

INCLUSIVE SKILL DEVELOPMENT FOR CHEMISTRY EDUCATION PROGRAMME

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Abstract

This article aims to inform the reviewers of Chemistry Education curriculum on the need for inclusive skills in chemistry education programme. Chemistry Education itself is a pseudo-scientific research field, studying the process of teaching and learning of chemistry through the procedural connections among research, theories and practices. Recently, the introduction of Inclusive Education Policy (IEP), into the entire education system where special need students with physical, hearing and visual impaired must be accommodated to learn with conventional students, requires that pre-service teachers be empowered with coping skills. It has also become a reality that many chemistry education graduates are working in various organizations other than schools including; banks, social media, advertisement industries, etc. This reality requires that students be guided towards diverse career prospects. They need training not only in the technical skills required by the teaching profession but also soft skills such as emotional intelligence, digital literacy, and interpersonal skills among others. These skills are not only imperative to becoming professional teachers but also transformative leaders in their future organizations. Consequently, this study describes the benefits of inclusive skills and suggested their inclusion into the curriculum to accommodate special need students, and increase post-graduation employability ratio.

Keywords: Chemistry Education Programme; Hard Skills; Soft Skills; Emotional Intelligence.

INTRODUCTION

Education is a lifelong process through which knowledge, skills and positive attitudes require for a good life could be acquired. This should be, irrespective of the students' disabilities such as those presented by the special need students covered by the Inclusive Education Policy (IEP). Inclusive Education policy mandated every school to give all students equal treatments in schools and classrooms. Chemistry classrooms cannot be an exception to this policy. Apart from the hereditary connection with successful individuals and hardworking culture, any other type of legal connection is a reflection of interpersonal relationship with other people during and after course of study including Chemistry Education programme.

Chemistry education programme is the type of education specifically designed for producing chemistry teachers for all levels of education where chemistry is taught. As enshrined in the Benchmark Minimum Academic Standard (BMAS) for Chemistry Education Programme by the Nigerian University Commission (2021), the objective of

chemistry education programme is to enable students acquire the various concepts, principles, theories, laws and relevant conceptual schemes to make them become effective classroom teachers [1]. The programme should expose students to industrial applications of the chemistry, acquire the ethics of teaching profession and become professional science teachers as well as disseminate information in chemistry education to the society.

By the end of the programme, the students are expected to have been groomed into developing necessary laboratory skills, positive values and attitudes for efficient discharge of their duties as teachers. Chemistry education ought to equip students with knowledge of scientific, mathematical processes skills, teaching skills, problem-solving skills and research method [2]. The graduates of chemistry education programme, should be able to carry out chemistry experiments, acquire competency in problem solving through education research, cultivate skills of teaching, information dissemination, improvisation, interpersonal relations and application of teaching

methods. However, every citizen including the special-needs citizens has the right to be educated satisfactorily so as to contribute their quota to self growth, their future organizations and the society.

Recently, literature has shown that chemistry education graduates are now finding their ways into many sectors of the economy other than the schools and the chemistry classrooms [3][4]. So, non-technical skills otherwise soft skills are as important as the professional skills in an undergraduate programme. The call for including wider skills development in Chemistry degree programme is at least 40 years old and since then, a growing body of work has revealed the importance of skills in students' study before graduation [4][5].

Another reason for inclusive skills is that, the disparity between the content of Chemistry degree programme and the skills-needs of new graduates in employment has also been highlighted showing that graduates are often distributed almost evenly across different spheres of life [6]. These include trade occupation, associations, technical occupations, managers, directors and senior officers, professional occupations, sales and customer service occupation, caring leisure and other service occupations while others are unemployed. As reported by Hill, et. al., (2019), this has called for a greater focus on the recognition of vocational skills in Chemistry Education [7]. Neiles and Mertz (2020), reported that in a survey of the characteristics of successful staff of Google in the year 2017 found that being a good coach, ability to communicate and listen well, possession of insights into others, having empathy and supportive for colleagues, being a good critical thinker and problem solver as well as being able to make connections across complex ideas, were the top six in hierarchy [8]. These characteristics could be regrouped as; interpersonal, communication, collaboration and big picture thinking skills. Therefore, these soft skills should be the focus of higher Chemistry education programme.

