

Anatomy Education: Perceptions and Experiences of Nigerian Anatomists towards Contributing to Programme and Career Advancements

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Abstract

Anatomy, a foremost basic medical science (BMS) has evolved in content and context, while remaining the most fundamental BMS subject. Stakeholders have continually made efforts especially in recent time to achieve an evolution of this subject. The primary aim of this work was to study the perceptions and experiences of Anatomists towards contributing to programme and career advancements. Following ethical approval, structured questionnaire was administered to Nigerian anatomists using a Google form. It is a total population study. The questionnaire had 13 sections, with each section addressing a theme that was integral to the subject of research interest. The last section collected free responses as qualitative information. After indicating informed consent, 106 anatomists properly completed and returned the questionnaires. Statistical and quantitative analyses of results were done. The most popular field amongst respondents was Neuroscience (60.9%); followed by Histology or Microscopic Anatomy (53.6%), Embryology or developmental anatomy (35.5%), Gross anatomy (34.5%) and Histochemistry (30.9%). About half of Nigerian anatomists involved in the study had a PhD degree. Training emphasized the cognitive domains the most. Consequently, emphasis should be laid on the psychomotor (skills) and the affective domain (attitude) to improve capacity, competences, and the job prospects of trainees. The consensus was that the programme trained students and prepared graduates as medical educators, scientists, and researchers. Anatomy has significant potential to contribute to development with proper programme design, emphasis on re-

search, teaching and applied services competencies, effective policy formulation and implementation and adherence to best practices.

Keywords

Anatomy, Anatomical Sciences, Education, Curriculum, Career, Prospects, Nigeria

1. Introduction and Literature Review

Anatomy is currently studied as an academic programme leading to the award of degree certificates in Nigeria. It is a basic medical science discipline that has ever been relevant to the training and practice of medicine, biomedical science, and other health sciences. It also has applications to several walks of life. While the relevance of the subject has remained undisputable, its context and scope have evolved greatly over the years. There have been concerted efforts to ensure that the advancements in African institutions offering this course would match the rest of the world in terms of the changes that have accompanied the evolutions of Anatomy as a course of study in content and context. Very importantly, this reality cannot be overlooked if African anatomists must adequately contribute their quotas towards developing the continent and their countries especially in the areas of education and health among others.

This research is therefore very crucial towards ensuring a holistic approach to achieving advancement of the discipline. Considering the fact that there is relative paucity of research findings on Anatomical education and its prospects in Nigeria and Africa in general, this research is a practical approach towards addressing the identified challenges. The primary aim of the proposed study was to explore the perceptions and experiences of Anatomists with emphasis on programme philosophies, training methods and career prospects in representative institutions in Nigeria in order to develop practical and solution-oriented teaching and career development strategies for anatomists-in-training towards meeting the demands of the Africa continent especially through research and specialised skills applications.

There is a need to properly define career prospects, develop effective policies and improve training methods with respect to the training of basic medical scientists towards developing human resources and personnel in the field of Anatomy [1] [2] [3]. The training programme and career prospects of anatomists in the twenty first century should be given a serious consideration, taking into account the importance of the subject. This effort may also serve as a reference for other disciplines of basic medical sciences. The series of changes that have accompanied the evolution of anatomy as a course of study over the years demand for conscientious efforts to ensure the evolution of anatomy programme's philosophies, programmes' design and methodology of delivery, the course contents, requisite competences of the trainees, and the programme outcomes towards

meeting the need of the society in the 21st century [4] [5] [6]. There is a need to also develop the various aspects of anatomical sciences. This might be termed unbundling anatomy as a subject. While in certain parts of the world, the various dimensions and aspects of anatomical sciences have been explored and further developed to optimally benefit from the diverse applications and multiple prospects of the discipline, such development has not taken place in some other places where stakeholders are still largely stuck with the ancient paradigms, traditional philosophies about the subject, old pedagogies of teaching and methods of training [1] [7] [8]. Nigeria, for instance has begun to emphasize the need for thorough, intentional, and conscientious curricula re-evaluation and development to meet the need of the modern demands especially in the health sector. This should be done with adequate reference to developmental needs in Nigeria and the rest of the world [1] [7] [8].

The above realities further point to the need to carefully consider the peculiarities of educational, health and research demands on the African continent while making efforts to review, redesign and develop solution-oriented modern curricula for anatomical sciences. This further emphasizes why it has become very important to evaluate the current scenarios in Nigerian and African institutions. This would help educators and stakeholders deepen their insights and broaden their perspectives about career development and programme prospects [1] [3]. It will also help to appreciate the real needs that the competences acquired from training should meet on the African continent [1] [3].

There will be many dimensions to addressing the challenges with anatomical education and training. This particular effort specifically emphasizes Nigerian anatomists' perceptions of the subject, and their experiences as anatomists towards contribution to programme and career advancements. The potential benefit of such studies would include the acquisition of reliable empirical data and quality insights that might help in developing improved and practical curricula, enriched with solution-oriented programme philosophies, that also engage the most effective modern pedagogies towards training anatomists to acquire appropriate competences in meeting the demands of the 21st century especially in Nigeria and on the African continent. It is also in line with notable previous efforts towards enriching the available literatures on anatomical education [2] [3].

2. Materials and Methods

2.1. Structured and Validated Questionnaire

Structured questionnaire for the purpose of educational research was prepared and validated, based on the principles and recommendations in the UNESCO's quantitative research methods in educational planning by the International Institute for Educational Planning [9]. The original information was collected with the aid of pilot study questionnaires strategically administered for the purpose. The sections of the questionnaire addressed various research themes

as follows: Section 1. Personal Information; Section 2. Background Information; Section 3. Anatomy in Context; Section 4. Knowledge of Programme; Section 5. Interest in Anatomical Education and Research; Section 6. Training Facilities; Section 7. Job description and Career Satisfaction; Section 8. Knowledge of Career Prospects and Diversity for Graduate of the Anatomy Programme; Section 9. Courses and Areas of Specialisation; Section 10. Perspectives; Section 11. Teaching Methods and Preferences; Section 12. Teaching Methods and Aids; Final Part. Qualitative/Free Responses regarding personal insight into Anatomical Education. The questionnaire was administered in the year 2020.

2.2. Administration of Questionnaire to the Faculty

The structured questionnaire was administered to the Nigerian anatomists in electronic format using a Google form. The questionnaire was carefully curated to have 13 sections, with each section addressing a theme that was integral to the subject of research interest. The last section collected data as free qualitative responses. The Google form questionnaire was opened for 1 month with access provided to complete the form via the Nigerian Anatomy professional bodies official platforms.

