

ANALYSIS OF PSYCHOMOTOR DOMAIN AS A RELEVANT FACTOR IN THE UNDERSTANDING OF MATHEMATICAL CONCEPTS

Dr. Rev. A. C. Egereonu

Abstract

This paper focuses on assessment of Psychomotor as relevant to understanding of mathematical concept. Psychomotor involves all movement whether micro or macro, slight or profound. From creation action is relevant for survival whether in teaching, learning, war, politics, farming, sports, sex or otherwise. Any fundamental law whether biological, glandular or environmental involves action. So, mathematics in teaching and learning even evaluation cannot survive without psychomotor and practice using gadgets within or outside the homosapients. Both psychomotor and mathematics including mathematics related subjects are complementary. Therefore it is recommended that all tiers of government and institutions should be involved in policies and practice for implementing mathematics with psychomotor elements.

Introduction

From time immemorial, mathematics, queen and servant of the sciences has been an important components in the origin of civilization. Similarly, psychomotor from the origin of creation had to do with manipulative skills. For instance, from the stone age man, farmer and shepherd who used matching devices to check his counting, e.g. pebbles, shells, stones, sticks, clods of earth, scratches on the ground, knots on rope, notches on sticks, and clubs for hunting, to the modern chemist, measuring liquids and solids, physicist measuring solids space, and motion, biologist measuring growth, symmetry of curves of animate objects like a beautiful women; economist measuring human nature, money production, demand and supply, to the literary scholar measuring the rhythm of words, oratory, the mathematicians measuring appreciation of beauty of nature expressed in lines, solids & structures and the engineer quantifying (measuring) mass, weight and proportion of matter to matter, mathematics and psychomotor had and has played wonderful roles that are not only complementary, but have simplified learning, understanding, thoughts and feeling into concrete terms and action.

Emenalor (1986:4) in a paper presented at the seminar and workshop on “mathematics phobia and psychology of learning mathematics stressed that:

Mathematics teachers should begin to talk about applicable mathematics i.e. mathematics applied to the needs and demands of the society and it's technological development.

He further explained that, if applicable, mathematics were present, the mass failure in mathematics should have been minimized.

Mathematics should be related to the environment, since we now realize that nearly all endeavours contain elements of motion, action, activity and motor movement in producing geometrical lines, shapes, and solids. In fitting objects into grooves, holes like putting plug into an engine, fighting knots, pumping tyres, verbalizing instructions, gesticulating with mathematical signs; building structures and measuring their dimensions. These involves psychomotor & precision.

Definition of Psychomotor

The psychomotor domain is concerned with muscular activities with those movements of the body, limbs or other body parts (e.g. fingers) necessary for a given action.

Mkpa (1984) explains that the psychomotor domain is “concerned with outcomes in the area of manipulative skills and acts requiring neuromuscular co-ordination”. (p.90).

Gay (1980) believes that psychomotor domain entails physical abilities, those involving muscular or motor skills, manipulation of objects or neuromuscular co-ordination.

The Chambers Twentieth Century Dictionary defines mathematics as “The science of magnitude and number, and of all their relations.....”

(p. 809). Can one imagine magnitude, number and relation without a corresponding structures, model

or instrument that matches. These calls for three things: psychomotor cognitive and affective applications..... Thinking, appreciating and activity – the circuit is complete.

So in teaching mathematics, it has to be “applicable”. Psychomotor then becomes an important and crucial tool for understanding mathematics.

Assessment according to Aikan (1979) could be defined as:

Appraising or estimating the level of magnitude of some attribute of a person. The assessment of human behaviour and mental process involve observations, interviews rating scales, checklists, inventories, projective, and psychological test. (p. 302)

Here the word magnitude (level of) is mentioned. Other words are interviews, rating scales, human behaviour, checklists, etc. These words connote either verbalization, writing, movement, or action (elements of psychomotor). The more we assess, express and practice, the more psychomotor is involved that is the teacher assesses whether the student is expressing or practicing knowledge properly.

