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INFLUENCE OF TIME-OF-DAY OF INSTRUCTION ON THE PERFORMANCE OF SENIOR SCHOOL STUDENTS IN PHYSICS IN ILORIN, NIGERIA

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Abstract: The study examined the influence of time-of-day of instruction on students' performance in physics.The study was a descriptive research and 578 senior secondary two (SS II) students were randomly selected from twenty co-educational public secondary schools based on the time-of-day physics.Proforma, questionnaire and physics lesson timetable were the instruments used. Percentage was used to answer the research questions raised and the hypotheses were tested with t-test at 0.05 level of significance. The findings revealed that students who received physics instruction at times-of-day akin to their peak time-of-day outperformed those who received the instruction at times other than their peak time-of-day. Gender and score levels influenced the time-of-day of instruction on the performance of students in physics. It was recommended among others that school management, especially of the schools that enrol male students only, should construct the timetable and place physics lessons in accordance with the time-of-day that is congruent to the majority of the students.

Key words: Time-of-day of instruction, Students' Chronotype, Physics and academic performance.

1. Introduction

Physics is essential as it makes a momentous input to many of the inventions that shape modern day and has contributed to explaining many of the events being encountered in everyday life. Physics is pivotal to the technological breakthrough of the modern world.Erinosho (2013) reported that physics is basic to understanding the complexities of modern technology and is indispensable for technological advancement of a nation.

The world depends on energy which is one of the basic elements of physics.Omosewo (2009) defined physics as a branch of science that concerns energy and matter and their interaction. The study of physics has given rise to hydroelectricity, nuclear power, digital computer and satellite; and in the area of healthcare, it concerns the imaging, screening, diagnosis and treatment. Togonu-Bickersteth (2013) stated that in Nigeria, a sub- discipline, exploration geophysics, enabled extraction of oil and gas from under the seabed; and, alike, much of solid minerals and underground water resources. In spite of this huge benefit of physics, it is evident that the performance of senior school students in physics is not satisfactory as revealed by the poor academic performance of students in physics in external examinations such as the West African Senior School Certificate Examination (WASSCE) in the last few years.

Akanbi (2003) submitted that poor performance in physics may be due to a number of fundamental reasons like shortage of physics teachers, inadequate laboratory equipment and facilities, and a shortage of suitable physics textbooks. Bamidele (2004) observed the lack of interest in physics by students, due to the preconceived idea that physics is a difficult subject, has affected the enrollment and performance of students in physics. This is in consonance with the submission of Erinosho (2013) that physics remains the least favoured science subject among students generally. In comparison with other science subjects, fewer students study physics at the senior secondary schools and subsequently, at the institutions of higher learning.

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One of the possible reasons why students have been recording low performance in physics is the time-of-day physics is taught. Learning and understanding have been found to be a factor of environment, sociology, physiology and psychology. Time-of-day of learning is governed by a physiological term called circadian rhythm. Marano (2016) defined circadian rhythm as a biological process that controls the body through cycles of sleep and alertness.

A research was conducted in the United Kingdom by Hartley and Nicholls (2008) to determine whether college students performing at a congruent time-of-day would show better achievement in the morning, intermediate or evening hours. Students who opted for morning and intermediate times-of-day outmatched those who picked evening times-of-day in terms of scores in exams. However, the performance of students preferring morning and those who preferred intermediate times-of-day were not significantly different.Pope (2016) used data from Los Angeles County schools to determine how secondary school students perform in morning as against afternoon courses. The researcher observed that understanding monotonically decreases throughout the day and that having a mathematics class in the morning instead of the afternoon increased a student's GPA.

It has been established that gender is related to the sociological and psychophysiological makeup of learners. Consequently, many researchers have considered gender as a moderating variable in their studies and have reported its relevance and irrelevance in the performance of students. As observed by Bello (2002), gender difference is observable in the scantiness and underachievement of the females in science, especially physics. It is noticeable that fewer female students major in physics and so there are fewer female physics teachers and lecturers.