Sample size determination and determination of validity-considerations

- 1) Total population survey of all anatomists at all career levels in Nigeria.
- 2) All returned and properly completed questionnaires were considered.
- 3) Confirming informed consent on questionnaire was a requirement for participation, and validity of returned questionnaires.

2.3. Data Handling, Statistics, Analysis, and Record Keeping

1) Data management procedure: Returned questionnaires were collated and sorted to only consider those that met the criteria that included proper and clear completion and accompanying informed consent. The Microsoft Excel was used to create a raw database for analysis.

2) Data analysis: The GraphPad Prism (statistical software, Version 7), and the Microsoft Excel packages were used for descriptive statistical analysis. Result presentations were made as tables, charts, values, and qualitative analyses based on suitability for purpose.

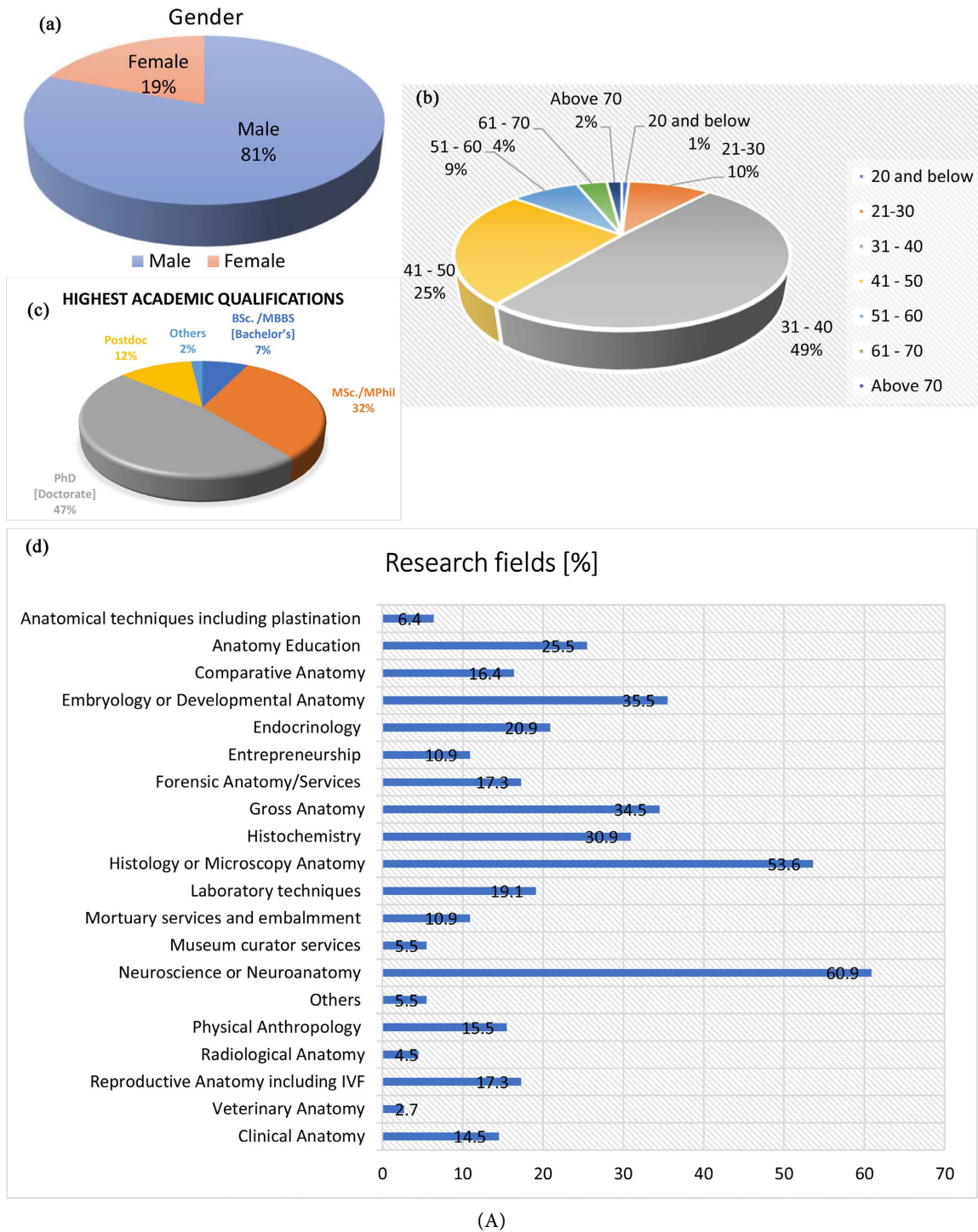
2.4. Research-Related Ethical Considerations

Data safety and confidentiality issues related to data: Only the researcher(s) had access to the raw completed questionnaires and the data was handled with utmost adherence to ethics. There was also no conflict of interest in the study. Respondents' identities were anonymized, data and pieces of personal information were assigned codes and confidential. Respondents' names and personal identities were not to be used specifically in any report or publication. The approval ethical number as obtained from Babcock University is BUHREC 701/18.

3. Results

3.1. Demography of Participants

All respondents (100%) were Nigerians by nationality and Anatomists by training. The modal age group was 31 - 40 (47.3%). A good proportion of participants had terminal academic degrees as almost half (47.3%) of respondents had a PhD (Figure 1(A)). Respondents were allowed the latitude of selecting



