SECOND EDITION

Brain-*Compatible* Mathematics

Diane Ronis

Foreword by Bena Kallick

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EDUCATION

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The Six Pillars of Performance Task Development

1. Establish clear performance goals (content standards).
2. Seek to employ "authentic" tasks and products.
3. Teach and emphasise criteria levels and performance standards.
4. Provide models and demonstrations of excellence.
5. Teach strategies explicitly.
6. Use ongoing assessments for feedback and adjustment.

Performance-based instruction is an effective methodology because it allows the teacher to continually monitor for student understanding and be able to then adjust the instruction to clarify and/or eliminate potential areas of confusion and misunderstanding. On the following pages explanations are given for each of the six basic principles that provide the framework for the design, development and implementation of performance-based learning. Each principle is related to one or more specific steps in task design and development.

1. SET UP CLEAR PERFORMANCE GOALS

Principles

- Focus on results (content standards).
- Focus on what students should know and be able to do.
- What is *not* taught is just as important as what *is* taught.
- Concentrate on the critical and essential.
- Concentrate on clear articulation and communication of the performance criteria.

Tasks

- Begin all designs with a clear statement of what is to result: the intended achievement(s) as well as how that achievement will be assessed. (For help in doing this, see Figure 2.1, Sample Project Organiser.)
- Determine those learner goals or content standards that are to be assessed. (What critical and essential outcomes do we want to evaluate?)
- Identify observable and meaningful indicators for each standard. (What must students show they know and can do well in order to prove that they understand? How will we know it when we see it?)

What we do not teach is just as important as what we do teach. By being selective in our choices, we are better able to focus the curriculum on the

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SAMPLE PROJECT ORGANISER

CURRICULUM AREAS:
PROJECT TITLE:
YEAR LEVEL:
PROJECT LENGTH:
RESOURCES/MATERIALS:

PROJECT DESCRIPTION

Description of the task/project only [not the steps for lesson initiation, procedures or assessment]

STANDARDS ADDRESSED

MATHEMATICS	**VISUAL ARTS**
List of content standards and process skills addressed by this project/activity	List of content standards and process skills addressed by this project/activity
ENGLISH	**SCIENCE**
List of content standards and process skills addressed by this project/activity	List of content standards and process skills addressed by this project/activity
TECHNOLOGY	**SOCIAL STUDIES**
List of content standards and process skills addressed by this project/activity	List of content standards and process skills addressed by this project/activity

PROJECT OBJECTIVES

COMPREHENSION OF CONCEPTS	**SKILL AND PROCESS DEVELOPMENT**
Project objectives for comprehension refer to concepts for which the students will be able to demonstrate their understanding at the task's completion. [It is *neither* the *activity* that helps accomplish the learning *nor* the *teacher's behaviour*]. 'AT THE END OF THIS PROJECT, THE STUDENT WILL BE ABLE TO DEMONSTRATE COMPREHENSION OF . . .' [refer back to the various area standards to help identify those concepts specifically targeted for comprehension by this particular project]	Skill or process development objectives refer to those specific skills or processes that the students will be able to demonstrate at project completion

PRODUCTS AND/OR PERFORMANCES

GROUP PRODUCTS	**INDIVIDUAL PRODUCTS**	**EXTENSIONS**
• List the product created by the group	• List the product created by the individual group members	• List any possible project extensions

CRITERIA FOR PROJECT EVALUATION

GROUP PRODUCTS	**INDIVIDUAL PRODUCTS**	**EXTENSIONS**
Keep in mind: Criteria for group and individual products become the project rubric criteria		

Figure 2.1

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Teaching to the Eight Intelligences: Ronis's Quick Reference Guide