Score level has been considered to be one of the factors that can determine the efficacy of new or different teaching techniques, learning mode or a treatment on the performance of students in school subjects. Based on their academic stands, students are categorized into high, medium and low scorers. Olasehinde (2003) posited that students who are quickly able to transfer their understanding to a different circumstance and utilize such understanding in a new way, perform well on imperative knowledge, unlike students with low level of conceptual understanding need more practice in order to acquire procedural knowledge (Adedayo, 2008).

This study investigated the influence of time-of-day of instruction on students' performance in physics. The study considered gender and scoring levels as moderating variables.

Research Questions

The following research questions were raised in the study.

1. What arethe prevalence of chronotype A (morning type) and chronotype B (evening type) among senior school physics students?
2. What are the proportion of schools in which physics is scheduled to be taught during the mid-morning, late morning and early afternoon?

Research Hypotheses

The following null hypotheses were tested:

H_{01}: there is no significant difference between the performance of students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day.

H_{02}: there is no significant difference between the performance of male students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of- day.

H_{03}: there is no significant difference between the performance of female students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day.

H_{04}: there is no significant difference between the performance of high scorers that were taught physics during their congruent times-of-day and those taught during their incongruent time-of-day.

H_{05}: there is no significant difference between the performance of medium scorers that were taught physics during their congruent times-of-day and those taught during their incongruent time-of-day.

H_{06}: there is no significant difference between the performance of low scorers that were taught physics during their congruent times-of-day and those taught during their incongruent time-of-day.

2. Method

This study was a descriptive research type of the survey method. This is because data were collected from existing school records, so there was no manipulation as the researcher was only interested in determining the influence of the selected variables –time-of-day of instruction, students' gender and score level on their academic performance in physics.

The sample consisted of 578 students (292 males and 286 females) drawn from the target population. The study involved twenty (20) co-educational public secondary schools in Ilorin metropolis. Purposive sampling method was used to select:

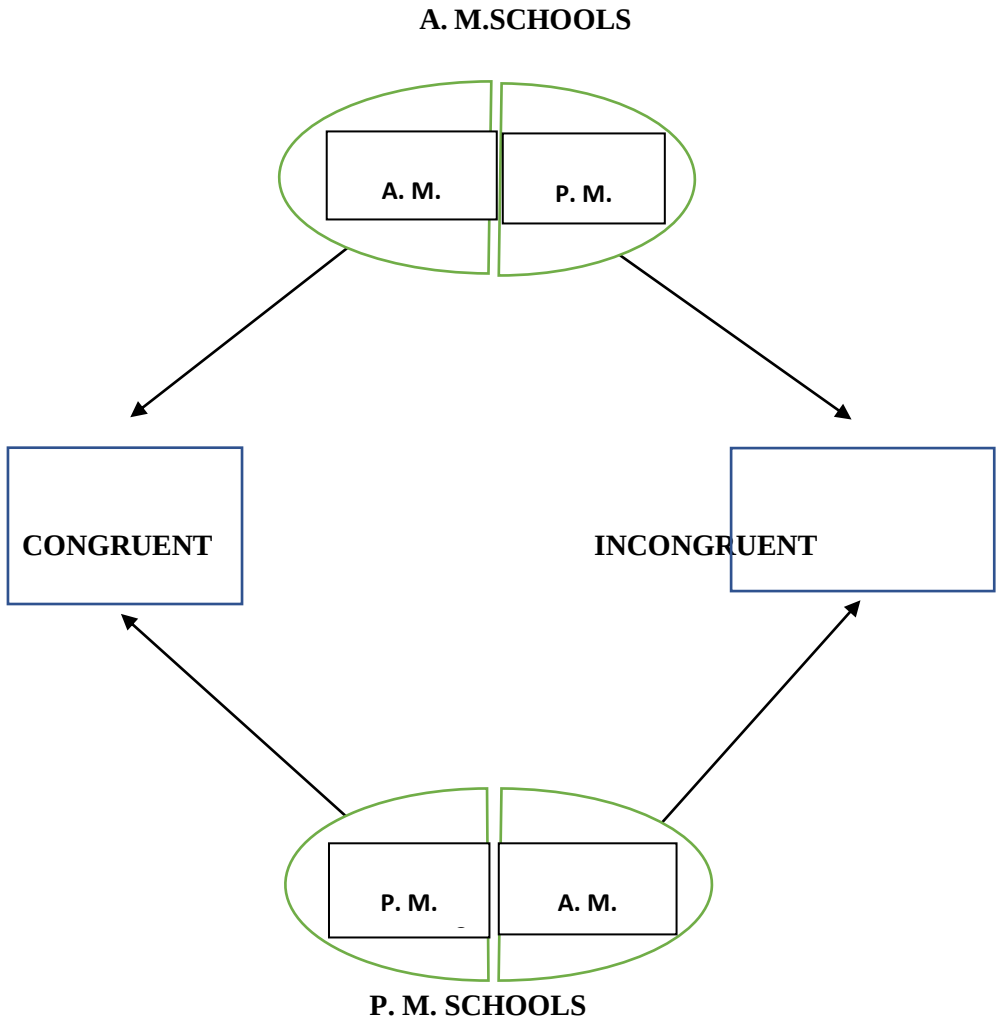
i. Schools in which physics lessons are all or majorly scheduled to be taught in the mid-morning (as observed by the researcher in the course of the pilot study);
ii. Schools in which physics lessons are all or majorly scheduled to be taught in the early afternoon;

