Mathematics Evaluation: Purpose and Process

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The evaluation process—the diagnostic and remedial process at the Center for Teaching/Learning of Mathematics has been designed by considering that mathematics learning and achievement are a function of many factors related to the student, the content, and the teaching models. It is the interaction of three sets of variables: content, learner, and environment (e.g., teaching).

When we consider student variables, we need to keep in mind a student's: **cognitive development**, **mathematics learning personality**, acquisition and mastery of **pre-requisite skills**, fluency and understanding of **mathematics language**, and level of development of **key mathematics milestones**.

When we look at the content of mathematics, we need to examine:
the three key components of mathematics

- **linguistic**
- **conceptual**
- **procedural**

and the six levels of knowing

- **intuitive**
- **concrete**
- **pictorial**
- **abstract**
- **applications**
- **communications**

and the integration of quantity and space.

When we look at the teaching processes, we need to consider the choice of **models**, **sequence of activities** and **quality of student and teacher interaction**.

Not every student with difficulty in learning mathematics has learning disabilities or other manifestations such as dyscalculia or mathematics anxiety. Many students have difficulty in learning mathematics for a variety of reasons some as simple as poor teaching or lack of experiences inside and outside the classroom. Therefore, the process used for a mathematics evaluation is to assess the student's potential, achievement, and reasons for

difficulties in mathematics. Professor Sharma's protocols are based on research in the field and his own extensive work at the Center and at institutions of higher learning. The process is based on the work of Feuerstein, Piaget, Sharma, Denckla, and others and is used for designing remedial and instructional activities at the Center.

The development of the evaluation process has been supported by the work published in *Focus on Learning Problems in Mathematics*—an interdisciplinary, refereed research journal intersecting the fields of language development, psychology of mathematics, special education, neurology, neuro-psychology, and cognitive psychology. For the last thirty years, *Focus* has been a key journal in the field of mathematics anxiety, learning problems in mathematics, and dyscalculia. For example, visual perceptual disintegration is highly correlated with dyscalculia and almost 40% of dyslexics also show signs of dyscalculia because of common language aspects and prerequisite skills involved in acquiring reading skills and conceptualizing and using mathematics concepts.

Professor Sharma developed his evaluation process over many years and with hundreds of students, ranging in age from 5 to 85 and demonstrating varying degrees of learning problems, difficulties, and disabilities in mathematics - from underachieving gifted and talented to children on the autism spectrum. Though it is not a standardized or normed process, Professor Sharma's evaluation approach uses formal and standard protocols and is augmented by informal ones. It is a diagnostic process and conducted one-on-one in an interactive manner. A student's parents and teachers are encouraged to observe both evaluation and remediation activities.

Evaluation findings help create and design instructional strategies. Before any student is accepted for remediation, findings inform the tutor, teacher, or parent about the nature and extent of remedial interventions.

The objective of Professor Sharma's assessment process is to discover the reasons for the student's difficulty in mathematics and the nature of the potential for learning mathematics. A related objective is to find out if there are effective ways to help the student learn mathematics in order to realize his/her potential.

Our evaluation procedures are conducted to determine the student's:

Potential for learning mathematics
The important information for remediation is not just what the student can do now but what he/she is capable of doing. This means: What can the student do in mathematics now? What can he/she learn in mathematics when assistance is provided? How does he/she respond to strategies and models?
Protocols used and results:

1. ***The Wide Range Achievement Test*** and other informal inventories and activities are used to determine the level of achievement and potential in mathematics skills and procedures.
2. ***The Concrete Reasoning and Formal Reasoning tests*** are used to determine the cognitive level, cognitive strategies and the reasoning process of the student. With each question, the examiner asks a great deal of hypothetical questions to determine the thinking and cognitive strategies used by the student in arriving at the answers.

Mathematics learning personality
How does the student process mathematics information and make sense of received mathematics information? Is the student strong in the conceptual or procedural part of mathematics?
Protocols used and results:

1. ***The Rey-Osterrieth Complex Figure Test*** **is** borrowed from neuro-psychology and modified to observe mathematics processing and visual perceptual integration, short-term, working-memory and long-term memories functioning. Visual perceptual integration is highly correlated with mathematics processing and achievement.

Preparation for learning mathematics
Has the student acquired the appropriate prerequisite and basic skills needed to learn mathematics? Mathematics learning is dependent on several prerequisite skills. When these prerequisite skills are present mathematics ideas can be conceptualized and they get anchored.
Protocols used and results:

1. ***The Rey-Osterrieth Complex Figure, Concrete and Formal Reasoning Tests*** serve to observe prerequisite skills on and during concrete manipulative activities: *sequencing*, *pattern analysis*, *visualization*, *spatial orientation* and *space organization, estimation*, *deductive* and *inductive reasoning*. All of these are observed by posing questions during concrete and paper-pencil activities.

Development of mathematics language
Has the student acquired the language of mathematics—appropriate vocabulary, syntax, and the translation from mathematics language to English and from English to mathematics language?
Protocols used and results:

1. Soliciting the mastery of terms on mathematics vocabulary list developed by the Center, writing number sentences and number stories and translation activities from mathematics to English and from English to mathematics language.

Level of mathematics achievement and mastery
What is the student's current level of functioning in mathematics and has he/she acquired the milestones of mathematical conceptual development?
Protocols used and results:

1. *The Wide Range Achievement Test* assesses through formal tasks and mathematics activities designed by the Center such as: skip counting (forward and backward) starting from an arbitrary number (using whole numbers 1, 2, 10 and 5, fractions, decimals, etc.), number grid, fraction strips, algebra tiles, pin-ball wizard, and oral questioning.

Approach, attitude toward mathematics learning and problem solving
What is the student's response to mathematics activities? Does he/she demonstrate math anxiety? What is the nature of the anxiety? This is done through observations.

Assessment results are used to design an appropriate mathematics remedial/instructional program to give the student confidence in learning mathematics and to reach his/her potential in mathematics.

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Professor Mahesh Sharma is the founder and President of the Center for Teaching/Learning of Mathematics, Inc., of Framingham, Massachusetts, and Berkshire Mathematics in England. Berkshire Mathematics facilitates his work in the UK and Europe.

Professor Sharma is the former President and Professor of Mathematics Education at Cambridge College, where for more than thirty-five years, he taught mathematics and mathematics education to undergraduate and graduate students.

He is internationally known for his groundbreaking work in mathematics learning problems and education, particularly dyscalculia and other specific learning disabilities in mathematics. He is an author, teacher and teacher-trainer, researcher, consultant to public and private schools, as well as a public lecturer.

Professor Sharma is the Chief Editor and Publisher of *Focus on Learning Problems in Mathematic*s, an international, interdisciplinary research journal with readership in more than 90 countries, and the Editor of *The Math Notebook*, a practical source of information for parents and teachers devoted to improving teaching and learning for all children.

Professor Sharma provides direct services of evaluation and tutoring for students (children as well as adults) who have learning disabilities such as dyscalculia or face difficulties in learning mathematics. He works with teachers and school administrators to design strategies to improve mathematics curriculum and instruction for all.

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