A consistent focus of higher education is the employability of its graduates, but the employers of labor at the job market have realized that job schedules that the students are currently facing is

drastically different from that of a decade or even five years ago [9]. The skills employers require of their employees have undergone a rapid transformation, and in response, job candidates that were not exposed to these skills during their undergraduate programme in chemistry education are tasked with finding a way to learn them on their own in order to secure the position and succeed in the long term. Also, outgoing students seeking employment often realized that their programs of study are not fully translating to success in the career market. This is possible in that the jobs available in most cases are usually different from what they specialized on while in schools. They therefore needs certain skills to navigate the huddles of job interviews first, in order to secure the jobs which will later give them opportunity to learn on the job. Although opportunities for skill in the areas of chemistry education programme at the degree level are not available in Nigeria but many institutions in the world. Even though, some institutions in Nigeria have started reasoning it, another problem arise with the current opportunities stem from the fact that, for various reasons, not all students engage with them since such skills were taking as either adjunct or general study courses. The implication of this problem is that unemployable graduates are now increasing globally. Therefore, urgent attention is required to address the anomalous before it translates to many other social problems in Nigeria already [10].

METHOD

This study being a qualitative research and review article to be precise utilizes primary and secondary sources of data. The primary data was sourced using observation and the structured interview. Alumni members of Yusuf Maitama Sule University, Kano were the target population. They were streamlined to graduates of Chemistry Education among them. The sample graduate interviewed was sourced through snowball sampling techniques. Nevertheless, the secondary data sources are the authoritative works of scholars such as published journal articles, book chapters, textbooks and other online resources.

RESULT AND DISCUSSION

The following are the results of qualitative studies and review articles as well as procedures that have been defined in the research method.

Skills in Chemistry Education Programme

This study intends to inform the Chemistry Education Curriculum reviewers not only in Nigeria but globally on the need for the integration of inclusive Skills into Chemistry Education Programme as a consideration. The reason is not only to improve students' academic performance and interpersonal relationship which will in turn ensure civility and improve peaceful organizational climate but to also reduce post-graduation unemployment among the trainees.

However, Chemistry Education programme, as described, is a programme designed to shoulder the responsibility of producing qualified, professional and skillful chemistry teachers to guide students through the teaching of Chemistry at all levels of education. This implies that chemistry education programme is offered at the tertiary education level as a component of teacher education programme. Since tertiary education is meant to produce the highest level of manpower, Chemistry education programme in Nigeria tertiary institutions should therefore be restructured with inclusive skills to focus on its graduates becoming credible leaders in their various career paths. This is one of the criteria for measuring social impact in the global university ranking [11]. However, even to secure a job in an ideal 21st Century economy and beyond, many activities such as job interviews where the students will be tested in emotional intelligence, communication skills and digital literacy skill could hardly be avoided. Also, becoming a leader in such organization after securing the employment requires these special skills. All skills needed by the in-service chemistry teachers while in tertiary educational institutions are referred to as the skills in Chemistry Education Programme. The types of skills are stated, defined, and their benefits are explained with clear examples as follows in this study.

Types of skills in Chemistry Education

All the important skills in Chemistry Education programme could be categorized into two major types vis-a-vis technical and non-technical skills.

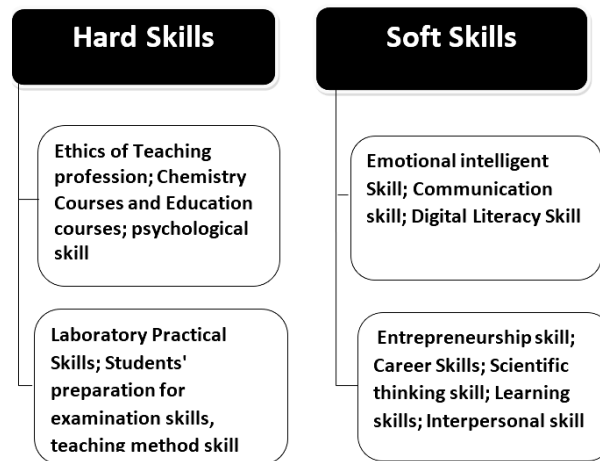


Figure 1. Inclusive Skills for Chemistry Education

After the observation of the problem trends and the literature review, the skills shown in figure 1 were discussed as follow for the easy comprehension of the target audience including Chemistry Education curriculum reviewers, textbook author, students and the entire Chemistry Education' teaching community.

