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Review Paper

The need for skill development/acquisition in science, technology and mathematics education (STEME) in Nigeria

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This article discusses the basic concepts of skills and provide frameworks and perspectives on how productive work, skills and aptitudes are interrelated, albeit, to provide justification for the adoption of skills focused on instruction and assessment by teachers in everyday classroom practice. The processes of skill development and acquisition in science, technology and mathematics education (STEME) are also presented. The relationship amongst the concepts of skills, aptitudes, and works in STEME, as well as the roles of skill acquisition in STEME is discussed in this article.

Key words: STEME, science, technology and mathematics education.

INTRODUCTION

Brief origin of science, technology and mathematics education (STEME) in Nigeria

Prior to 1859, no science was taught in any school in Nigeria. At the establishment of the first senior secondary school (the C.M.S Grammar School, Lagos) in Nigeria in 1859, arithmetic, algebra, geometry and physiology were introduced into the school curriculum (Omolewa, 1977; Adeyemo, 2003). A number of Secondary and Teacher training institutions were founded between 1859 and 1929, and their curriculum were science subjects friendly. These science subjects include astronomy, chemistry, physiology, geology and botany. Omolewa (1977) reported that science teaching and learning suffered in the hands of teachers and students. Entry and performance at external examinations were very poor.

When the Phelps-Strokes funded education commission visited West Africa in 1920, it found that the state of science education was deficient, consequently, a strong recommendation for the inclusion of science subjects in the curriculum of all secondary schools was made. Even when very competent science teachers were available in a few schools for a long time, "the provision for, and method of teaching science were very unsatisfactory" (Omolewa, 1977; Adeyemo, 2003).

Before 1960, classics and arts subjects were emphasized in most Nigerian secondary schools while general science was being taught in lower forms of secondary schools. The government and mission schools taught biology, chemistry and physics in the senior forms presumably due to availability of science teachers and equipment. Health science was taught and taken at the school certificate examination as an alternative to biology in the final year of the secondary school course. The science content in schools was dictated by an external examination board (London Universities Examinations Syndicates) with little or no regards to peculiarities in Nigeria (Ivowi, 1984; Adeyemo, 2009). Science teaching and learning in schools was in fact a privilege. The ministry of education inspected and recommended schools in recognition of their science teaching and learning and for West African Examination Council's (WAEC) approval to present candidates for science subjects at the school certificate examinations. In most cases, the order of approval was usually biology, chemistry and physics, and in few cases, a school had approval for the three science subjects at the same time (Ivowi, 1983; Adeyemo, 2003).

The attainment of political independence in 1960 marked the start of a new era in a number of activities in Nigeria. Modification on the basis of nationalism became a common feature soon after 1960. In education, more institutions were established to cope with increased demand for formal learning with special emphasis on

science teaching and learning especially at the secondary school level. The numbers of courses available in our educational institutions were increased and these courses were made more relevant to the needs of the country. In particular, science, agriculture and technical courses began to acquire their due position in the scheme of things. By the end of the first ten years of independence, Nigeria's curriculum development movements became established and concrete efforts at innovations had begun to manifest their reality (Ivowi, 1984).

The experiments in education soon after independence, typified by the events at the Comprehensive High School, Aiyetoro, the polytechnic (then Technical College) Ibadan, had proved so encouraging during the period that a number of activities aimed at improving education generally began. Curriculum development conferences and workshops were held between 1969 and 1975 culminating in the production of science curriculum materials for both primary and secondary levels and the national policy on education on document. Debates on the policy document and on other policy statements on education by our various governments were affected to have received appropriate attention in different communities of the country (Ivowi, 1982, Adeyemo, 2003).

The provisions for STEME consist of curriculum, personnel and equipment (Ivowi, 1993). According to (Ivowi, 1984; Adeyemo, 2003), STEME policies may be put as follows:

1. Science shall be taught to all children in primary and secondary levels.
2. The teaching and learning of science shall be done in such a way as to develop the child in three domains (cognitive, affective and psychomotor) of educational objectives.
3. Equal opportunity in terms of the provisions of curriculum materials, resource persons and laboratory facilities shall be given to all.
4. Every child shall take at least one science subject at the end of the secondary school course examinations.
5. Local production of science equipment and the practice of improvisation shall be pursued vigorously.