Simple random sampling technique was used to select the participated physics students from each of the sampled schools. The instruments used for this study were students' academic Performance Proforma Questionnaire and physics lesson timetable. The proforma was designed to obtain SS II students' third term (promotion) examination scores in physics as contained in the schools' records. The questionnaire was two-sectional: sections A and B. Section A dealt with for the personal data of the respondents and B consists of nineteen (19) items adapted from Morningness-Eveningness Questionnaire (MEQ), an instrument devised by James and Olov (1976) . This instrument, MEQ, is free to be used and has been widely used to categorise students into chronotypes, i.e., morning type and evening type. Values ranging from 0 - 4 or 0 - 5 have been ascribed to each item of MEQ and the composite score of each respondent falls within certain ranges which enables their chronotype to be determined. The schools' academic timetable was collected. This was used alongside with the questionnaire to determine:

i. physics students taught at their congruent times-of-day, i.e., the morning types that were being taught in the mid-morning or late morning and the evening types that were being taught in the early afternoon; and
ii. Physics students taught at their incongruent times-of-day, i.e., the morning types being taught in the early afternoon and the evening types being taught in the mid-morning or late morning.

The terms "mid-morning", "late morning", and "early afternoon" are 8:00 a.m.-10:00 a.m., 10:00 a.m.-12:00 p.m. and 12:00 p.m. -2:00 p.m. respectively as defined by Angelfire (n.d.).The researcher solicited the permission and assistance of the appropriate authorities in the schools involved in the study and consent letters were given to the parents of the participants through the selected participants. The researcher subsequently accessed the schools' promotion examination results and entered the required information in the proforma and, as well, the schools' timetables were collected and recorded to know when physics lessons are being taught. The questionnaire was, afterwards, administered to the respondents by the researcher. The researcher waited for the collection of the completed questionnaire. As a result of the matching of the questionnaire and the schools' timetables, two groups were created: the congruent and the incongruent group. The congruent group consisted respondents who are taught physics at the times-of-day that corresponded with their chronotype i.e. The morning types taught in the morning and evening types taught in the afternoon. The incongruent group, on the other hand, consisted respondents who are taught physics at the times-of-day that did not correspond with their chronotype i.e. The morning types taught in the afternoon and evening types taught in the morning.

Figure 1 gives the diagrammatic illustration of the matching of the timetable and students' chronotype to form the two groups.