Technical Skills/Professional Skills/Hard Skills

Technical skills can also be called professional skills or hard skills [12]. In Chemistry Education Programme these skills are primarily designed to produce professional chemistry teachers for secondary and tertiary education levels. In the United Kingdom, as reported by the Royal Society of Chemistry (2019), most Chemistry degree courses are accredited by the Royal Society of Chemistry (RSC) in accordance with the Quality Assurance Agency (QAA) benchmark [13]. The benchmark requires that Chemistry courses must develop students' professional and chemical skills. They were included in the Curricula of Chemistry Education programme nationwide. This is an indication that the curriculum of Chemistry education program in the UK contains mainly Chemistry courses and the Education courses. Similarly, in Nigeria, the Curriculum of Chemistry Education Programme

includes Chemistry courses and education as well. In most cases, the students do receive their Chemistry knowledge from the lecturers in the Department of Chemistry, faculty of Science while the professional Education courses are handled by professional Educators in the faculty of Education. However, not all technical skills have been integrated into chemistry education curriculum; students are expected to acquire them personally either through practice, digital access or informally as a non-written content of the curriculum. Consequently, the technical skills in Chemistry Education programme are;

a. **Psychological skills:**

This skill primarily focuses on the systematic study of human minds through visible characteristics such as sudden change in behavior. It is the rationale for psychology of Education as a course in Chemistry Education programme. This course provides chemistry teachers with background information through nature versus nurture controversy on while students behave as they do. Psychological skill is often used by supervisors to detect examination malpractices in the examination hall. The signs to observe include sudden change in students' behavior.

b. **Counseling skill:**

Naturally, all teachers should be academic leaders that are knowledgeable in counseling practices due to individual differences among students. However, counseling skill is more of hereditary rather than nurture, but due to its immense importance in the school system, it is taught by the teacher education institutions as a course and the act learnt by all chemistry teachers in training. This skill will help them successfully guide their future students towards learning chemistry with little or no stress and anxiety.

Specifically, special needs students need every support they could get from everyone including their chemistry teacher to cope with the challenges of chemistry learning. These challenges can only be surmounted under well research findings communicated to special need students during counseling periods. Such counseling aspect the students must be willing to receive include coping with learning challenges through some

study habits, coping with examination as a special need student.

c. **Students' evaluation skills:**

This is a skill required by the teacher to know if the study objectives have been realized or not so as to know whether to re-teach a particular topic or not. The essence of this skill enveloped in courses such as Test and measurement, Educational Statistics and measurement and evaluation is to equip the would-be chemistry teachers with the students questioning skills, test administration, scripts marking, result compilation, test recording and many more.

Similarly, there are so many terms which are related to students evaluation and test items in which teachers in training knows nothing about. This includes the Bloom's Taxonomy and the evenly distribution of test items to cover important areas of the study content such as understanding, knowledge, synthesis, analysis and evaluation. Another aspect of test item analysis includes the Facility Index (FI) and the Discrimination Index (DI). Facility index which can also be called Difficulty index is the measure of difficulty or simplicity of every test item used for students' evaluation. In Practice, a test item should not be too difficult or too simple. The discrimination index is the ability of test item to differentiate between above average, average and bellow average students in the classroom through their test scores. Also, students' scores should be normally distributed.

An important question of an inclusive Chemistry Education programme is how can special need students be evaluated without putting them at disadvantage compare to regular students?

d. **Lesson Planning Skills:**

Lesson Note/plan is a step-by-step presentation of what, where, when and how the teacher is going to teach. It also entails what the teachers are going to use to support their teachings which will make students understand better and remember the content taught after a long time. Similarly, it captures the method of knowing if the student have understood what has been taught or not. Lesson Plan is one of the most significant identities of a trained teacher. So, a chemistry

teacher who cannot write a good lesson plan is not qualified. Unfortunately, many people do not know that lesson plan construction is a skill; involving the use of teachers' hands (psychomotor) and technicality rather than cognitive or affective domain of learning. A good lesson planning requires teachers' ability to keep abreast with how questions on that particular topic are set in external examinations and carefully create instructional objectives to capture all important points in the textbooks.