Although adequate strategies have been devised for the implementation of the policies, a closer examination of the implementation process shows that the objectives are far from being realized. A detailed analysis of the implementation strategies of the national policy is properly documented in Ivowi (1983), and a mismatch between policy and implementation are also identified. For example, while government wants all children to do sciences in schools, most schools have no laboratories at all. Apart from poor provisions for STEME in terms of facilities, the problem was compounded by the large population in schools far back as late 1970's (Ivowi, 1984). Based on these major landmarks in STEME since 1960 in Nigeria, the emphasis of science education in this twenty-first century should be on quality assurance for science teachers, science students and the Nigerian society at large. To achieve this and many more, a skill-focused study that is qualitative in its approach, purpose, objecttive and methodology is indeed timely.

Acquisition and reinforcement of skills and aptitudes through laboratories and workshop practice and other curricular and extra-curricular activities represent the most natural ways of stimulating education and real life work which lead to high productivity. These considerations underscore the need to focus on skill development and assessment in our teacher education and in service-training programmes, more especially in the science based teaching subject areas of physics, chemistry, biology, integrated science agricultural science, introductory technology, wood work, metal work, electrical electronics, home economics, clothing and textiles. This article therefore attempts to explore briefly, the concept of skill, aptitude, work, practical skill; their development and acquisition and how they are related with special consideration of their roles in science, technology and mathematics education.

CONCEPT OF SKILL

Skill as basic ability is the means by which a person adjusts to life. A person's aptitude and work functions are required and necessary as antidotes suggesting the suitable skills performance and acquisition of same by going through a given work sample. In the work place, skill is what the workers give in exchange for remuneration. If the skill (or the cluster of skill popularly referred to as aptitudes) given is satisfactory, the worker gets satisfaction and the employer gets satisfactions in correspondence (Baiyelo and Adeyemo, 2001). This process, if sustained, culminates in promotion, retaining and prolonged tenure that leads to productivity (Darwist and Lofquist, 1967).

On retirement from active working life, a person's repertoire of skills will no longer be relevant to help him or her adjust to life. He or she needs new skills in how to enjoy leisure and adjust to the new way of life. This situation is the same for a handicapped person, a widow or indeed any person whose way of life has changed rapidly. Hence a person's rehabilitation in these contexts requires new skills with special consideration to his or her aptitudes and work functions. In the case of youth, whole adjustment in the world of work will rest solely on skills developed and used first at school and later at work; the economic, moral and political future of the nation will in time to come depend on it and these will from time to time determine its survival (Darwist and Lofquist, 1967). In a classroom situation, skill is the ability to perform some tasks creditably. Up to a point, the more practice in the doing of specific task, the faster and better they can

be done. It is associated with know-how while speed and accuracy are some of its traits and characteristics. Children who love to paint with crayon and water colour often develop unusual perspective and excellent representation of nature. Ability to identify and measure these aptitudes in children for placement, promotion and remediation is a highly treasured experience which every good teacher must possess.

Until the 1940s, the study of skill was largely confined to industry. People were regarded as skilled when they were able to carry out a trade or activity that involved knowledge, judgment, accuracy and manual dexterity while qualifications are usually acquired as the result of long training. In contrast, an unskilled worker was not expected to do anything which could not be learned in a relatively short time. This industrial definition of skill expressed fundamentally in terms of the amount of training and experience required for effective performance has remained essentially the same to the present time. This performance is not exclusively concerned with annual operations, it includes process control, and office as well as attempts to understand the human factors involved in managerial decision making (Welford, 1967).

Skill is thought of as a quality of performance which does not depend solely upon a person's fundamental, innate capacities but must be developed through training, practice and experience. Although, skill depends essentially on learning, it also includes the concepts of efficiency and economy in performance. Modern concepts of skill stress the flexibility with which a skilled operator reaches a given end on different occasions, varying specific actions according to precise circumstances.

However, it must be reiterated that even though basic human capacities are not sufficient to produce skills, they form the necessary basis of their development. Skills represent particular ways of using capacities in relation to environmental demands, with human being and external situation together forming a functional system (Adeyemo, 2009).

Surprisingly, although the concept of skill is intimately related to classroom activities and its measurement, assessment and general evaluation may be central to the affairs of the school system, little is done about it in teacher education. Its records are also seldom kept in continuous assessment in schools despite the national Policy on Education (F.M.E, 1981) that requires teachers to make instruction concept centered, activity based and work related. An apparent glaring neglect of policy as presented above well illustrates a major way in which standards are often compromised in Nigeria's school system. Baiyelo (1999) has shown how bending of policies, rules and regulations often lead to various acts of indiscipline among stake holders in education, in the implementation stage of the school curriculum. This fact underlines the need to focus skill assessment on school instruction for the benefit of school and society.

