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Application of Linear Growth Model on Students' Enrolment for Expected Classroom Space with Social Distancing in Federal Polytechnic Offa (A Case Study of Main Campus)

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Abstract— *This study examined the projection of student enrolment into Federal Polytechnic Offa and to determine the required space (m2) in accordance to COVID – 19 social distancing sitting arrangement. The intake of new students into tertiary institutions in Nigeria continues to be on the increase as many candidates apply yearly for admission due to rapid increase in population and lack of sustainable job for unskilled workers. The study considered the three schools in the polytechnic main campus; School of Communication Technology, School of Environmental Studies and School of Business Management Studies. The data of student enrolment for 2016/2017 to 2018/2019 session was collected from the polytechnic and the projection of students' enrolment was carried out using Arithmetic (linear) growth model. The analysis revealed that the highest increase of projected students' enrolment for 2019/2020 session for NDI was from Accountancy with 221 students and the lowest was Urban and Regional Planning with 24 students. Whereas the highest for HNDI was Mass Communication with 477 students and the lowest was Marketing with 57 students. The number of students in a class according to NBTE standard is 30 in a standard class of 75m2 which is now for 18 students due to COVID -19. The space requirement for students in NDI Accountancy, for instance, is 900m2 which is equivalent to 12 classes in compliance with social/physical distancing. The projection of students' enrolment will help the stakeholders to make provision for adequate classroom space in and post COVID -19 period.*

Keywords— *COVID -19: Classroom Space: Linear growth model: Projection: Students' enrolment.*

I. INTRODUCTION

The intake of new students into tertiary institutions in Nigeria continues to be on the increase as many candidates applied yearly for admissions due to rapid increase in population and lack of sustainable job for unskilled workers. There is certainly pressure on these institutions to admit more than what they can cope. The supervisory bodies of this institutions acting as a watch dog to checkmate the abuse of admitting above the capacity might not be enough to end the pressure also in compliance to social distancing rule. Therefore, schools can look into the angle of increasing their capacity by improving on the necessary requirement for increase capacity. The institutions should plan for increase capacity to reduce the pressure by having a short and long term plans.

This study is to assess the facilities in Federal Polytechnic Offa and pattern of student enrolment for some years. These are needed in developing a model for projecting the student population in subsequent years for effective classroom planning and management to forestall overcrowding/over population in the campus. There has been strict adherent to student capacity by institutions, in recent time, causing a lot of admission seekers to stay at home. It is of great consequences to the nation for them to be idle which can lead to increase in crime.

This study will project the intake of students for some years and the classroom facilities required in taking care of the expected students. Therefore having adequate projection of student enrolment, the stakeholders can systematically improve on facility without waste of resources to accommodate more student, this will also save cost of establishing new polytechnics to gather for more admission of students. The National Board of Technical Education (NBTE) (2014) requirements for a stream of thirty students in a course of study in the polytechnic in terms of classroom is a 30-seater standard classroom.

In compliance with COVID- 19 social distancing rule, the school now have to undertake a new seating arrangement in each classroom for a healthy study for both the student and lecturers.

II. LITERATURE REVIEW

There has been various polices to bring about quality education in Nigeria and various researchers has carried out studies on the effects of these policies in the education sector of the nation. The National Board of Technical Education (2014) Guidelines and Procedures stipulates the carrying capacity for each stream of students in terms of staff, classrooms, library and so on. In the study carried out by Ademola, Ogundi and Babatunde (2014) on Students' Enrolment into Tertiary Institutions in Nigeria take a look at the influence of the founder's reputation and other surveys on educational policies with special attention on factors of the increasing population of the admission seekers with reference to teaching facilities, spaces, quality of tutors and mentorship. The study revealed ninety-eight percent of the respondents agreed to the fact that the state of the art infrastructure influenced their decision on choice of university for admission.

The statistics of students' enrolment into tertiary institutions is on the increase most times. This according to

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Shu'ara (2010) the students' enrolment increased from 1,079,515 in 2007 to 1,502,072 in 2008 and 1,527,559 in 2009 with fluctuation in 2010 to 1,375,671. The admission into monotechnic, polytechnic and college of education had almost double intake in 2008 with 310,022 as against 167,836 in 2007. The effect of over population in any institution is always devastating. In many countries population pressures is one of the factors in massive natural resource depletion (Ahmed and Mallick, 1999).

The infrastructures/facilities no doubt have effect on learning either on the part of teacher or student. Schneider (2002) considers indoor air quality, ventilation, and thermal comfort, building age, quality, and aesthetics as some of the factors that affect academic performance. The researcher from the findings agreed that school facilities affect learning.

The infrastructural development should go hand in hand with increase student enrolment or else the current facilities will be over used. This according to Moja (2000) the Nigeria educational sector experienced overpopulation mainly through the introduction of universal primary education which put pressure on educational facilities. This happened because the facilities expansion was not at the same rate as the school population.