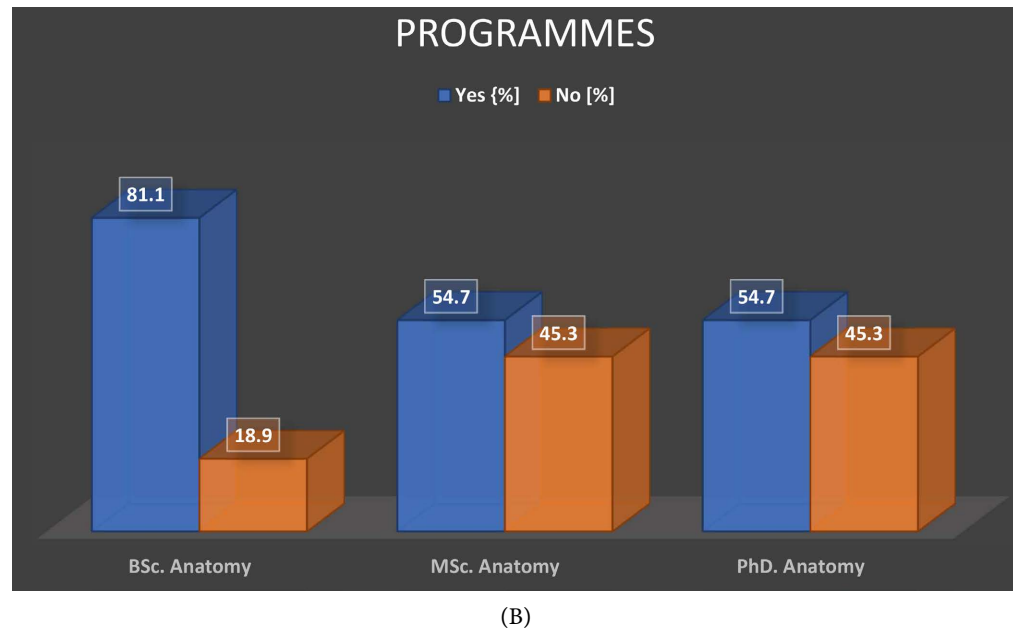


Figure 1. (A) Figure showing the demographics of participants. Most participants (80.9%) were males. Most participants worked with a masters' degree as their highest qualification at the time of study. Neuroscience (60.9%), Histology or microscopic anatomy (53.6%) and Gross anatomy ranked first to third as fields of anatomy that participants considered their primary fields of expertise professionally. (B) Figure showing the degree programmes in anatomy as currently offered in the institutions that of participants. Generally, more than half of the educational institutions in which the Anatomists currently work offer degrees programmes in the fields of Anatomy including bachelor's, master's, and doctorates (PhD) (**Figure 1(B)**).

multiple fields that match which aspects of Anatomy they considered or could term their primary field of expertise, professionally. The most popular field amongst respondents was Neuroscience (60.9%) followed by Histology and Microscopic Anatomy (53.6%) and Embryology or developmental anatomy (35.5%), Gross anatomy (34.5%) and Histochemistry (30.9%) as the topmost popular fields amongst Nigerian Anatomists. Research interest was also considered; Neuroscience also topped the fields of research interests amongst Nigerian anatomists. It is also important to note that Nigerian anatomists have their research interests across all major traditional and modern aspects of anatomy including neuroscience, clinical anatomy, embryology, andrology, and reproductive anatomy, diabetes and metabolisms studies, endocrinology, anatomy and medical education, biological anthropology, forensic anthropometry, reproductive health, reward and addiction neurobiology, stem cell research, health informatics and vision studies. About half of respondents indicated various aspects of neuroscience as their current field of research activities. Also, the larger proportion of respondents indicated that institutions offered anatomy training at bachelor's, master's and doctorate or PhD levels (**Figure 1(B)**).

3.2. Background Information and Context

Most respondents indicated their minimum programme duration requirements

as follows: BSc.—4 years, MSc.—2 years and PhD—3 years. In terms of definition and nomenclature, most respondents considered their anatomy programme as Human Anatomy or Anatomical sciences in general (91.7%). Also, respondents were unanimous on the position that Anatomy as offered in their institutions is a basic medical science (BMS) discipline (98.2%). In an effort to probe the mindset of respondents about their opinions about why the degree programmes in anatomy were offered, 60.9% would consider Anatomy as a requirement for the pursuit of a medical degree, while 33.6% would think otherwise. However, majority (82.4%) would consider the anatomy degree as a foundational degree for biomedical specialisations. Anatomy was also considered overwhelmingly as a research oriented BMS programme (92.7%). It is not uncommon to find medical school prospects and hopefuls taking biomedical or basic medical sciences degrees first to possibly increase their prospects of a medical school admission, hence we probed this. Only about half (53.2%) agreed that this was a reason for offering degree programs in Anatomy. Another controversial but not unpopular opinion is about candidates that enroll into the Anatomy degree programmes because of their inability to gain medical school admission, hence we probed whether the programme was to serve an alternative programme for unsuccessful medical school prospects of which two-third replied that it was not (No = 62%) and only one-fifth responded in affirmative (Yes = 21.3%). Others (16.7%), however, were unsure (Figure 2).

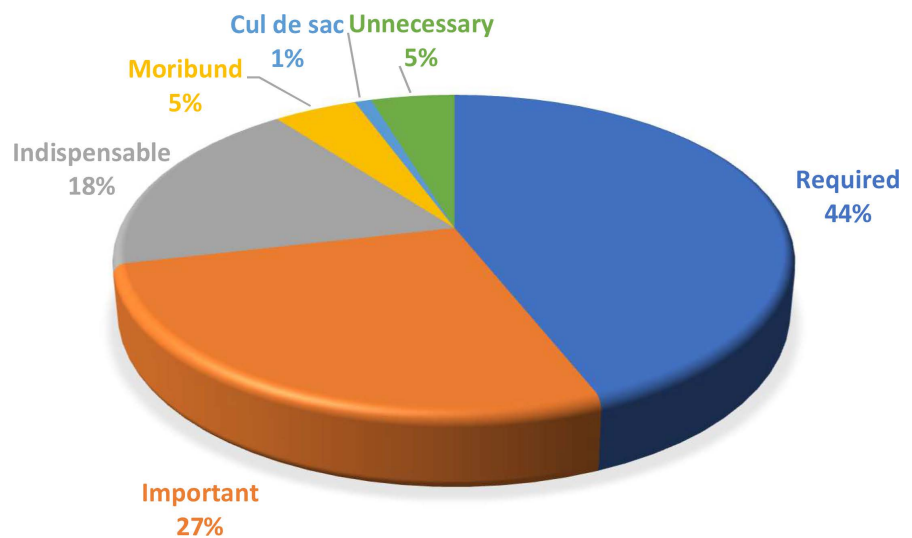


Figure 2. Pie chart showing the distribution of responses based on how respondents would describe the Anatomy programmes as offered in Nigerian universities. A collection of terms was presented as obtained from the initial pilot efforts. These included three relatively positive terms and three relatively negative terms were presented to respondents. Clearly, most respondents selected the positive terms to define their position with respect to the advancement of medical education and research in Nigeria. Approximately 9-in-10 respondents (90%) used one of the words “Required” (44%), “Important” (27.5) and Indispensable (18.3), to describe the Anatomy degree programmes. This would indicate that the programme was highly popular and endorsed amongst Nigerian Anatomists.