SKILL TYPES AND THEIR ACQUISITION

The great advantage of any task is that, if properly undertaken it helps both to develop and to reinforce skills. Although, any attempt to catalogue a hierarchy of skills will always have a gap, it should not be a reason why we should not delineate skill areas. Generally, the types of skill commonly encountered in the school system (that is, intellectual skills) are as follows:

1. Motor skills
2. Memory
3. General cognitive (verbal, perceptual and quantitative)

These classifications and many more are in relative rather than in absolute term. A total of eighteen constructive tests have been developed by McCarthy (1972) covering these intellectual skills which she organized into six scales. These constructive tests include block building, puzzle solving, pictorial memory, word knowledge, number questions, tapping sequence, verbal memory, right left orientation, leg coordination, arm coordination, imitation action, draw a decision, draw a child, numerical memory, verbal fluency, counting and sorting, opposite analogies, conceptual grouping. These 18 separate tests assess the child's skills/ability in a variety of crucial areas. The tests have been grouped into six scales: verbal (V), perceptual-performance (P), quantitative (Q), general cognitive (GC), memory and motor. The first three do not overlap in content and when the tests constituting these three scales are considered altogether, they form the general cognitive scale. Therefore the following relationship exists among the first four scales:

$$V + P + Q = GC$$

It is to be noted that in each of the above cases, acquisition of skills seems not to increase basic capacities, but to improve the efficiency, economy and effectiveness with which they are used (Welford, 1976; Adeyemo, 2003). Also note that where the measurement, assessment and evaluation of skills and skill impacts have been alluded to as problems in operating continuous assessment in schools, the question of efficiency, economy and effectiveness with which skills are performed have often been overlooked. And it is probably more for this than other reasons that process skills have been exclusively focused on school instruction whereas it is the skills, efficiency, economy and effectiveness that really ensure high productivity in industries (Adeyemo, 2009).

The oversimplification of focusing on process skills to the exclusion of other types of skills in school instruction is in part to be held responsible for the gap often easily noticeable between "work" in schools and "work" in real life. Hence, effort should be made to investigate this

neglect, identify its pervasiveness and types of skill involved and seek how to propagate and reinforce them as well as sensitize teachers to their measurement assessment and evaluation in order to bridge the yawning gap between school and real life.

The process of skill acquisition in line with Lofquist and Darwin (1976) and Hattie et al. (1996), can be thought of as a sequence of five stages viz:

1. Comprehension of the task
2. A temporal storage which gives time for more permanent, long term training to form
3. Passing material of long term store
4. Retention in long term store
5. Retrieval for use

Reinforcement requires that something must be learnt before it can be consolidated through reinforcement. Some traditional elements that contribute to reinforcement include:

1. General outline or "schema"- this shapes both perception and recall
2. Degree of care and effort
3. The relationship between aim and result, leading to diagnosis and feedback for further skill reinforcement.

Ability to select and identify the number of discrete units or items about which decisions are to be made improves assessment of particular skill previously acquired. The following are the basis of assessment:

1. Source of data
2. Sensory qualities
3. Semantic grand
4. Attitudes
5. Hypothesis brought to an existing situation from that experience

It can be argued that "the cost of making the selection (based on the assessment criteria) in terms of time, effort or possibility of error may sometimes be more offset than the extra work" involved in attending to redundant parts of the display task etc (Taconis, 1995). However, the assessment may be biased as a result of the following factors such as sensory adaptation and interaction, the after-effect of previous activities, familiarity, expectations, aims and desires.

CONCEPT OF APTITUDES

Aptitude is an inborn trait that gives people an easy disposition to perform better in one operation than in another. Performance is at best when the right aptitude is called into play. To Heally (1982), the knowledge of a person's aptitude and work function skill is very useful in suggesting suitable occupations and training programs. In effect, a person will not succeed in an occupation without minimum prerequisite aptitude and work function abilities. Review of relevant literature revealed the aptitudes considered to be relevant for skill performance. The aptitudes are general intelligence, numerical aptitude (reasoning and computation), spatial aptitude, form perception, motor coordination, manual dexterity, verbal aptitude, clerical perception and finger dexterity (McCarthy, 1972). Nneji (1995) presented this list of aptitudes to experts in testing, industrial psychology and electrical trade for the purpose of validation and found that (based on the ratings of experts) all but clerical perception are relevant for skill performance. These relevant aptitudes for skill performance form the bases of development of aptitude test in a given situation.

