluded that it is not the length of instructional time that results in learning, but rather, the time the students themselves are engaged in learning activities. It is therefore recommended that activities that would increase student-engaged time and numerical skills should be introduced into the chemistry curriculum. The result of this study would serve as a source of empirical evidence to help policy makers and curriculum planners to ascertain the extent to which school time variables would predict academic achievement. This would help them in reviewing and evaluating the allocated school time. The report of this study would also benefit teachers and students in helping them to realize the extent to which the time students spend engaged in learning activities contribute to achievement in chemistry.

Keywords: teacher instructional time, student-engaged time, numerical ability, Chemistry achievement, prediction.

INTRODUCTION
Policy makers in the educational sector have equated increasing the length of time teachers spend in classrooms to improved academic achievement. Various countries across the world have school hours running averagely from 8am to 4pm with the exception of Brazil which runs from 7am to noon (Hughes 2007). However, research reports on the complex relationship between time and learning has been controversial. According to Lavy (2010), though some studies have established positive relationship between length of instructional time and academic achievement in developed countries, there has been limited empirical evidence to establish the relationship between school time variables and academic performance especially in the developing countries. In Nigeria, the current emphasis on performance standards has led to after school hours running to 5pm especially in private secondary schools (Igomu 2013). Hence, the question is, does the length of instructional time that teachers use in classrooms school correlate with academic achievement of students?

Jez and Wassmer (2011) stated that while conventional wisdom may expect a positive relationship between additional hours in classroom and a higher standardized test scores, evidence from empirical research on this subject is relatively thin. School time variables according to Karweit 1989 and Huit (2005) could be expressed as a continuum of three factors; allocated time (amount of time allocated for instructional and non instructional activities in the classroom), engaged-time (the amount of time the student is engaged in learning tasks) and academic learning time (the amount of time student successfully engaged in learning task). In her review of time and learning, O’Brodovich (2004) provided a succinct review of the relationship between teacher-student contact time and student learning (achievement). She noted that research and opinion had focused on allocated instructional time, though there does not seem to be a clear evidence on its relationship to student learning. However, other researches indicated that there is a stronger relationship between engaged, or time-on-task learning, and an even stronger positive relationship between academic learning time and student learning. Moreover, Carroll (1963) in his article titled ‘a model of school learning’, proposed elements that contribute to effectiveness of learning as: Aptitude (a measure of numerical ability or verbal reasoning), Ability to understand instruction, Perseverance (the amount of time the individual is engaged in learning), Quality of
instruction and Opportunity to learn (time allowed for learning). He expressed the degree of learning as time spent/time needed. Many of the studies conducted on instructional time and achievement presented instructional time as the time allocated for instructional activities in the classroom. That is the length of time of a lesson period. In this study, the actual time a teacher spends in teaching in the classroom from the time the teacher enters, to the time the teacher leaves, excluding time taken out for non-instructional activities within the lesson period is taken and termed as the teacher instructional time.

The student-engaged time is taken as the part of instructional time when students are actively engaged in learning activities like, listening, writing, asking questions, working exercises and so on. There is a need to establish with supporting empirical evidence, which school time variable(s) would significantly predict academic achievement of students. This would enable the policy makers to review and evaluate their policies on allocated school time and also help the curriculum developers in appraising the quality of classroom activities involving both the teachers and the students. The result of this study would enable educators at large to know whether increasing the length of time teachers spend in classrooms really contributes to achievement of students or whether it is the time students themselves spend engaged in learning activities within and outside the classrooms that contributes to academic achievement.

STATEMENT OF THE PROBLEM
This study therefore aimed to examine the extent to which the school time variables (teacher-instructional time and student-engaged time) would predict achievement of students in chemistry. Also, the influence of numerical ability as a measure of the aptitude is also investigated.

RESEARCH QUESTIONS
The study seeks to provide answers to the following research questions:
1. What is the composite effect of teacher instructional time, student engaged time and numerical ability on performance of students in Chemistry?
2. To what extent would teacher instructional time, student engaged time and student numerical ability when taken together predict the performance of students in Chemistry?
3. What is the relative contribution of the independent variables to the prediction?

METHODOLOGY
Design, Sampling Technique and Sample.
The design used for the research was an ex-post facto descriptive survey design. This was adopted because the study involved on-the-spot observation of behavior of participants (who are representatives of the target population) that could not be manipulated. The target population was the senior secondary school science students of Ibadan North Local Government Area, Oyo State, Nigeria. This Local Government was chosen because of its central position and the fact that it has the highest number of schools in Ibadan metropolis. The sample comprised 90 students randomly selected from 6 schools. 15 students were randomly drawn from senior secondary II science classes of each school for thorough observation of on-task behavior.