Reviews of the Need to Assess Psychomotor Ability in Mathematics

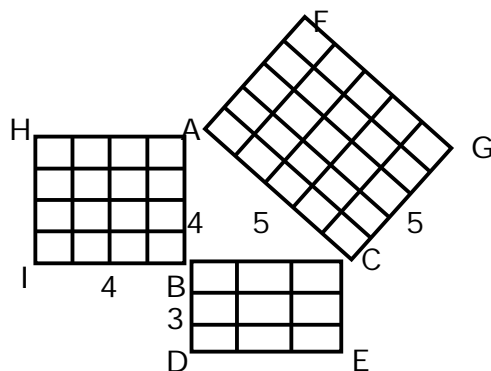
The following are some needs for assessing psychomotor in mathematics:-

1. For high concurrent / predictive validity
2. Basic for new tasks
3. To avoid fixation at later stage – one task precedes / depends on previous one.
4. The predominance of psychomotor activities – even from time immemorial.
5. The neglect of psychomotor in preference to cognitive assessment.
6. Law of contiguity – To remove abstraction
7. To apply the concepts of Piaget / Bruno’s concept on movements and icons respectively.
8. Law of Anticipatory Morphological maturation: the sucking propensity from the womb by the child and the womb outside the child on breast sucking.
9. To balance the personality development for future challenges ahead.
10. For early deflection of positive/negative endowments in sports activities and similar options for encouragement / remedial.

Details

1. For Validity

A lot of theories exist in mathematics. If one learns a theory (cognitive), one should practice it (psychomotor). But in assessing ones ability, a second psychomotor activity is relevant to confirm the validity of the first theoretical concept. The first test becomes the predictor for the criterion e.g. if a child is taught Pythagoras Theorem that $3^2 + 4^2 = 9 + 16 = 25$; to confirm understanding of this concept, the child is given the following diagram for assessment.



This diagram could be constructed structurally using cardboard sheets by the student to conform knowledge acquisition. This can be done in a short – time concurrent validity. Also since there are taxonomy of psychomotor objective, they can help to validate mathematics. Using blocks on the triangle, practice can confirm understanding.

2. Using Mathematical Instruments as Basic for New Tasks

If a student had not mastered an earlier task, the later task cannot be mastered. Piaget calls it fixation. A task portrays work action and psychomotor property. For an example if a learner in driving a motorcar and had not mastered the “cues” or parts of the car and their functions, motor movement is impossible. This stage is called the cognitive stage. The second stage is applying the cognitive to psychomotor development called intermediate stage. And the third stage is the autonomous (the mastery or efficient) stage, which is mostly psychomotor.

3. Psychomotor Occupies Time and Space

Mkpa (1984) says that “As far back as we can push the history of man; one discovers that most learnings of man had to do with manipulative skills.” As the writer said in the introduction, even in modern times, psychomotor is involved in all aspects of profession and human endeavour.

Man in quest to subdue the earth in all ramifications calls for psychomotor activity. It will be then strange (as we find these days) that teachers do not assess students in “psychomotor.” An engineer must have built a house to be able to assess house-builders. Physical education where psychomotor activities abound much has engulfed the whole world in sports, football, basket ball, etc.

In health physical education professions, assessment is purely on psychomotor activity, using many types of instruments and tests. What happens in England and United States as compared to what obtains in Nigeria cannot be compared because we are lacking behind. The youths want action and the actions should be geared towards productivity positively.

So, there is need to use psychomotor to measure distance (metres); weight (kilograms), and all variables of nature. This is mathematics in psychomotor.

4. Law of Contiguity

Using Ivan Parlor’s (1927) controlled experiments on learning of associations through conditioning as a cue, we can conclude that stimuli and events is the key to recognition.

Good and Brophy (1986): 165) explained that the key to recognition of “these associations of lightening and thunder is contiguity.”

Usually, however, association develop gradually through a combination of contiguity and repetition – repeated encounters with the associated items make us more and more aware of the fact that they are associated. We become conditioned to expect the association stimuli to occur together.

If a teacher teaches with aids, instruments, visual instruments, verbalizations, movement, he should assess also using same criteria. In mathematics, it is not relevant to go to the examination hall to assess without using same criteria as verbalizations, instruments, aids action or motion. These are psychomotor oriented. So it is important to apply contiguity in assessing mathematics as in teaching also. When students see a cube (real or improvise) with $(3 \times 3 \times 3) \text{ cm}^3$ with the concept of x^3 ($X \times X \times X$), this removes abstraction.

5. Concept of Piagets/Bruno’s Cognitive Development via Psychomotor of a Child

Piaget believes in toys, while Bruno believes in icons, images in development to improve cognitive development of the child. Cognitive and psychomotor are complementary such that it is difficult to draw the line where one stops.

Psychology believes that the first seven years of a child is crucial to development in later life.