The situation in our schools today which has led to the exclusive use of interest inventory for sorting students into arts and science specialization areas is an open demonstration area of another brazen neglect. To possess interest alone is not enough; there is a need to combine the possession of requisite aptitudes. A situation where measurement of aptitudes is simply dropped because teacher education does not prepare teachers for it is unfortunate. After all, there are experts who are capable of identifying the aptitudes possessed by individuals and this can most easily be done at the Junior Secondary Schools/ Senior Secondary Schools (JSS/SSS) interphase.

The result of the present neglect of identifying aptitudes in children is manifest in the number of children who become frustrated after indicating early interest in science. At present, ability to pass in integrated science, introductory technology and elementary mathematics is used as an indication that children will do well in single science subjects of physics, chemistry, biology, mathematics and further mathematics at senior secondary level.

This assumption is grossly misplaced as Baiyelo (1997) has shown that JSS science based subjects are poor predictors of success in SSS science subjects mainly because of slight differences in complexity of content, processes and problem solving techniques.

Adoption of a simple approach to the measurement of aptitudes in teacher education curricula will be a tremendous step towards popularizing the use of a combination of interest and aptitude as measures for sustaining viable choices in school science for careers in science based subjects in the nearest future.

CONCEPT OF WORK

Typical definitions of work include; activity in which an individual engages for pay, to make a living, or to earn money, the activity that utilizes his or her abilities or skills in some special or economic enterprise (employment),

the activity which he or she feels called upon to do (vocation), or the activity which he or she is contracted to do (job). These definitions however are not sufficient to bring out the full meaning of work to the individual (Darwist and Lofquist, 1967). As a result, there are different perspectives in which work can be described. These include:

i) To Hebrews and Greeks, their ideas about work are that things that can be referred to as a curse, punishment, activity not included as part of the good life and as a necessary evil (necessary only to sustain life).
ii) To the people of the middle ages, work was a natural right and duty, the basis for society, the foundation for property and the source of prosperity (Pieper, 1952).

It is easy to see that work, then has had at least three basic meanings: (1) Work was a hard necessity, painful and burdensome, (2) Work was instrumental, as means towards ends especially religious ends and (3) Work was the creative act of man, therefore intrinsically good (Darwist and Lofquist, 1967). However, work has negative as well as positive meanings. Again, put in another way, expressed as follows: work does not provide enough rewards. The pay is rarely satisfactory in most cases. Work is dull, boring exhaustive and dangerous. Work reduces one's self respect and provides little or no prestige. Work forces on a person associations with people that one may not like. Work is uninteresting and distasteful (Lofquist and Darwist, 1967). At work, one finds little opportunity for service to others, for self expression or for creativity.

Therefore one can confidently say that work is central to a person's development and total life adjustment, and that work provides a situation for satisfying needs. However, needed satisfaction as the reward of work must not fall short of one's true requirements and reasonable aspiration. A mismatch between training, education and general preparation for life and the actual work that one later undertakes will lead to frustrations such that skills acquired during training will not serve any useful purpose in helping to reach goals and target.

The total absence of work is even worse as skills need practice to sustain. This situation becomes even worse still as skill is a dynamic function that is tied to technology so that as technology changes, old skills attract less importance and new skills will have to be learnt to stay in one's trade. The above considerations must guide us in our organization and management of instructional leadership.

RELATIONSHIP AMONG SKILLS, APTITUDES AND WORK

Science, technology and mathematics teaching that attempts to solely impart to students accumulated knowledge leads to very little understanding and certainly not to the development of intellectual independence and facility. Screen (1986) advised that if any quality or generic skills are transferable, the process must for a substantial proposition of any STEME curriculum and any preparation of young people take into account the transferable skills which they need to succeed in a given work. Therefore, with emphasis on practical work, courses should be provided in such a way that they would give pupils appropriate opportunities to make observation, seek and identify required aptitudes for optimal performance in a given work. Also, practical oriented courses would enable pupils to design and carry out experiments including appropriate form of measurement of skills, aptitudes and work satisfactoriness. This would enable them in the final analysis to manage and organize practical works and resources, and break ideas and concepts of skills/ work down to manageable parts (Adeyemo, 2009).