3.3. Data on Respondents' Knowledge of Programme with Respect to Programme Philosophy, Course Structure and Importance. Respondents Indicated Their Agreement or Otherwise to What Constitutes the Programme Philosophy, Course Structure, Programme Importance and Career Prospects

The consensus was that the Anatomy programmes trained individuals as bio-medical scientists, researchers, and medical educators (Table 1). Generally, interest in teaching anatomy subjects to students and trainees and conducting research in the field of Anatomy ranked highest amongst respondents' primary professional interests (Table 2). Concerning the availability of training and teaching facilities, respondents indicated diverse facilities amongst which gross anatomy laboratories, histology laboratories and anatomical museums ranked as the top three (Table 3). Job satisfaction among respondents would be considered largely positive with the level of job satisfaction specifically ranging between average to high, whereas the quality of career development support received was merely rated average (Table 4). Regarding respondents' knowledge of career prospects and diversity of the same for graduates of the anatomy programme, availability of jobs in academia ranked top, indicating that most graduates would be expected to teach anatomy or related basic sciences (Table 5).

Gross Anatomy was found to be the most popular primary sub-domain of anatomy amongst respondents based on perceived importance (Table 6(A)). In terms of applied anatomical fields, research methods, clinical anatomy, laboratory techniques, neuroscience, museum technique, radiological anatomy, and endocrinology were the most popular (Table 6(B)). Also, other basic medical sciences were quite popular amongst the Anatomists. Physiology, Biochemistry and Neuroscience were the top three in this regard (Table 6(C)). In the early stage of training, foundational science subjects were typically considered, with

Table 1. Table presenting data on respondents' knowledge of programme with respect to programme philosophy, course structure and importance.

Data on respondents' knowledge of programme with respect to programme philosophy, course structure and importance	Yes %	No %	Not sure%
1 Teaching jobs in the Universities and Higher Institutions	82.7	10.9	6.4
2 Graduates of basic Medical Sciences in preparation for the Medical School	58.7	33.9	7.3
3 Medical Scientists for the Biomedical-technology Industries	82.6	10.1	7.3
4 Medical Scientists for the Paramedical services	76.1	13.8	10.1
5 Jobs that require applied anatomical skills and knowledge	84.4	9.2	6.4

The data from respondents would indicate that the programmes train graduates for jobs that require applied anatomical skills and knowledge (84.4%), teaching jobs in the universities and higher institutions (82.7%), and medical scientists for the biomedical-technology industries (82.6%). It would be quite important, however, note that only two-third (58.7%) would agree that the programmes would prepare individuals who are its graduates for the medical school.

Table 2. Table presenting data on respondents' interest in anatomical education and research, whereby they rated their interests from 0 (lowest) - 5 (highest).

Respondents' interest in anatomical education and research	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
1 Rate your interest in Anatomy as a subject	0	0.9	1.8	3.6	17.3	76.4
2 Rate your affinity for alternative job opportunities	7.3	18.2	18.2	25.5	15.5	15.5
3 Rate your in interest in teaching Anatomy subjects	0	0.9	0.9	5.5	14.5	78.2
4 Rate your interest in research	0.0	0.0	1.8	1.8	16.5	79.8
5 Interest in Applied/Public Services related to Anatomy	9.1	12.7	28.2	30.9	11.8	7.3
6 Interest in Applied/Public Services not related to Anatomy	2.7	1.8	2.7	8.2	31.8	52.7

Interest in teaching anatomy subjects to students and trainees as well research in the field of Anatomy could be considered high based on responses. On the contrary data would show that respondents were relatively not keen about alternative job opportunities and interests in applied/public services were only generally average.

Table 3. Table presenting data on training facilities by asking respondents to indicate whether the facilities were available in their current institution.

Data on training facilities	Yes%	No%	NS%
1 Lecture Classrooms	58.2	40	1.8
2 Gross Anatomy Laboratories	93.6	3.6	2.7
3 Histology Laboratories	90.9	7.3	1.8
4 Histochemistry Laboratories	47.3	43.6	9.1
5 Neuroscience Laboratories	23.1	67.6	23.1
6 Anatomical Museums	89.1	6.4	4.5
7 Physical Anthropology Laboratory	15.5	76.4	8.2
8 Molecular Biology/Biotechnology Laboratories	16.4	72.7	10.9
9 Plastination Facilities	5.5	83.6	10.9
10 Embryology/Reproductive Anatomy/Andrology Laboratory	68.2	20.0	11.8
11 Simulation Facilities	11.8	76.4	11.8
12 Forensic Anatomy/Science Laboratory/Facility	13.6	77.3	9.1

NS = Not sure. Data shows the available major anatomy-specific training facilities in respondents' institutions. Gross anatomy laboratories, histology laboratories and anatomical museums ranked as the three top teaching facilities while plastination facilities, simulation facilities, and forensic anatomy laboratory ranked as the least popular.

Biology, Chemistry and Physics being the top three in this category. Health Science, which ideally would be the closest foundational science to Anatomy was however relatively unpopular (**Table 6(D)**).

Table 4. Table presenting data on job and career satisfaction by rating specific relevant factors that define job and career satisfaction from 0 (lowest) - 5 (highest).

Data on job and career satisfaction	0 (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
1 Level of job satisfaction	0.9	1.9	7.4	27.8	33.3	28.7
2 Positive impression of the nature of one's job	0.0	2.8	5.6	20.6	36.4	34.6
3 Feasibility of job continuity until natural retirement	3.7	0.9	4.6	18.5	23.1	49.1
4 Rating the quality of financial remuneration	5.6	19.4	25.0	36.1	12.0	1.9
5 Quality of career support development received till present	13.0	11.1	25.9	30.6	15.7	3.7

Responses generally showed that attributes that define career and job satisfaction were relatively positive, ranging from average to fairly high. More specifically, the level of job satisfaction ranged between average to high whereas the quality of career support development received till present was relatively average.

Table 5. Table presenting data on respondents' knowledge of career prospects and diversity of the same for graduates of the anatomy programme by rating jobs availability in major sectors or industries from 0 (lowest) - 5 (highest).

Respondents' knowledge of career prospects and diversity	0	1	2	3	4	5
1 Rate availability of jobs in academia	0.0	11.8	23.6	40.9	18.2	5.5
2 Rate availability of jobs in hospitals	17.3	40.0	25.5	13.6	3.6	0.0
3 Rate availability of jobs in industries	11.8	29.1	40.9	11.8	2.7	3.6
4 Rate availability of jobs in public service	10.9	34.5	30.9	18.2	4.5	0.9
5 Rate availability of jobs in private sectors	4.5	28.2	30.0	26.4	10.0	0.9

Availability of jobs in academia ranked top in terms of places of work that might account for the career prospect of trainees cum graduates of the program. This was followed by availability of jobs in the private sectors. In either instance, availability could only be rated between average and slightly high. Altogether, career prospects based on responses in the five key areas of primary relevance based on training might only be rated between average and slightly high.