According to Mohammed and Grema (2011) in the study titled "Management of Available Infrastructural Facilities and Students' Academic Achievement in Borno State Colleges of Education in Nigeria" revealed that there was fairly adequate management of available infrastructural facilities in the college. But there was significant relationship between student academic performance/achievement and management of available infrastructural facilities in the college. They stressed the need for improved/adequate infrastructure to the college of educations in Borno state to enhance good academic performance.

In other to make appropriate planning, a model should be developed to determine population growth and match up with infrastructural/facilities developmental plans to gather for subsequent intake of students. This will help in improving the standard of polytechnic education.

III. Statement of Problem

The polytechnic education came as result of the quest for technological development by the government. The necessary fund to run such establishment has been a setback. In order to sustain the institutions more students were admitted and other nontechnology courses were introduced to boost revenue generation. This led to increase in population of students in campuses. Other reasons are the increase in Nigeria population, primary and secondary schools. The pandemic COVID – 19 has also brought a drastic change in learning system, interaction between people, sitting arrangement in places like classroom which calls for urgent attention in our institutions. Therefore, the way forward is eminent which this research work will proffer.

IV. Arithmetic (Linear) Growth Model

This model is based on the assumption that growth is linear. In the other way the population follows an arithmetic progression with a constant amount of increase per unit of time. The projection equation (model) is given as

$$P_t = P_1 + dw \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where

$$d = \frac{P_l - P_0}{l}$$

P_t = projected size of students' enrolment in 2019/2020 session

P_1= population in the launch year1 (2018/2019 session)

P_0 = size of the population in the base year 0 (2016/2017 session)

d = average absolute change of the population

w = length of the time interval in the projection horizon (number of years between the launch year and target year)

l = number of years in the base period (number of years between launch year and base period)

(George, Smith, Swanson and Tayman, 2004)

V. Projection of Students' Enrolment

The projection is done based on the linear model explained above. The tables below show the length of the time interval in the projection horizon (w) and average absolute change of the population (d) used for projection for each of the level/department.

TABLE 1: ND I full time students' enrolment in main campus, Federal Polytechnic, Offa in 2019/2020 Session

SN	Programme	d	w	Proj (19/20)
1	Accountancy	22	1	221
2	Architecture	9.5	1	45
3	Banking and Finance	10	1	83
4	Building Technology	-6	1	30
5	Business Administration	30.5	1	151
6	Estate Management	7	1	36
7	Insurance	4	1	75
8	Library Information Science	27	1	185
9	Mass Communication	24	1	181
10	Office Tech. & Management	0.5	1	39
11	Quantity Surveying	5.5	1	46
12	Urban and Regional Planning	1	1	24

The projection of students' enrolment into first year of the ND for 2019/20 sessions shows that Accountancy was expected to enrol the highest number of students with 221 students, followed by Library Information Science with 185 students. The third in the list is Mass Communication with 4 students less than Library Information science.

TABLE 2: HND I full time students' enrolment in main campus, Federal Polytechnic, Offa in 2019/2020 Session

SN	Programme	D	w	Pro (19/20)
1	Accountancy	52.5	1	424
2	Architecture	10.5	1	64
3	Banking and Finance	41	1	313
4	Building Technology	13	1	106
5	Business Administration	41	1	375
6	Insurance	9	1	145
7	Library Information Science	23	1	231
8	Marketing	0.5	1	57
9	Mass Communication	86	1	477
10	Office Tech. & Management	12	1	128
11	Quantity Surveying	-3.5	1	59

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The last column of table shows projection of students into first year HND Mass Communication for the period considered (2019/2020) as 477 students, followed by Accountancy with 424 students. Next to Accountancy is enrolment is Business Administration expected new students' enrolment of 375 students.

VI. Expected Classroom Space

The space required for each course having in mind COVID-19 specification for students to sit in such a way that social/physical distancing is adhered to the fullest. There are two types of arrangement that will be considered. These are sitting arrangement with single table and chairs and tablet arm chair.

The standard space per sit/student as measured is 2.5 m^2

Standard class size by NBTE = 30 students

Expected space per sit/student (ESPS) = 2.5m^2

Expected class space (ECS) = 2.5 x 30 = 75m^2

Expected class space per progamme for table and chair (ECSPP) sitting arrangement = 2.5 x n_p (where n_p is the number of students in a programme).

Classroom with Table and Chair

The standard space of 2.5 will be used in table and chair sits in which 75m^2 accommodates 30 students. The 30 students in a class can be arranged in two ways. This is either 6 rows and 5 columns or 5 rows and 6 columns.

i. The arrangement is 3 students/sits per row of 6 rows and 5 columns with social/physical distancing.

Number of students per class during COVID-19 and Post COVID-19 era = 15.

ii. The arrangement is 3 students/sits per row of 5 rows and 6 columns with social/physical distancing.

Number of students per class in COVID-19 and Post COVID-19 era = 18.

The classroom space is optimally utilized for 18 students per class in compliance with COVID-19 social/physical distancing.