In his work, Nneji (1995) found that in a descending order, practical work, aptitude, level of formal reasoning, theoretical knowledge, and use of learning resources contributed substantially to practical skill acquisition. Greg (1975) suggested "activity" method as a strategy to be employed during practical work for effective skill development. He defined activity method as the interaction of selected creative (though innovative) activities with the language work undertaken and with the experience (existing and provided) of the children which differentiates lifeless, unfruitful and unrealistic activity work from that which is existing, alive and meaningfully inter-disciplining. Therefore, one can argue the following as the roles/impact of activity method in skill development.

i) Heightening of children's understanding through interaction among related and useful experience
ii) Involvement of their senses and emotions
iii) Development of new concept
iv) Ability to make active contribution to their own learning

Activity methods do more than provide an opportunity for children to practice existing skills. Since learning is a cumulative process with each new task or experience being dealt with in terms of skills acquired consequent upon the most prominently displayed aptitude in dealing with previous situation, there is a plea for education which is work oriented and activity based (Olagunju, 2004; Adeyemo, 2009).

ROLES OF SKILLS IN SCIENCE, TECHNOLOGY AND MATHEMATICS EDUCATION (STEME)

Science, technology and mathematics teaching that attempts to solely impart to students the accumulated knowledge leads to very little understanding and certainly

not to the development of intellectual independence and facility. According to Screen (1986), if any quality or generic skill is transferable, then the processes must form a substantial proportion of STEME curriculum and preparation of young people must take into account the transferable skills needed to succeed (in any task). Based on this argument, there is no doubt about the worthwhileness of studying skill performance by the teachers and students alike and the extent of its impact on students achievement. Science curriculum developers have been enjoined to pursue science teaching with the emphasis on science methods that introduces pupils to wide varieties of skills (Des, 1985). With emphasis on practical work, courses should be arranged and presented in such a way that they give pupils appropriate opportunities to:

i) Make observations.
ii) Select observations relevant to their investigation for further study.
iii) Seek and identify patterns.
iv) Design and carry out experiments including appropriate form of measurement to test explanations for the pattern observations.

From the foregoing therefore, one may infer that skills can be encountered with ease in a carefully arranged, and sequential oriented work. Also, technology is based on science and pivoted on advancing the economic growth of a nation and as a result has always had an advantage over science and mathematics with regard to the attention given to its practical processes. Hence, in any practical situation, task analysis has long been evolved as a method of understanding job requirements. This is simply because task analysis has contributed immensely to the identification of knowledge, skills and attitudes relevant to the effective performance of any kind of job (Baiyelo, 1999; Adeyemo, 2009).

According to Alhassan (1995), task analysis is the determination of the knowledge and skill requirement of the job. Basic to the task analysis is the identification of the kind of performance and capabilities demanded by the task. It goes beyond job description by going beyond a general statement about what a person on the job does into telling something about the conditions under which he does them.

It is a detailed inquiry into the actions that need to be taken in the performance of a specific task or job. It involves making an inventory of what has to be done, which include:

i) Information about the knowledge and motor actions that is required.
ii) Information about the skills and attitudes that is necessary.

For example, task analysis as applied to job analysis in industry identifies knowledge, skills and attitude relevant to the needs of employers and the clientele community (Lindsay, 1980; Mager and Beach, 1967). For the development of appropriate curriculum and instruction, the selection of appropriate objectives, contents, sequences, methods, media and evaluation criteria depend on the correct identification of the capabilities needed to perform the tasks (Alhassan, 1995).

Also, if there is the need to develop skills in students, then there is also a need to create time for the learners and not put them under the examination pressures we are so used to. In this twenty first century, science curriculum developers must bring to the open, skills that will provide science, technology and mathematics learners with the confidence to make significant contributions for the scientific, technological and mathematical development of Nigeria (Rae, 2007 and Adeyemo, 2003). Ndu (1993) opined that the most prominent roles skills played in STEME are to promote effective learning activities, manipulative skills, good memory, organizational skills, communication skills, power observation, relation between form and function, data analysis, power of hypothesisation, creativity, experimental and drawing inferences.