However, special needs students should be considered while choosing a teaching methods, audio and visual resources should be integrated depending on the category of special need students involved in the classroom to teach.

e. Laboratory Practical Supervision Skills:

A laboratory is a place of work for all scientists and particularly for chemistry educators. This is because practical chemistry is a core aspect of chemistry usually at the secondary school level without any student will pass the subject in the terminal external examinations such as WAEC and NECO. Unfortunately, many Chemistry Education students that are graduating recently whom some of them are expected to be engaged as lab-technician in tertiary institutions and to prepare standard solution for volumetric analysis practical could not do so. This is because, many institutions do not have dedicated laboratory for such purpose and their host departments only exposed the students to already diluted solutions. Thus many students do not know that the methyl-orange indicator is a powder at room temperature which is a big slap on their faces as teachers.

f. External Examination Coaching Skills:

Coaching could be seen as a teaching method designed for training students in some special skills. For instance, a special set of students may be coached to become representative of the school in different inter-school competitions such as football, quiz, debate, match pass, relay race and other sports competitions. Similarly, most adults who wanted to further their education but do not want to seat in class with their children may bargain for special coaching lesson after being register for examination. If a teacher contacted for such duty

lack the skill, he/she may lose a life changing opportunity.

g. Teaching method formulation skills:

Chemistry teaching methods are well researched techniques specifically designed for effectively dissemination of chemistry knowledge to students. However, not all teachers are aware of all suitable chemistry teaching methods' existence, let alone using them or creating one. For this reason, teaching method is a career-long process skill for every chemistry teachers, who are expected to be creative enough in proposing new teaching method for researchers' evaluation. Nevertheless, to start with, all chemistry education pre-service teachers should be exposed to all existing chemistry teaching methods while in training and be encouraged that after graduation to keep updating their knowledge through the advantages provided by educational forums such as conferences, workshops and the internet.

h. Preparation for External Examination skill:

External examination is a must for all science students graduating from secondary schools. This is for the reason that, the certificate require for admission into tertiary institutions often come from such examination body and the quality of the result is a determinant for such admission feasibility. Since proper preparation has strong ability to prevent poor performance, a chemistry teacher who has ability to prepare students efficiently for such examination is an added advantage to the students which will surely translate to school productivity due to the teacher's effectiveness. It is good to acknowledge that some chemistry teachers have short cut to objective questions' answers than their contemporaries. This is evident in the fast manner at which some students do answer questions during inter-school quiz competitions.

i. Ethics of Teaching Profession Skills:

Ethics of teaching profession are the basic rule guiding the moral practices in teaching profession. It involves do and don't in Chemistry Education environment. Since Chemistry are perceived by many students as difficult, many of the students are likely to seek short cuts and that is where the Chemistry teachers teaching ethics needs to guide the teachers on the redlines which needs

not be crossed. However, ethics of teaching profession has seems to be an overlook arena in the school system because many school leaders considered it a non-written aspect of the school curriculum. Hence, the several unwanted cases have become a recurring in the school system globally where a number of cases are reported annually. Therefore, it is high time such skills are taught as important component of Chemistry education programme.

Non-technical skills/ Soft Skills

Non-technical skills in Chemistry education programme are the skills which are not primarily designed for teachers from the inception of teaching profession. They are soft skills which are traditionally not part of the courses designed for chemistry teachers. As reported in [14], Soft skills includes but not limited to creativity, leadership skill, team work, job ethics, empathy, and Communication skills. Soft skills may be used even outside the teaching profession including industries, politics and in organizational management and leadership roles. Agarwal (2018), explains that most lucrative industries of this century are those that were created in the last decade and require a complex mixture of skills in their workforce to prosper [15]. Thus, in this dynamic working atmosphere, companies are reassessing which skills are critical to the success of their workforce and discover that technical skills are not the only valuable skills require in their future employees but non-technical skills. Examples are;

a. Digital Literacy Skill:

This simply means being a computer literate, in this century information are important key to success and luckily such information required to succeed formally hidden in the literature have migrated from books to become digitalized; now hidden on the internet. Thus, chemistry teachers in training needs to keep updating their knowledge regularly as information can promote security, increase knowledge. Today, even Chemistry teaching has been digitalized; we now have online classrooms, e-library and e-laboratories all of which helps to promote safety, save cost and promote convenience to teaching and learning.

b. Emotional Intelligence:

This simply means ability to manage ones emotions such as anger, jealousy, hatred, joy and excitement even when being intentionally stimulated by the risk factors without losing control or compromise standard. As reported in [16], the concept of emotional intelligence (EI) is a construct combining emotions and intelligence which has emerged to explain behavioral variance and how growing research on EI can lead to professional success. Emotions are natural. Humans are likely to get angry when provoked, feel sad when mistakes are made and happy when success is achieved. Conversely, how workers are able to control themselves to manage whatever situation without damaging the relationship with clients and co-workers falls within the scopes of the emotional intelligence. Take for instance; a chemistry teacher who is teaching at the secondary schools will surely have adolescent as clients and have youthful exuberances to contend with. So, chemistry teachers need emotional intelligence to cope.

c. Career skills:

This is a type of skill required for securing the career choice. It includes; job searching, resume writing, networking, and professional mindset, handling interviews and writing of application letters. It is good to acknowledge that emotional intelligence of every candidate seeking job will be tested during job interview. The candidate may be intentionally provoked so as to know whether he/she will get angry and talk carelessly. Also, communication skills will be accessed since a good teacher should not shout on the students but speak calmly, clearly and loudly.

d. Scientific thinking Skill:

This a scientific identity development skill required in decision making process, financial management discipline and living a good life. Such skills include critical thinking, problem solving, and big picture thinking. According to [14], critical thinking skill, leadership skill, and problem-solving skills are very much important since a teacher might be unable to control class or progress without them.

e. **Learning skills:**

These are study skills or learning strategies needed by the students to improve their academic performance and learning retention capacity. They are both inborn and acquire methods usually applied by the students to improve their memory retention capacity. The skill is meant to imbibe in the in-service chemistry education teachers, the culture of long-life learning. Example of such skills is self-regulated learning, initiative, Mnemonics, regurgitations, soliloquizing, mind mapping and many more.

However, special needs students seem to be a neglected part of the chemistry education programmes when it has to do with study skills. The question here is “how do the blind students study on their own” are they also using the same study skills with other conventional students. What do they need to do so as to commit what they have been taught into memory and be able to remember the contents as much as possible when the examination comes? The answers to these questions need to be researched on, developed and integrated into the inclusive skill in Chemistry Education programme. School Counselors need such information to do their jobs; school administrators need such information to plan his communication with teachers during instructional supervision of schools.

f. **Communication skills:**

Communication skills are the qualities and abilities required for achieving personal, interpersonal and social goals as well as having a good organizational climate. Most importantly while in leadership roles, communication skill becomes imperative force of cohesion, synergy and Success. It is a crucial soft skill believed to be hereditary for some individuals but everyone can learn the art, they only need extra efforts to make it feasible. According to [17], communication skill is required in workplace as almost all careers need engagement and interaction with diverse people. A good communication skill requires that someone should be able to speak as much as possible correctly, clearly, boldly, calmly, convincingly and with friendly dispositions such as wining a glowing smile and maintain good eyes contacts.

Particularly, Good communication skill in a Chemistry educator is the ability to confidently explain learning concepts clearly and, answer students' questions calmly without shouting, frowning or insulting the students. [14] reports that Communication, both oral and written, is an important soft skill for teachers to have in order to properly receive and distribute information as well as wonderfully express ones feelings and ideas in a peaceful manner that does not provoke clients. An efficient and effective teacher must be skilled communicator who knows how to communicate with a wide range of people. Characteristics of good communication skill includes; good listening, ability to summarize information, creative presentation, good writing skill, public speaking skills and ability to use Information communication technology gadgets for presentations.