Intelligence	Examples of Relevant Behaviours	Teaching Activities	Teaching Materials	Instructional Strategies
LINGUISTIC The ability to use language effectively	• Presenting persuasive arguments • Composing poetry • Recognizing subtle nuances in word meanings	Lectures, discussions, word games, storytelling, reading, journal or poetry writing	Books, tapes, records, computers, and software	Read about it, talk about it, listen to it, write about it
LOGICAL-MATHEMATICAL The ability to form hypotheses, draw conclusions, and reason logically	• Formulating and testing hypotheses • Quickly finding clear and direct solutions to problems • Generating mathematical proofs	Critical-thinking tasks, brain teasers, problem solving, puzzles, number games, mental calculations	Calculators, computers, manipulatives, math games, puzzles	Think about it critically, analyze it, conceptualize it, quantify it
SPATIAL The ability to observe details as well as imagine and "manipulate" objects mentally	• Creating mental images • Drawing an object accurately • Making fine discriminations among very similar objects	Visual presentations, artistic activities, creative games, visualization	Graphs, maps, videos, construction toys [LEGO sets], art materials, optical illusions, cameras, picture library	See it, draw it, visualize it, construct it, color it, create it
BODILY-KINESTHETIC The ability to use one's body skillfully	• Dancing • Playing a sport • Performing athletically	Dance, performance activities, sports activities, tactile activities	Building tools, art supplies, sports equipment, manipulatives	Build it, perform it, touch it, "feel" it inside, dance it
MUSICAL The ability to create, appreciate, and understand music	• Playing a musical instrument • Composing music • Identifying music's underlying structure	Lyrics, rhythms, and melodies that aid instruction	Musical instruments, tapes and tape recorder, CDs and CD player	Sing it, play it, "rap" it, listen to it, create it
INTERPERSONAL Sensitivity to subtle aspects of other people's behavior	• Demonstrating sensitivity to another's mood • Detecting another's underlying intentions and motives • Using knowledge of others to influence their thoughts and behaviors	Cooperative and collaborative learning, peer tutoring, peer counseling	Board games, room arrangement, role-play props	Teach it to each other, collaborate on it, interact with it
INTRAPERSONAL Awareness of the subtle aspects of one's own feelings and motives	• Discriminating among such similar emotions as anger and frustration • Recognizing the motives behind one's own behavior	Student reflection, independent study, alternative options for learning	Educational computer software, reflection guides, journals	Connect it to your personal life, analyze your behavior and motives
NATURALIST The ability to recognize patterns in nature as well as subtle variances among natural objects and life forms	• Differentiating among similar species • Classifying natural forms • Practical application of one's knowledge of nature (e.g., gardening, bird watching)	Moving the learning environment outdoors	Magnifying glass, drawing supplies, guide books	Through nature identify patterns and similarities, connect with previous experiences

Figure 3.1

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Assessment Vocabulary Based on "Bloom's Taxonomy" of Cognitive Function

Cognitive Domain	Descriptive Verbs	Assessment Words And Phrases
KNOWLEDGE	identify, define, list, describe, name, classify	describe . . . select . . . who, what, where, when, why, how, which one, how much
COMPREHENSION	explain, outline, propose, infer, modify, vary, summarise, change	what does this mean? rephrase or restate in your own words . . . explain why . . . summarise, outline . . .
APPLICATION	explain, estimate, plan, solve, predict	explain what would happen if . . . what and how much would change if . . .?
ANALYSIS	compare, contrast, equate, examine, deduce	what conclusions can be made from . . .? what is the relationship of . . .? which concepts are the most important?
SYNTHESIS	create, design, plan, imagine, set up	create, design, choose, plan
EVALUATION	evaluate, judge, assess, determine, conclude, critique, rank	which is more valid/logical/ appropriate? compare and contrast, critique . . .

Figure 3.3

New Brain Research and Twelve Implications for Teaching

Recent Research Suggests	Teaching Suggestions
I. The brain performs many functions simultaneously. Learning is enhanced by a rich environment containing a variety of stimuli.	I. Present content through a variety of teaching strategies, such as physical activities, individualised learning times, group interactions, artistic variations and musical interpretations to help orchestrate student experiences.
2. Learning engages the entire physiology. Physical development, personal comfort and emotional state affect the ability to learn.	2. Be aware that children mature at different rates; chronological age may not reflect the student's readiness to learn. Incorporate facets of health (stress management, nutrition and exercise) into the learning process.

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