3.4. Data about the Availability of Dedicated Research Facility

Respondents were availed the opportunity to indicate the research facilities that they have in their institutions that were dedicated to research in the form of free responses. The free responses about dedicated research facilities that were available in respondents' institutions could be put into about five categories. Histology or microscopic anatomy-related research facility as well as neuroscience-related research facilities topped the list with both seemingly having equal levels of popularity amongst respondents. Following these would be histochemistry related research facility and physical anthropology, morphology, and gross anatomy-related research facilities. The least but equally mentioned field in which respondents' institutions had research facility included molecular biology (**Table 7(A)** and **Table 7(B)**).

Table 6. (A) Table presenting data on courses and areas of specialisation whereby respondents indicated which courses are taught in their school/department of anatomy and rated their perceived importance as anatomical subjects from 1 (lowest) - 3 (highest). (B) Table presenting data on applied subjects or courses that are related to Anatomy whereby respondents indicated which of the courses were offered in their school/department of anatomy and rated the perceived importance as an anatomical subject. (C) Table presenting data on Anatomy-related basic medical sciences whereby respondents indicated which of the courses were offered in their school/department of anatomy and rated their perceived importance as basic medical sciences. (D) Table presenting data on basic science and foundational subjects whereby respondents indicated which of the courses were offered in their school/department of anatomy and rated their perceived importance as basic medical sciences.

(A)

Data on courses and areas of specialisation-Basic Anatomical Courses	0 (%)	1 (%)	2 (%)	3 (%)
1 Gross Anatomy	0.0	1.8	6.4	91.8
2 Embryology	0.0	2.7	9.1	88.2
3 Histology	0.9	0.9	10.0	88.2
4 Genetics	3.6	11.8	20.9	63.6
5 Histochemistry	3.7	7.3	25.7	63.3
6 Neuroanatomy	1.8	4.5	16.4	77.3

Gross Anatomy remains the most popular aspect of anatomy amongst respondents based on perceived importance. This is being followed by histology and embryology respectively. All the major or traditional branches of Anatomy remained very popular amongst respondents. A long list of anatomy related disciplines were listed under the free response section, the main ones being cell biology, stereology, aesthetics, radiological anatomy and forensic sciences.

(B)

Data on applied subjects or courses that are related to Anatomy	0 (%)	1 (%)	2 (%)	3 (%)
Teratology	6.6	14.2	15.1	64.2
Human Reproductive Technologies	7.3	13.8	14.7	64.2
Biostatistics	24.5	18.2	19.1	38.2
Molecular Biology/Genetic Engineering	14.8	16.7	25.9	42.7
Introduction to Histopathology	22.9	11.9	22.0	43.1
Developmental Mechanics	42.7	18.2	20.0	19.1
Applied Anatomical Sciences and Skills	19.3	17.4	24.8	38.5
Fundamentals of Anatomical Education	40.7	18.5	21.3	19.4
Mortuary Science and Remains Preservation	18.2	13.6	24.5	43.6
Entrepreneurial Anatomy	38.9	21.3	12.0	27.8
Forensic Anatomy/Morphological Analysis	25.0	23.1	20.4	31.5
Neuroscience	13.8	11.0	17.4	57.6

Continued

Museum Techniques	14.5	12.7	14.5	58.2
Radiological Anatomy	9.1	16.4	20.9	53.6
Laboratory Techniques	5.5	14.7	21.1	58.7
Anthropology	12.7	10.9	20.9	55.5
Clinical Anatomy	5.5	11.8	20.9	61.8
Histochemistry	5.5	8.2	21.8	64.5
Research Methods	5.5	10.0	13.6	70.9
Biomedical Genetics	21.3	18.5	19.4	40.7
Cell Biology	6.4	14.5	17.3	61.8
Cell and Tissue Culture	25.5	17.3	20.9	36.4
Endocrinology	7.3	18.3	22.9	51.4
Anatomical/Medical Simulation	43.5	25.0	16.7	14.8

A large collection of advanced and applied anatomy-related subjects was generally popular amongst Nigerian Anatomists, especially research methods, clinical anatomy, laboratory techniques, Neuroscience, Museum technique, radiological anatomy, and endocrinology. Others with least popularity included Anatomical/Medical simulation, developmental mechanics and anatomical education. Other specifically mentioned anatomy-related areas included laboratory animal breeding, handling and experimentation, anatomical art and prosthetics design and manufacturing.

(C)

Data on Anatomy-related basic medical sciences courses that were offered in their school/department of anatomy	0 (%)	1 (%)	2 (%)	3 (%)
1 Physiology	2.8	2.8	13	82.6
2 Biochemistry	5.5	3.7	19.3	71.6
3 Neuroscience	11.9	7.3	18.3	62.4
4 Pharmacology	13.8	6.4	25.7	54.1
5 Public or Community Health	32.1	12.8	19.3	35.8

Responses showed that other basic medical sciences were quite popular amongst Anatomists in this study, with Physiology, Biochemistry and Neuroscience being the top three. Other specifically mentioned areas under free responses included basic pathology, law and research ethics, bioinformatics, immunology, paleontology as well as vocation and entrepreneurship anatomical practices.

(D)

Data on basic science and foundational subjects or courses that were offered in their school/department of anatomy	0 (%)	1 (%)	2 (%)	3 (%)
Biology	3.7	4.6	6.4	85.3
Chemistry	5.5	3.7	7.3	83.5
Health Science	45	13.8	12.8	28.4

Continued

Mathematics	16.5	12.8	15.6	55
Physics	6.4	5.5	13.8	74.3

The foundational subjects were generally popular with Biology, Chemistry and Physics being the top three as indicated by respondent. Interestingly, Health Science was generally unpopular, despite being a major foundational subject that is most relevant to Anatomy or Anatomical Science.

Table 7. (A) Table showing materials and methods as they were engaged in the teaching of anatomy by respondents. (B) Table showing the specific methods that were used in the teaching anatomical sciences.

(A)

S/N	Materials and methods as they were engaged in the teaching of anatomy	Yes%	No%	NS%
1	Oral Lectures Using PowerPoints only	97.3	1.8	0.9
2	Use of Anatomical Models	97.3	1.8	0.9
3	Use of Human-body Specimens e.g. cadavers/platinates	97.2	2.8	0.0
4	Use of Non-Human Source Specimens e.g. plastic models	89.1	8.2	2.7
5	Use of Simulations and animations	48.2	36.4	15.5
6	Use of Software Programmes as Teaching Aids	57.4	29.6	13.0

The use of PowerPoint to aid didactic lectures, anatomical models, and cadavers or platinates as teaching aids topped respondents' preferences of materials for the teaching of anatomy subjects, simulations come last on the list. Other specifically mentioned methods and tools for teaching Anatomy (not listed in the main categories) included educators' illustrations, radiographs the Anatomage table.