Classroom with Tablet Arm Chair

Standard space per sit/student for tablet arm chair (SSS_{TAC}) sitting arrangement = 1.9m^2 (measured)

Number of students per class for tablet arm chair (SCS_{TAC}) sitting arrangement $= \frac{ECS}{SSS_{TAC}} = \frac{75}{1.9} \approx 40$

This is above NBTE standard of number of students per class, but that notwithstanding, the new arrangement with social/physical distancing will settle the overcrowding.

The 40 students in a class can be arranged in two ways. This is either 8 rows and 5 columns or 5 rows and 8 columns.

i. The arrangement is 4 students/sits per row of 8 rows and 5 columns with social/physical distancing.

Number of students per class during COVID-19 and Post COVID-19 era = 20.

ii. The arrangement is 3 students/sits per row of 5 rows and 8 columns with social/physical distancing.

Number of students per class in COVID-19 and Post COVID-19 era = 24.

The classroom space is optimally utilized for 24 students per class in compliance with COVID-19 social/physical distancing.

TABLE 3: ND I full time COVID-19 space (m^2) and classrooms required in main campus, Federal Polytechnic, Offa for the projected Year 2019/2020 Session

SN	Programme	Projection (19/20)	ECSPP (m2)	Table and chair		Tablet arm chair	
				No. of classes (30 per class) before COVD-19	No. of classes (18 per class) in COVID-19	No. of classes (30 per class) before COVD-19	No. of classes (18 per class) in COVID-19
1	Accountancy	221	553	8	13	8	9
2	Architecture	45	111	2	3	2	2
3	Banking and Finance	83	208	3	5	3	3
4	Building Technology	30	75	1	2	1	1
5	Business Administration	151	376	5	9	5	6
6	Estate Management	36	90	2	2	2	2
7	Insurance	75	188	3	5	3	3
8	Library Information Science	185	463	7	11	7	8
9	Mass Communication	181	453	7	11	7	8
10	Office Tech. & Management	39	96	2	3	2	2
11	Quantity Surveying	46	114	2	3	2	2
12	Urban and Regional Planning	24	60	1	2	1	1

The spacing of students in the classrooms with COVID-19 protocols of social and physical distancing adherent is estimated based on the type of sits and number of students per class.

For instance in Table 3, ND I Accountancy requires 553m^2 for projected enrolment of 221 students, in a class having table and chair, the number of classes required for 30 students per class before COVID-19 and 18 students per class during COVID-19 for Accountancy are 8 classes and 13 classes respectively. Whereas, Tablet arm chair sits for classroom of 30 students per class before COVID-19 and 24 students per class during COVID-19 for Accountancy are 8 classes and 9 classes respectively.

Table 4 is for HND I where the spacing of students in the classrooms is equally made to comply with COVID-19 protocols of social and physical distancing by considering also the type of sits and number of students per class.

HND I Accountancy in Table 4 requires 1060m^2 for projected enrolment of 424 students. Considering table and chair classroom, the number of classes required for 30 students per class before COVID-19 and 18 students per class during COVID-19 for HND I Accountancy are 15 classes and

24 classes respectively. Whereas, Tablet arm chair sits for classroom of 30 students per class before COVID-19 and 24 students per class in COVID-19 for the same class are 15 classes and 18 classes respectively.

TABLE 4: HND I full time COVID-19 space (m^2) and classrooms required in main campus, Federal Polytechnic, Offa for the projected Year 2019/2020 Session

SN	Programme	Projection (19/20)	ECSPP (m2)	Table and chairs		Tablet arm chair	
				No. of classes (30 per class) before COVD-19	No. of classes (18 per class) in COVID-19	No. of classes (30 per class) before COVD-19	No. of classes (18 per class) in COVID-19
1	Accountancy	424	1060	15	24	15	18
2	Architecture	64	160	3	4	3	3
3	Banking and Finance	313	783	11	18	11	13
4	Building Technology	106	265	4	6	4	4
5	Business Administration	375	938	13	21	13	16
6	Insurance	145	363	5	9	5	6
7	Library Information Science	231	578	8	13	8	10
8	Marketing	57	143	2	4	2	2
8	Mass Communication	477	1193	16	27	16	20
9	Office Tech. & Management	128	320	5	8	5	5
10	Quantity Surveying	59	148	2	4	2	2

It should be noted that the space for 30 students in a class before COVD-19 can be used by 24 students with table arm chair during COVID-19. Whereas, 18 students can use the same space with table and chair.

VII. Conclusion

The projection of students' enrolment has given an idea of the enrolment expected and the subsequent classroom space calculated based on the expected enrolment will give an input for adequate planning. Thereby, making adequate provision for the incoming and existing students, especially with the new trend of life style due to the present pandemic (COVD-19). The table arm chair is more economical in terms of spacing with COVID-19 protocol whereby more sits can be arranged in the same space than table and chair.

VIII. Recommendations

There are various adjustment going on in educational sectors to adapt to new protocols, but the following areas of adjustment is desirable at this present time.

The table chairs sitting facility should be replaced by table arm chair which is less expensive than constructing new classroom blocks.

Where the students' enrolment is on the increase, some programmes should be run online to reduce number of students using the classrooms.

The school year should be 12 calendar months of January to December made up of two sessions of two semesters each for different set of students.

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