RESEARCH INSTRUMENTS
The instruments used are: Time-on-Task Observation Instrument (TOI) adapted from Stalling’s model of recording time-on-task; Chemistry Achievement Test (CAT) drawn from standard test questions and Numerical Ability Test (NAT) adapted from Differential Aptitude Test, each contains 30 items. The instruments were given to three experts to validate, an inter-rater reliability test was conducted on recorded observations of two different observers who scored the same set of students independently and a reliability coefficient of 0.670 was obtained using Scott’s reliability test. A reliability coefficient of 0.730 was obtained for CAT using Kuder Richardson formula 20 and for NAT, a reliability coefficient of 0.844 was obtained using Gutman’s –split half.

METHOD OF DATA ANALYSIS
The data collected were analysed using stepwise multiple regression analysis to examine the relationship between the independent variables (teacher instructional time, student-engaged time and numerical ability) and the dependent variables (scores of students in chemistry achievement test). It would also enable the researcher to determine which of the independent variables could predict the students achievements and to what extent.

RESULTS
Research question 1:
What is the composite effect of teacher instructional time, student engaged time and numerical ability on performance of students in Chemistry?

Table 1: Composite Effects Of The Independent Variables (Teacher Instructional Time (TIT), Student-Engaged Time (SET) And Numerical Ability (NA)) On Chemistry Achievement (CA).

<table>
<thead>
<tr>
<th>R</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>Standard Error Of Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.807</td>
<td>0.651</td>
<td>0.639</td>
<td>10.55</td>
</tr>
</tbody>
</table>

The result in Table 1 shows that the independent variables (TIT, SET, NA) together correlated 0.807 with the dependent variable (CA). These three
independent variables also contributed 63.9% to the variance of the dependent variable (Adj R² = 0.639). The remaining about 36% could be due to residual error and other factors not investigated in the study. This answers research question 1.

RESEARCH QUESTION 2
To what extent would teacher instructional time, student engaged time and student numerical ability when taken together predict the performance of students in Chemistry?

RESEARCH QUESTION 3
What are the relative contributions of teacher instructional time, student-engaged time and numerical ability to the prediction?

As shown in Table 3, the partial correlation coefficient (Beta) for Teacher Instructional Time (TIT) has t-value that is not statistically significant (p>0.05). However, Student-Engaged Time (SET) and Numerical Ability (NA) have significant t-values (p<0.05). Hence, they can be used to predict performance of students in Chemistry. Moreover, numerical ability had a Beta weight of 0.570 followed by student-engaged time 0.334 and lastly teacher instructional time with a Beta weight of -0.042. This further implied that numerical ability contributed most to the prediction followed by student-engaged time.

DISCUSSION OF FINDINGS
The results of the analysis showed that Teacher Instructional Time (TIT), Student-Engaged Time (SET) and Student numerical Ability when taken together, predict to a significant extent the students’ achievement in Chemistry. However, the Teacher Instructional time has no statistically significant relative effect on the Chemistry Achievement of students (sig. t = 0.523). This finding is in keeping with Slavin (1994) that there is little or no relationship between instructional time and students’ achievement and that this could be due to the fact that the length of instructional time tells us the quantity and not the quality of instruction.

The student-engaged time and numerical ability showed significant relative effect on achievement of students in chemistry (sig. t=0.00) corroborates the reports of Frederick et al (2004); Klem and Connel 2004; Putman et al 2003 that student-engaged time is a very important time variable as it represents the students become actively involved in their own learning. Also, Olatoye and Aderogba (2011) reported from their findings that the highest positive significant relationship is between student performance and numerical ability rests. According to them, aptitude tests measure students’ overall performance across a broad range of mental capabilities. Hence, this study adds to the growing body of knowledge on the composite and relative effect of student-engaged time and numerical ability on achievement of students.

CONCLUSION AND RECOMMENDATIONS
The study revealed that the amount of time students spend actively engaged in the learning and working exercises significantly predict achievement than the amount of time teachers spend in classrooms. Also, that the numerical ability of students is one of the strongest predictors of achievement in chemistry. Based on these findings, policy makers and educational stakeholders should focus more on introducing activities that increase the time students spend actively engaged in learning tasks rather than increasing school instructional time. Moreover, teachers should closely monitor students’ learning behavior during instructional time and give additional exercises that would engage the students and at the same time enhance their aptitude skills.
REFERENCES