(B)

	Specific methods that were used in the teaching anatomical sciences	0 (%)	1 (%)	2 (%)	3 (%)
1	Dissection	1.8	1.8	14.5	81.8
2	Prosections	8.3	13.8	33.0	45.0
3	Simulations and Digital Aids e.g. Virtual Dissector	58.3	19.4	13.9	8.3
4	Experimentation	6.4	16.5	33.0	44.0
5	Real-life Modelling and Demonstrations	28.4	23.9	23.9	23.9
6	Diagrammatic Illustrations	1.8	4.6	25.7	67.9
7	Power Point Presentations with Images	0.0	3.6	11.8	84.5
8	Customised Programmes	43.4	23.9	21.1	15.6
9	Use of Atlas and Similar Image Compilations	1.8	3.6	27.3	67.3
10	Use of the Microscope e.g. for Histology etc.	0.9	2.7	10.9	85.5

Responses showed that use of microscope for teaching the histology of structures, the use of PowerPoint (in support of didactic lectures) and dissection ranked top among the method that the respondents were using to teach Anatomy. Responses showed that all respondents (100%) did use PowerPoint presentations. Simulations and Digital Aids e.g. Virtual Dissector and Customised Programmes were the least popular methods. Other specific methods mentioned by respondents included the use of micrographs, and modified surgery procedures and group-based learning methods.

3.5. Qualitative Results

Respondents were required to provide qualitative information in the form of free responses. They provided their personal insights into anatomical education in terms of philosophies, training, and prospects in Africa in connection to how to improve training and career prospects and to meet the needs for services and skill demands in the various walks of life. A thematic analysis of the free responses is being presented as a pictograph (Figure 3) with themes coloured differently and the font sizes approximately and proportionally representing the emphasis on the themes.

Themes as obtained from the qualitative free responses

Theme 1: Professionalism and specialisation: regulations, council, anatomy education (1-in-3)

The need for specialisations and professionalism stands out amongst the themes that constituted participants' free responses. This was emphasized by 1 in every 3 respondents. A significant number of respondents held the opinion that professionalism would involve elaborating Anatomy as a scientific discipline to explore its various sub-domains, with emphasis not just on the fundamentals but also acquisition of competences and skills that could be applicable to diverse fields of endeavour. In line with this is also the fact that a number of respondents held the opinion that it could be more expedient if anatomists are trained to hone their skilled in specific sub-domains to such an extent that they acquired both fundamental discipline knowledge, basic competences with anatomical methods and procedures, as well as applied skills that could make them provide services using such anatomical knowledge and specialised skills. A good number of respondents also believed that to be able to achieve professionalism, there would be a need to ensure adequate specialization.

Certain respondents emphasized a need for an overhaul of the programme design, curriculum, and approach to training. They equally believed that there would be a need for a superintending body in the form of a council that will also regulate the training of anatomists as well as the provision of anatomical science services in different walks of life. Coupled with these suggestions or opinions is another, stating that anatomy education needs to be critically considered such that the design of training programs would appreciate the diversities within



Figure 3. Figure showing the major themes from participants free-responses and the hierarchical organisation of the themes by virtue of occurrence and emphasis. The need for professionalism and specialisation in training (emphasized by 1 in every 3 respondents), curricular changes and career development by gaining relevant competencies and skills topped what Nigerian Anatomists emphasized in their free responses.

anatomical sciences and towards re-thinking training programmes. Participants believed that giving adequate consideration to all these could greatly help to improve the career prospects of trainees. Very importantly, respondents would think that interested individuals should be trained as Anatomy education specialists, as this remains a relatively unexplored area. Such skills and competences could be brought to bear when designing programmes for example.

Theme 2: Curriculum: review, redesign, philosophy, (1-in-4)

Emphasis on curriculum is the second most addressed theme in the free-response qualitative aspect of this study. This was emphasized by 1 in every 4 respondents. Respondents would generally think that there must be a significant review or re-design of the existing curricula. They also did flag not just the need to emphasize curricular indicative contents but also the philosophies, emphasizing the need to consider adequately the sub-domains that encourage cutting edge research and use of modern research approaches, technologies and methods. The need for curricula to emphasize specific competences that are related to diverse fields of Anatomical sciences and in various walks of life including industrial and research field was considered quite vital. The need for a paradigm shift from emphasis on “structural and functional explorations of whole body, systems organs, milieus and phenomena” at gross, macroscopic and molecular levels to “acquisitions of knowledge and competences for education, research, applications, services, and innovations in diverse walks of life” seems to stand out in the responses as well.

Theme 3: Career development, competences, and skills: specific applications (1-in-8)

The need to emphasize specific competencies was severally mentioned. This was emphasized by 1 in every 8 respondents. Respondents indicated the need to equip trainees with specific competencies that are discipline and area-specific, with the idea that this would enhance not just employability but also specific capabilities to proffer services in specific walks of life and to address specific problems that could help create values. Respondents also highlighted the need to train anatomists to have research skills in specific areas, including and essentially laboratory skills to carry out specific procedures. Respondents generally recognized the fact that it might be impractical to train all anatomists and at all levels to acquire all specific skills in all aspects of anatomical sciences, however, they emphasized the needs for trainees to have adequate skills in certain specific subdomain of Anatomy that would enable them proffer valuable specialized skills. It was generally believed that this consideration would enhance the fortune of trained Anatomists through better career prospects.

Theme 4: Funding (1-in-8)

Funding was also mentioned as an important consideration towards advancing Anatomy as a discipline. This was emphasized by 1 in every 8 respondents. More specially, funding was said to be required for research support, procurement of equipment and remuneration for researchers.

Theme 5: Research: Agenda, technologies, applications (1-in-30)

The need to significantly emphasize research during training was also highlighted. This was emphasized by 1 in every 30 respondents. Respondents would think that research, using anatomical knowledge and skills could significantly contribute to development. However, to achieve this, and create research-related opportunities for Anatomists, training must significantly emphasize cutting edge research. The need to introduce and use modern technology and techniques was also indicated as a factor that could improve anatomy research output, applications, extrapolations, and relevance to development. Very importantly, there was a call to improve emphasis on research efforts with practical applications.

Theme 6: Others-Engagement (1-in-100)

One other thing that was not severally mentioned but that would stand out was the need for quality engagement with stakeholders between the anatomy society bodies and stakeholders in government and other sectors. This was emphasized by 1 in 100 respondents. The emphasis on this was for anatomists to explore opportunities and promote the field for recognition and advancement. Internal engagement as indicated would include robust conversations between society leadership and membership to deliberate and collaborate to proffer practical solutions on how to advance Anatomy in Nigeria and enhance career prospects of anatomists and would-be-anatomists.