KEY:

A. M. SCHOOLS- Schools in which physics lessons are taught in the mid-morning or late morning
P. M. SCHOOLS- Schools in which physics lessons are taught in the early afternoon
A. M. STUDENTS- Students that are morning type
P. M. STUDENTS- Students that are evening type

Figure 1: *Mapping of Timetable and Students' Chronotype*

The data collected were analysed using descriptive and inferential statistics. Percentage was used to analyse the demographic information of the students as well as to answer the research questions. Hypotheses 1, 2, 3, 4, and 5 were tested using t-test.

3. Results

3. 1. Research Question One: What are the prevalence of chronotype A and chronotype B among senior school physics students?

Table 1 reveals that out of 578 SS11 physics students sampled, 53.29% of the respondents were chronotype A while 46.71% were chronotype B. This shows that chronotype A was the more prevalent among the respondents than chronotype B.

Table 1. *Distribution of the Respondents Based on Chronotype*

Chronotype	Frequency	Percentage
Chronotype A	308	53.29
Chronotype B	270	46.71
Total	578	100.00

Research Question Two: What is the proportion of schools in which physics is scheduled to be taught during the mid-morning, late morning and early afternoon?

Table 2 shows that 55% of the sampled schools scheduled physics to be taught in the mid-morning, 25% scheduled physics for the late afternoon while 20% scheduled it for the early afternoon.

Table 2. *Categorization of Schools Based on the Time-of-day Physics is Taught*

School	Frequency	Percentage
Mid-Morning (8 a.m.-10 a.m.)	11	55.00
Late Morning (10 a.m.-12 p.m.)	5	25.00
Early Afternoon (12p.m.-2 p.m.)	4	20.00
Total	20	100.00

Table 3 was created from tables 1 and 2 to categorize the respondents into congruent and incongruent groups. All the hypotheses formulated were based on table 3.

Table 3 shows that out of 578 SSII physics students who are chronotype A or chronotype B, 55.19 % of them are incongruent group while 44.81% are in incongruent group.

Table 3. *Distribution of the Respondents Based on Congruence*

Congruence	Frequency	Percentage
Congruent Group	319	55.19
Incongruent Group	259	44.81
Total	578	100.00

Hypothesis One: There is no significant difference between the performance of students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day.

Table 4 reveals that the t-value was 3.38 with 576 degree of freedom computed at 0.05 significance. Since the p-value was less than 0.05, hypothesis one was rejected. This implies that there was a significant difference between the performance of students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-dayin favour of the congruent group, $t_{(576)} = 3.38$, $p < 0.05$. Thus, being taught at congruent times-of-day influenced the performance of students in physics.

Table 4. *The t-test Analysis of the Performance of Students in Congruent and Students in Incongruent Group*

Variables	No of Students	Mean	Standard Deviation	t-value	df	p-value
Congruent Group	319	56.42	10.42	3.38	576	0.00
Incongruent Group	259	53.38	11.14			

P < 0.05

Hypothesis Two: There is no significant difference between the performance of male students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day.

Table 5 showed that the t-value was 2.86 with 290 degree of freedom computed at 0.05 significance. Since the p-value was less than 0.05, hypothesis two was rejected. This means that there was a significant difference between the performance of male students that were taught physics during their

congruent times-of-day and those taught during their incongruent times-of-day in favour of the congruent group, $t_{(290)} = 2.86$, $p < 0.05$. Thus, being taught at congruent times-of-day influenced the performance of male students in physics.

Table 5. *The t-test Analysis of the Performance of Male Students in Congruent and Male Students in Incongruent Group*

Variables	No of Students	Mean	Standard Deviation	t-value	df	p-value
Congruent Group	161	58.61	9.68	2.86	290	0.00
Incongruent Group	131	55.24	10.42			

P < 0.05

Hypothesis Three: There is no significant difference between the performance of female students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day.