Baiyelo (1999) on the other hand added the four roles of skills that is, to promote effective managerial skills, valuing skills, parsimony skills and economy skills. For the above roles to be felt and effectively practiced by students, the science teacher must possess the following competencies Aliyu (1995):

i) Adequate up to date knowledge of science subject under focus.
ii) Educational knowledge relating to psychological characteristics of the students.
iii) Knowledge of processes (and methodologies) involved in learning and how to promote them.
iv) Motivation or new enforcement of learning to keep the enthusiasm of the students.
v) Skills for effective planning and presentation.
vi) Above all, he must possess technical and scientific skills for proper performance of requisite skills.

Equally, Sweeney (1982) identified six leadership behaviours expected of teachers that have been consistently associated with schools that are well managed and whose students achieve and that these behaviours can be incorporated into science practical skills in classroom situations (that is, learning environment). These behaviours include:

i) Ability to emphasize achievement.
ii) Ability to set instructional strategies (that are skill performance friendly).
iii) Ability to evaluate student progress effectively and efficiently.
iv) Ability to coordinate instructional programs according to the dictate of practical work.

Effective utilization of the above strategies and the superior knowledge of teaching techniques (and the underlying learning theory) helps both the teacher and the students to build successful friendly interpersonal relationship that enable them to comprehend better various aspects and demands of skill performance.

According to Ndu (1993), practical skills can be easily acquired through:

i) Practical work in subject teaching area.
ii) Course on laboratory techniques.
iii) Course on laboratory management and organization.
iv) Special methods course e.g. activity method.

It is therefore a must for all science, technology and mathematics teachers to possess appropriate skills of teaching in order to meet the productivity of our teaching most especially in this new millennium.

CHARACTERISTICS OF SKILL AND SKILLED PERSONS

To know how skill is acquired in the presence of some recurring factors, it is pertinent to know about skill itself and the person who possesses skill. This will enable us to know and recognize when a skill has been acquired. In spite of the minor differences, all kind of skills, physical and mental appear to possess three characteristics. Skills consist of the building of an organized coordinated activity in relation to an activity involving the sensory, central and motor mechanism, which underlie performance. They are learnt and built up gradually in the course of repeated experience. They are serial in the sense that within the overall pattern of the skill, many different processes or actions are ordered and coordinated in a sequence. Within any skill performance, these identities are closely bound together and anyone attempting to gain a view of the nature should consider them.

As skill and a skilled person may not be easily separated, a good perception of the latter can be gained by looking at the former. To differentiate between a person who can overtly perform from an ignorant and clumsy person, measurement should be made to enable the labeling of one person as skilled and another as unskilled. Fryklund (1956) regards a skilled person as representing the highest type of workman, whether in production industry or in trade.

To qualify as a skilled person, one has got to be able to perform practically all operations and have command of all scientific facts and be able to read drawings and make any calculations that may be essential to the performance of one's work. From this exposition, an unskilled person lacks not only the practical ability, but also the required knowledge necessary for a successful performance. Thus, an assessment on skill should not stop at looking at the physical dexterity but should extend into the search of his or her intellect. Holdings (1965) describes a skilled person as:

i) Accurate and wastes little time.
ii) Beautiful to watch.
iii) Coordinated and patterned in action.
iv) Stable in performance despite distraction.
v) Involuntary in movement and control.

Roberts (1957) complemented this description by saying that a skilled worker is a man who has achieved a high degree of proficiency and recognition in his vocation. To Legge (1970), skilled performance has to do with production of appropriate responses to a particular problem. Sometimes, the responses are discrete and do not warrant rigorous level of accuracy. Other responses have to be precisely executed in time and space. In general, a skilled worker is one who has completed a training program in a trade in which technical knowledge and the exercises of judgement are required. An unskilled worker, who is generally called a labourer, is one who performs work that chiefly requires muscular energy and very little judgments. It is possible to draw a boundary line between a skilled worker and an unskilled one and enable skill to be acquired and assessed.

Two fundamental issues are raised when a new skill is to be acquired. The first is the conditions, which promote acquisition and the second is the change that will occur when the skill is acquired. The initial conclusion of early researchers into this issue was that skill is best acquired through the stimulus-response learning theory as proposed by Pavlov and Thorndike. However, recent thinking proposes that such theory would predict the development of relatively stereotyped chain of response instead of flexible pragmatic behaviour that characterized skilled performance. The stimulus response theory no doubt provides the best description of learning in simpler organisms but in people an emphasis on planning, organization, management and strategy would appear more appropriate. In the opinion of Miller, Galanter and Fribran (1960), organisms more often learn guiding principles and programmes rather than specific responses.