4. Discussion

4.1. Overview

The current study considered the perceptions as well as the professional experiences amongst Nigerian anatomists. To the best of our knowledge, it is one of the most extensive recent studies that considered what the population of Nigerian anatomists have experienced as well as their perceptions about anatomical science and being anatomists. It also considered the education of people in the field of anatomy and biomedical sciences, including their perceptions about being professional anatomists and the prospects of anatomy or anatomical sciences. It is believed that this study has yielded quality data, considering especially the response rate as well as the quality of responses that were provided by respondents who participated in the study after indicating their informed consent. The data and information as obtained from this study, therefore, has significant potential to contribute to knowledge with respect to anatomy education and the training of anatomists in Nigeria, and by extension in Africa. Such data and information can be applied to inform policies and practices with respect to undergraduate and graduate or postgraduate programs. It also addresses emphasis on the primary domains of education especially cognitive, psychomotor, and affective. By extension, this should inform program design, curricula structure, pedagogies as well as the philosophes underlying implementation of programs in institutions.

4.2. Programme Philosophy, Design and Structures

The consensus amongst participants is that the anatomy as an academic program presently offered in most institutions is designed to train medical scientist as educators, researchers, and scientists. More specifically, these educators are expected to be tertiary institution level educators such as university teachers, medical school teachers, nursing school teachers, instructors and educators in other relevant health workers training institutions. Also, most respondents indicated that such medical scientists could also work in the industry where they serve as medical scientists. This consensus is not unconnected with what most institutions would indicate in their curricular philosophy which in turn is to a large extent in alignment with the National University Commission philosophy for offering programs in Basic Medical Sciences [10]. One might therefore say that this position is not in any way markedly different from what is obtainable in several other institutions across the globe where medical scientists in different walks of life are trained as educators in medical and allied health institution as well as scientists in relevant industries.

What is however quite important to note is that to achieve this diversity in the role that the trainees and graduates of the program might serve, it would be quite important to equip them with relevant skills in all the primary domains of learning including cognitive, psychomotor, and affective. For example, a previous study had indicated that there is hardly any major course or module that addresses medical or health science education in the curriculum of most institutions that offer undergraduate and postgraduate programs in anatomy [11]. Therefore, it would be quite helpful, if anatomy departments that expect their graduates to be medical or health educators to include specific programs or course in medical education or health science education that could equip graduates of the program with skills in key areas of medical and allied health education such as pedagogies, assessment, learning theories, curriculum design, and educational leadership amongst others. Such courses might be offered in order to prepare the graduates of the programs for their roles as educators. One may also advocate that certain medical education innovations and technologies (Ed-Tech) be integrated into the teaching and training of anatomists as these resources are becoming quite relevant to medical, basic medical and allied health education across the globe.

With respect to training anatomists as basic medical scientists, it is agreeable that basic medical scientists should be able to offer technical and scientific services in the relevant industries. However, in order to equip and prepare a graduate of the program for such services, that require arguably more than theoretical understanding of concepts, one would advocate for adequate integration of practical activities and training into programs [12]. This reality was succinctly captured by Bosch and Casadevall [12], as follows: *graduate biomedical science education needs a new philosophy*. By extension, this will imply that laboratories must be functional, well equipped, and adequately resourced to train and mentor

trainees in order for them to have the required skills to offer such services in the relevant industries that they might target for jobs or career after graduation. One may further state that graduates of anatomy programs that would be able to work in the relevant industries would have not just basic anatomical skills but also advanced and applied skills. Hence, departments that offer programs in anatomy and anatomical sciences would be required to set up, in addition to the basic labs (histology, gross anatomy, embryology etc.) laboratories in advanced and applied fields of anatomy which might include but not limited to immunohistochemistry, molecular biology, anthropology, assisted reproductive sciences, neuroscience, experimental toxicology, anatomical and medical science education technologies amongst others. Clearly, it might be impractical for a single department or institution to have laboratories and facilities to train students or trainees in all aspects of advanced anatomical sciences. However, the appropriate thing to do might be to have areas of priorities and emphasis which could help to not just define the programs but also the skills of the graduates of the program and by extension the industries for which they are prepared to work in.

4.3. Programme Indicative Contents

Indicative content of the anatomy undergraduate and graduate programs in the study population could be said to be quite robust. The traditional fields-gross anatomy, histology and embryology topped the disciplines that ranked highest on the popularity scale amongst respondents. There is significant diversity in terms of applied and advanced anatomy-related subjects being offered. The anatomy programme as offered in the Nigerian context includes all the major branches of traditional and contemporary anatomy or anatomical sciences which include gross anatomy, histology, embryology, histochemistry, physical anthropology, radiological anatomy etc. The implication of this is that the programmes produce seasoned anatomists with holistic knowledge and understanding of anatomical sciences. The challenge, however, is how best to manage cognitive load [13] [14] [15] [16] [17]. Efforts should be made to address potential cognitive overload as these vast contents have been packed into just a 4 - 5-year programme in the universities. The need to also cover the vast fields of theoretical anatomy might also limit the dedication of time, emphasis, and resources to training that address research and service-related skills in the course of the programme. Furthermore, a way to avoid the almost inevitable compromise of quality training in the areas of research and service skills in order to cater for extensive theoretical knowledge would be the need for careful and strategic programme design to focus on specific areas of emphasis for advanced training and competences.

4.4. Programme Cognitive Potentials

Data and evidence from the current study would show that the training of anatomists in the Nigerian contexts include extensive and holistic study of body

form and functions from all subdomains of Anatomical science. In the actual sense, the curriculum and training encompass the major sub-domains or sub-disciplines of anatomy or anatomical sciences. The importance of this is that the graduates of the programme would have quite an extensive body of knowledge and appreciation for forms and functions of the human body as well as the comparative anatomy between human morphologies and functions relative to other forms of life in the kingdom animalia. This is no doubt a huge potential for the graduates of the programme as the extensive knowledge can offer a wide array of opportunities for diversification and specialisations in terms of research and skills application. This might explain why Nigerian anatomists have been found to be quite competent and dynamic to teach all primary aspects of medical and biomedical sciences both locally and internationally. This is also a contrast to the situation as reported in the USA, whereby *most anatomy educators have graduate training in gross anatomy, while lacking graduate coursework in other anatomical disciplines* [18]. The challenge with the Nigerian approach on the other hand includes the fact that in the context of a programme that runs for a definite number of years as specified by regulatory policies and institutional requirements, the trainees are at the risk of being overloaded with extensive contents, hence at the risk of cognitive overload. Efforts should therefore be made to manage this situation to prevent trainees from cognitive overload.