However, under the inclusive system of education, the special need students are expected to learn in the same classroom with their contemporaries without discrimination. In this situation, excellent kinesics interaction skill is needed by every Chemistry teachers to cope with the diversity of students of the inclusive classroom. Apart from this, today many teachers who are skillful with the communication with special needs students have greater chances of securing a job in many places such as Television stations, Radio stations and entertainment industries, to mention a few.

g. **Interpersonal skills:**

These are skills require to work with others in harmony and as a team. As emphasized by [14], one of the most important soft skills for instructors is interpersonal skills which involve cooperation and collaboration that is required to execute even the most basic activities such as group projects and peer-to-peer interactions among others. A person with good interpersonal skill does not backbite or backstab co-workers. He/she is with empathy and always ready to supports co-workers without expecting any reward. However, teamwork and leadership development are core here.

In an Inclusive Chemistry Education classroom, interpersonal skill is needed to motivate

the special needs students to keep coming to school. They might be discouraged in the atmosphere of incivility, bully and ridicules.

h. *Socio-economic Skills:*

These are Chemistry related Vocational Skills designed to ensure permanent and positive change in the creative ability of learners to gain vocations that are needed in the society for the purpose of job creation, entrepreneurship development, work place competencies and wealth generation. [18] states that vocational skill training is a non-formal education encompassing, very central and expedient for the acquisition of skills, abilities, values, attitudes and competencies essential for the purposes of employment, job improvement as well as poverty reduction.

It is essential for Chemistry Education students to acquire the necessary knowledge, skills, attitudes, values and experiences they require to perform effectively in the socio-economic space of the society. Therefore, [19] encouraged the development of vocational skills in Chemistry Education programme. Nevertheless, [20] had earlier suggested that such skills should be made part of Chemistry Education programme at the Degree level. However, the Chemistry related vocational skills amplified in this study includes but not limited to table water production, plastic recycling, electro-painting, Gold-smithing, soap and detergent making, dyeing in textile industries, chalk making, teaching aids productions and a host of others.

However, the discussion on independent learning at the Merdeka Campus (MBKM) has accommodated the importance of experience outside the study program [21]. Ofcourse, this is with preparation and soft skill training including all discussed in this study.

CONCLUSION

Traditionally, Chemistry educator's proficiency has been measured in the past through examinations, grades, and certifications. However, in the recent time, there are many traits considered intangible that can make them better, professionally and more effective teachers that cannot be measured. These abilities are generally referred to as the soft skills. These skills cannot be

quantified but can be developed with time to help educators interact better with students, colleagues, school host community and wider audience.

Whenever, Chemistry Education graduates are engaged in an organization other than the school systems, they are likely to start behaving like an amphibian animal such as a duck which has never entered water in its entire life but dropped into an ocean of water. They might commit a lot of blunders before adapting if not dead in the process or carried to an unknown destination. Hence, this study has presented a list of soft skills required to groom in-service chemistry teachers into professional and effective teachers wherever the profession they found themselves. The skills will help enhance their performance irrespective of individual differences including learning styles, study habits and socio-economic background. By creating and incorporating the varieties of skills into the curricula of chemistry education degree programme, it will not only develop chemistry teacher professionally but also better prepare students for self-reliance, job creation, life-long learning, skills trainers and future careers as world class work-force who can cope with the global work place challenges and reproduce themselves in all sectors of economy.

Suggestions for the Improvement of Chemistry Education Programme in Teacher Education

1. Inclusive skills should be integrated into the curriculum of Chemistry Education programme by the Curriculum reviewers.
2. Soft skills should be scaffold across courses by all Chemistry education lecturers whenever in position to ensure that learning is intentionally connected with students' daily living for better retention.
3. Inclusive skills ability should be assessed in teachers by the ministry of education during staff recruitment using clearly articulated student learning outcomes.
4. A Departmental course or general study programme should be developed to focus on soft skill development for students in Chemistry Education programme.
5. Curriculum Developers for chemistry education programme should inspect

employers of chemistry education graduates regularly for suggestions on skills expected to be included into the curriculum.

By creating and incorporating the varieties of skills into the curricula of chemistry education degree programme, it will not only develop chemistry teacher professionally but also better prepare their students for self-reliance, job creation, life-long learning, skills trainers and future careers as world class work-force.

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