Table 6 showed that the t-value was 1.87 with 284 degree of freedom computed at 0.05 significance. Since the p-value was greater than 0.05, hypothesis three was not rejected. This means that there was no significant difference between the performance of female students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day, $t_{(284)} = 1.87$, $p > 0.05$. Thus, being taught at congruent times-of-day did not influence the performance of female students in physics.

Table 6. *The t-test Analysis of the Performance of Female Students in Congruent and Female Students in IncongruentGroup*

Variables	No of Students	Mean	Standard Deviation	t-value	df	p-value
Congruent Group	158	48.12	11.11	1.87	284	0.06
Incongruent Group	128	45.56	12.02			

P > 0.05

Hypothesis Four: There is no significant difference between the performance of high scorers that were taught physics during their congruent times-of-day and those taught during their incongruent time-of-day.

Table 7 showed that the t-value was 0.67 with 69 degree of freedom computed at 0.05 significance. Since the p-value was greater than 0.05, hypothesis four was not rejected. This means that there was no significant difference between the performance of high scorers that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day, $t_{(69)} = 0.67$, $p > 0.05$. Thus, the performance of the students with high scores in physices is not influenced by being taught at congruent or incrongruent times-of-day.

Table 7. *The t-test Analysis of the Performance of High Scorers in Congruent and High Scorers in Incongruent Group*

Variables	No of Students	Mean	Standard Deviation	t-value	df	p-value
Congruent Group	42	78.22	9.23	0.67	69	0.50
Incongruent Group	29	76.56	11.50			

P > 0.05

Hypothesis 5: There is no significant difference between the performance of medium scorers that were taught physics during their congruent times-of-day and those taught during their incongruent time-of-day.

Table 8 showed that the t-value was 3.55 with 393 degree of freedom computed at 0.05 significance. Since the p-value was less than 0.05, hypothesis five was rejected. This means that there was a significant difference between the performance of medium scorers that were taught physics during their congruent times-of-day and medium scorers taught during their incongruent times-of-day in favour of the congruent group, $t_{(393)} = 3.55$, $p < 0.05$. Thus, being taught at congruent times-of-day influenced the performance of medium scorers in physics.

Table 12. *The t-test Analysis of the Performance of Medium Scorers in Congruent and Medium Scorers in the Incongruent Group*

Variables	No of Students	Mean	Standard Deviation	t-value	df	p-value
Congruent Group	218	58.47	12.48	3.55	393	0.00
Incongruent Group	177	54.12	11.64			

P < 0.05

Hypothesis 6: there is no significant difference between the performance of low scorers that were taught physics during their congruent times-of-day and those taught during their incongruent time-of-day.

Table 8 showed that the t-value was 2.02 with 110 degree of freedom computed at 0.05 significance. Since the p-value was less than 0.05, hypothesis six was rejected. This means that there was a significant difference between the performance of low scorers that were taught physics during their congruent times-of-day and low scorers taught during their incongruent times-of-day in favour of the congruent group, $t_{(110)} = 2.02$, $p < 0.05$. Thus, being taught at congruent times-of-day influenced the performance of low scorers in physics.

Table 8. *The t-test Analysis of Mean Score of Low Scorers Taught at Congruent and Those Taught at Incongruent Times-of-Day*

Variables	No of Students	Mean	Standard Deviation	t-value	df	p-value
Congruent Group	69	49.12	9.82	2.02	110	0.05
Incongruent Group	43	45.24	10.04			

P < 0.05

4. Discussion and Conclusion

This study revealed that there was a higher prevalence of chronotype A than chronotype B among senior secondary school students. This could be due to age-dependent nature of chronotype distribution. This agreed with the position of Merikantoet *et al*. (2012) that chronotype A is more common among secondary school students.

The study similarly showed that there was higher proportion of secondary schools which scheduled physics lessons for mid-morning and those which scheduled it for late morning and early afternoon. This inferred that many schools considered physics as a subject that should be taught in the morning. This is in agreement with the findings of Igbojinwaeku (2014) that school administrators favoured science subjects being taught in the morning.