One might also suggest that despite the extensive and robust foundation in anatomical science given students of the programme, it would be quite helpful to enable them to specialise in a preferred domain of sub-specialization by the time the students are graduating. For example, the fourth or fifth year of the programmes might be dedicated to specialisation in specific areas such as histochemistry, neuroscience, microscopic anatomy and histology, developmental anatomy and embryology, physical anthropology and/or forensic anatomy amongst others. A recommended approach would be that programme trainees are equipped with advanced theoretical knowledge (cognitive), advanced, research and applied skills (psychomotor) as well as opportunities for integrations into communities of practices and learning and professional grooming (affective) in their chosen fields of specification. In this article, we would therefore advocate for the need to incorporate advanced and applied subjects to support skills and competences for cutting edge research and services

4.5. Programme Psychomotor Potentials

Clearly, there is immense potential for the skills acquired from adequate training as anatomist, several of which could be very relevant in the biomedical industry. This is also largely the belief of the respondents. What is equally quite important is the fact that there must be adequate investment of time, resources, and efforts in skills acquisition. It might be quite expedient and pragmatic to connect training, especially in theoretical aspects, with the realities of skills and competences demands in the relevant industries. This would be another way of implying that training should be more industry-oriented than it is currently. This is the way to

go even globally [19]. Efforts should be made to put in place the relevant laboratories and facilities whereby trainees could hone their skills particularly in the various aspects of basic medical or biomedical research and services. The type of skills might be categorized as follows:

- 1) The basic anatomical science skills.
- 2) Research skills.
- 3) Applied and industrial services skills.

In line with such proposition for example, Ashiru and Akinola [20] had indicated that there are emerging and contemporary roles for the modern anatomist, of which assisted medical technology (ART) was emphasized in their publication. Also, Didia and Olotu [21], had advocated for the need to explore the prospects of anatomical science knowledge and applied skills within the field of forensic science.

One very important thing to emphasize in the current situation is a specific emphasis that the curriculum philosophy places on the need to train anatomists to be medical educators; more specifically, to teach medical and allied health science students. This statement will better be appreciated by first considering the context of medical education. It is important to note that medical education is not just about delivering knowledge to trainees but also the possession of adequate skills and extensive understanding of the theories and philosophy that underpin effective delivery of medical education. The implication of this is that their possession of anatomical knowledge and skills remains pivotal and indispensable; however, to be effective medical educators who can teach anatomy to medical and allied health science students, the other requirement remains the competences and skills to be a medical or anatomical educator.

Basically, one would expect an ideal medical educator to be grounded in core areas of medical education that include pedagogies and pedagogical principles, knowledge, and skills in the areas of learning theories, adequate understanding of curricular philosophy, design and implementation strategies, assessment, student mentorship and academic leadership. These listed requirements are not necessarily a core aspect of the science of anatomy and medicine but that of teaching. They are also not exclusive to those who teach anatomy or basic medical sciences, but all aspects of medical and allied health science. This reality becomes much more appreciated when considered in line with the significant evolution in medical education and training, globally and the need to have effective and dynamic educators, educational leaders, and mentors for trainees [22] [23] [24] [25] [26]. The implication of the current scenario or situation therefore will include that, a significant proportion of course time and resource allocation should also emphasize the training of anatomist as educators since the curricular philosophy specifically emphasizes this as a core competency based on their expected roles in the educational industry upon graduation.

4.6. Programme Affective Potentials

While the attitude is currently generally positive within the studied population,

there is still a need that has to do with improving training to boost trainees' career prospects beyond the limited job prospects in the academia. There is a sense of purpose and belief in the importance of anatomy or anatomical science as a field of endeavours. Most respondents would rather remain in domains of work and services that would enable them to continually practice their trade as anatomists. This might not be unconnected with the fact that respondents were almost all in the academia, with a category of jobs that could be termed stable employment, generally respected, and with prospects for long term employability. It might also be important to appreciate the fact that only a fraction of the graduates of the anatomy programmes do gain employment in academia. Hence, the current highly ranked positive attitude had come from employed anatomists in a relatively stable and respected sector of work or trade which is the academia or more specifically, tertiary education sector.

4.7. Need to Emphasize Medical Education

We would also recommend, based on the data and evidence obtained in the current study that programmes that might help to complement the skill sets of anatomists, particularly in the area of anatomy and medical education and research might be quite helpful. Noting that efforts to equip medical scientists generally in the various domains of research is not quite uncommon as professional bodies, international organizations and institutional departments do make effort to implement such training programs. The aspect that suffers relative neglect or inadequate attention would therefore be medical science education. There is a need to continuously rethink medical and health professions education in the light of current realities and anticipated future developments [27]. We would, therefore, recommend continuous education and training programmes in the forms of certifications and teaching tools workshops, and training the trainers programmes or other similar programmes. In addition, other efforts could include postdoctoral programmes in medical and anatomical science education. Postdoctoral training for anatomists has been recommended as a suitable option [28].

5. Conclusion

This research provides insight into major scenarios as well as current trends and practices with respect to the training of anatomists at bachelors, masters and PhD in Nigeria. The represented institutions offered human Anatomy as a basic medical science. Most participants (81%) were males. The most popular field amongst respondents was Neuroscience. Almost half of Nigerian anatomists involved in the study had a PhD degree. The standard minimum programme duration included 4 years for the bachelors, 2 years for the masters, and 3 years for the doctorate or PhD. Jobs in the academia and biomedical and/or biotechnology industries topped the perceived areas of career prospects. Respondents' interest in Anatomy as their career was generally high. Training emphasized the cog-

nitive domains the most. Consequently, emphasis should be laid on the psychomotor (skills) and the affective domain (attitude) to improve capacity, competences, and the job prospects of trainees. There must be quality integration of advanced laboratory, applied and research skills to enhance service delivery and capacity or competency. This would enhance the career prospects of trainees for relevance in the academia as educators or researchers and, as technical experts as well as scientists in the relevant industries. The consensus was that the programme trained students and prepared graduates as medical educators, scientists, and researchers.

6. Limitation

The current study had employed a cross-sectional approach, hence had limitations in capturing trends on the advancements of anatomical sciences beyond the review of literatures, relative to the time of the study.

Notes on Contributors

Author JOO conceptualized research and drafted research tools. All authors, JOO, SYO, AEA, AAT, participated in questionnaire validation, implementation, data collection and curation. Author SYO served as the liaison personnel. Author AAT served as the consultant. All authors contributed significantly to manuscript writing and editing. All authors approved the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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