When an adult human sets out to learn a new skill, he usually begins with a communicable programme of instruction. Another person, either verbally or by exemplification, communicate what he is supposed to do. Valid as the argument that mere knowledge of a strategy does not guarantee successful performance may be, a learner of a new skill does not jump into operation without first receiving the necessary verbal instruction (that is, prerequisite knowledge).

It is the skillful elaboration and execution of the instruction that gets the act safely done. The instruction perhaps given in bits, units, modules or stages must be fused together to form a skilled performance. It is quite possible to build up skills without verbalizing the strategy.

For instance, nobody can successfully communicate the strategy whereby a cyclist keeps his or her balance. For this, demonstration is employed. It is not also in all cases that the rules for performance must be observed and mastered by a skillful performer. Otherwise it becomes doubtful if we would ever be able to sit up in our cradle. In this regard, we rely on inarticulate guiding and demonstrating until the learner catches on or gets a feel of it. And to cap it up, knowledge or results facilitates the rate at which skill is required. It then follows that a skill evaluator must be aware of how skill is acquired, developed and performed to be in the position of designing his or her instrument, collecting and analysing data and drawing a reliable conclusion from the measurement. Measurement itself is not a spontaneous event but must have some underlying events, which must be concluded before it is embarked upon. These are all in-built in the nature of science and technological subjects (Adeyemo, 2009).

Even in a skill focused instruction, teachers still revert to assessment and evaluation criteria on the cognitive domain. In school continuous assessment and also in public examinations, skills are not classified and focused. They are therefore, poorly, if ever, reported upon. This is largely because the subjects of the measurement, assessment and evaluation of skills and aptitudes have remained theoretical issues in teacher education programs at all level. There is paucity of simple practical approach to the measurement, assessment and evaluation of skill performance in literature which justifies the qualitative nature of this study.

The implication of such neglect was that even with the strongest will to change practice, not much was achieved. Apart from Bloom's (1956) concept of iterative teaching towards mastery, difficulty studies were explored as other goal based instructional strategies to reach mastery learning but to no avail. As at this time, Bloom had classified educational objectives in the cognitive and not in other domains. Expectedly, his associates explored classification of other domains. It was not until the 70s that the full picture emerged about the other domains and how their relationship led to the discovery of the fourth domain, the perceptual. Despite these developments, it took some time before the full implications dawned on the STEME community in Nigeria, how it was necessary to align curriculum, instruction and assessment. However, with the policy requirement (FME, 1981), it posited that instruction in schools should be concept centered, activity based and work related. Hence, it became necessary to be equally keen on skill assessment and reporting, which is the long term aim and goal of this study. As teachers across all levels are involved, it is necessary that the skill assessment approach, adopted to be simple, easy to operate, and data from it, easily processed, analyzed and reported. These therefore are the reasons for justifying the adoption of the multiple assessment system in skill focused instruction most especially in STEME. Not only do teachers need to single out a student's strengths and weaknesses in their reasoning ability, understanding and application of principles, they also need to pinpoint the skills students have managed to acquire and those they have failed to acquire, describe their quality of performance, and trace their links with bottlenecks experienced generally in the course of instruction. It is not difficult to tie these indications to a student's general feelings about the physical and intellectual activities of the instruction. This holistic approach is capable of describing a student's disposition to school instruction in its entirety and this is the virtue of focusing on skills in this study most especially in analysis of the content of skill focused instruction (Baiyelo, 1999, 2000). This automatically led to the need for skill development and acquisition in STEME as being documented in this paper.

CONCLUSION

In observing an individual's behavior in STEME, one can identify recurring response sequences in classroom situation. These recurring response sequences tend to become modified and more refined with repetition. The identification of a common skill for several individuals' permits the definition of skill categories. The number of skill categories/ dimensions required for a given work/ task is however, extremely large. It is cumbersome to describe individual responses in terms of many skill dimensions. In effect, these concepts are interdisciplinary and hierarchically related, besides they are all encapsulated in productive work. Consequently, every teacher needs to understand the concepts of skill measurement, development and acquisition in STEME. An understanding of how these concepts are inter-related and inter-operate is imperative for proper conceptualization of the value of work in a person's life.

What is required to close the gap between school and work is the cultivation and reinforcement of relevant skills and aptitudes. The extent to which skills most neglected will be identified, their acquisition and reinforcement mastered, and their assessment explored and scaled and the precision with which their impact on student's achievement in STEME could be evaluated should become the focus of instructional leadership in the new millennium.

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