It was revealed from the findings that there was a significant difference between the performance of students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-dayin favour of the congruent group. This underscores the relevance of being taught physics at times-of-day that is congruent to the students' chronotype. This is in harmony with the findings of Goldstein et al. (2007), Sjosten-Bell (2005) and Pope (2016), all of whom agreed that a connection exists between the performance of students and their chronotype and, by extension, whether or not they are taught at congruent times-of-day.

The findings of this study revealed that there was a significant difference between the performance of male students that were taught physics during their congruent times-of-day and those taught during

their incongruent times-of-day in favour of the congruent group. This implies that the influence of being taught physics at the congruent times-of-day influenced the performance of male students. The finding corroborates the findings of Sjosten-Bell (2005) who also submitted that time-of-day of instruction influenced the performance of students.

The findings indicated that there was no significant difference between the performance of female students that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day. This implies that the influence of being taught physics at the congruent times-of-day did not influence the performance of female students. This finding is in contrary to the finding of Pope (2016) that time-of-day of instruction have an influence on the performance of students.

Also, the findings showed that was no significant difference between the performance of high scorers that were taught physics during their congruent times-of-day and those taught during their incongruent times-of-day. The implication of this is that congruence or incongruence of time-of-day of instruction does not determine the performance in physics among the high scorers. This is in contrary with the finding of Mulenga and Mukuka (2016) that students taught in the morning performed better than those taught in the afternoon.

The findings revealed that there was a significant difference between the performance of medium scorers that were taught physics during their congruent times-of-day and medium scorers taught during their incongruent times-of-day in favour of the congruent group. This means times-of-day of instruction matter in the performance of medium scorers in physics. This finding corroborates that of Hartley and Nicholls (2008) that chronotype A taught in the morning performed better than those taught in the afternoon.

Finally, the findings showed that there was a significant difference between the performance of low scorers that were taught physics during their congruent times-of-day and low scorers taught during their incongruent times-of-day in favour of the congruent group. This implied that time -of-day at which physics is taught is influential on the performance of low scorers. This agrees with the submission of Goldstein et al. (2007) that students' learning is influenced by their time-of-day congruence.

This is in contradiction with the submission of Dills and Hernandez-Julian (2008) that not chronotype of the students but the nature of the subject matters. It was evident from this work that students' chronotype and time-of-day when such students are taught physics could determine the rate in which they understand, assimilate, and retrieve information on physics and their performance. It was also indicated that students' gender and score level determine the degree at with time-of-day of instruction and their performance in physics interrelate.

From the analysis of data and results interpreted, it can be concluded that chronotype A is more common in the senior secondary school two (SSII) physics students than chronotype B. Most of the sampled public secondary schools scheduled physics lesson for the mid-morning and late morning. This means that school administrators regard physics as a subject that should be taught before noon.

Moreover, Students who received physics instruction at times-of-day akin to their peak time-of-day outperformed those who received the instruction outside their peak time-of-day. This was especially significant among the male students which points to the fact that the performance of males, unlike females, is influenced by chronotype and school schedule of physics. The influence of chronotype and school schedule of physics is significant among medium scorers and low scorers. It can be adduced that medium and low scorers are majorly dependent on school lessons alone as against the high scorers who could be attending extramural classes and engaging in night readings.

4. 1 Recommendations

On the basis of the findings and the conclusions drawn, this study recommends the following:

1. Secondary school management, especially of the schools that enrol male students alone, should construct the timetable and place physics lessons in accordance with the time-of-day that is

congruent to the majority of the students. To achieve this, morningness-eveningness questionnaire can be administered to the fresh physics students at the beginning of the first term of year one (SS I) so as to determine the students' chronotypes.

2. Students should determine their optimal time, in terms of cognitive alertness, in which they can study physics. This will enable them to schedule their private study accordingly and, also, induce them to study harder in other to make up for any undesirable influence of not being taught at their congruent times-of-day of instruction in their respective schools.

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