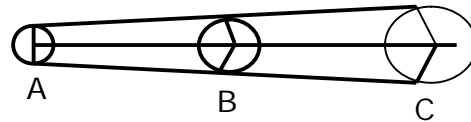
If a child misses any stage earlier, as we said; fixation / blocade will exist. To succeed in later life, a child must be taught with diagrams, toys, instruments, gadgets, etc. since the child is exploratory in nature (psychomotor), it becomes necessary to equip the child with mathematical solids, shapes, diagrams, etc preparatory for understanding complex hypothetical variables not only in the third dimension, but also, in the fourth dimension (spirit or occult realm). This also prepares the child to recognize geometric symbols. So assessment in psychomotor is the relevant and final stage to take off to new dimension or have a feedback for correction, on shapes, solids and their measurement.

6. The Law of Anticipatory Morphological Maturation

According to Nkwocha et al (1996:17) this means that the organisms like the fetus (child) anticipates its needs and because of this, it tends to develop natural capacities (abilities) that will enable it to meet future challenges as the need arises, e.g. the fetus (foetus) develops the sucking propensity, because after births, the child will need breast-feeding. At this, the child is matured

An Old Adage says “Practice makes Perfect.”

Teachers should practice psychomotor instruments with students for challenges in future. Different professions have different types of psychomotor elements or levels, so varied psychomotor practices equips the child for the future.. if a child is tested at the early stage with feedback, it could help to check future failures in professions dealing with such a subject e.g. if a student cannot understand the concept of magnetism and iron fillings in physics, he cannot expand in macro-tasks requiring such elementary and basic knowledge. This has to do with the concept of magnification. See diagram below:



7. Movement (Psychomotor) to Balance the Three Domains

There is the need to balance the imbalance among the three domains of learning outcomes. All over Nigeria, psychomotor appears in lesser degree in most schools curricular. The reasons and factors responsible could be extrinsic or other extraneous factors, but the fact remains that cognitive tests are more prevalent. So the psychomotor should thus be given “The emphasis it deserves is curriculum implementation” Mkpa (1984:91)

8. Early Detection of Problems on Progress

Except there is psychomotor mathematics either verbally, manipulating instruments, in summative, formative evaluations, blockades, faults, errors or ignorance, etc. cannot be easily detected for early correction; or if good, then encouragement and counseling into good professions.

When a child does an assignment / test (formative); feedback informs the students to correct errors, to avoid future blockades. If there is success, the next stage takes over and could be more cognitive than psychomotor, e.g. parallel lines create alternate angles, supplementary angles, corresponding angles, etc.

These concepts can be altered using paper cuttings to demonstrate this concept while measuring with mathematical instrument of the concept. If it is vague to the student, he goes back for correction.

Conclusion

There is absolute need to assess psychomotor ability in mathematics. After the Physical Education, the next subject that requires much psychomotor is physics and mathematics. Since mathematics appears or is subsumed into most professions, it may be more psychomotive than physics.

Psychomotor and mathematics are complementary and are relevant for Technological development. If used in teaching by the teacher, the teacher should invariably use psychomotor principles in testing as a foundation for optimal development on the macro level. The microcosm of the macrocosm.

Recommendation

The researcher recommends that the Federal Government and all schools should implement the policies on mathematics in the National Policy of Education to help the concept of psychomotor to help students learn better and use it for evaluation as a strategy.

References

- Emenalor S. I. (1986): Maths phobia causes treatment and prevention: *International journal of maths education, science and technology* 1.
- Mkpa N. (1987): *Curriculum development and implementation* Owerri: Toka Publishers.
- Gay L. R. (1980): *Educational Evaluation & Measurement (Competence for Analysis Application)* Columbus Charles Mem. Publishers Coy. Plc.
- Chambers Twentieth Dictionary* (1976): Mc Donald A. M. (ed) Adinburg Chambers Ltd.
- Aiken L. R. (1979): *Psychology Testing and Assessment* 3rd Edition: Boston Allyn & Bacon Inc.
- Ivan Pavlov (1927): In Egereonu A. C. (2005) *Psychology of human development* Owerri: Mkpa Publishers.
- Good T. L. & Brophy J. E (1977): *Educational psychology (A Realistic Approach)* New York. Holt Rinehart Wicton.
- Nkwocha P. C; Onyemerenkeya N. P; Elceada S. U. Ogudike H. U. C. Emenogu B. C; (1996): *Understanding the child* Owerri: Psychological, Perspective. Onitsha Noble Graphic Press.