

**Improving Student Achievement Using
Robert Marzano's
The Art and Science of Teaching:
Part One—Instructional Factors**

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**John L. Brown, Ph.D.
Association for Supervision and
Curriculum Development (ASCD)**

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Robert Marzano's *The Art and Science of Teaching* (2007)**

John L. Brown, Ph.D., Presenter

I. Key Research Conclusions from Robert Marzano (*The Art and Science of Teaching*):

- ❑ Teachers can make an enormous difference in promoting the academic success of all learners.
- ❑ Three components are necessary for effective classroom pedagogy: (a) sustained use of research-based effective instructional strategies; (b) ongoing use of effective management strategies to promote a true community of learning within the classroom; and (c) use of effective classroom curriculum design strategies.
- ❑ Students should clearly understand the purpose of what they are learning and why they are learning it.
- ❑ Students should track their own progress and assess how they are progressing toward proficiency and advanced competence relative to clearly-articulated learning goals.
- ❑ Effective teaching and learning requires that students move toward conceptual understanding and independent transfer/application of key knowledge and skills.
- ❑ Effective classrooms are collaborative partnerships and true communities of learning.

II. The Art and Science of Teaching “at a Glance”: Key Instructional Design Questions:

- ❑ Question 1: What will I do to establish and communicate learning goals, track student progress, and celebrate success?
- ❑ Question 2: What will I do to help students effectively interact with new knowledge?
- ❑ Question 3: What will I do to help students practice and deepen their understanding of new knowledge?
- ❑ Question 4: What will I do to help students generate and test hypotheses about new knowledge?
- ❑ Question 5: What will I do to engage students?

- ❑ Question 6: What will I do to establish or maintain classroom rules and procedures?
- ❑ Question 7: What will I do to recognize and acknowledge adherence and lack of adherence to classroom rules and procedures?
- ❑ Question 8: What will I do to establish and maintain effective relationships with students?
- ❑ Question 9: What will I do to communicate high expectations for all students?
- ❑ Question 10: What will I do to develop effective lessons organized into a cohesive unit?

Initial Reactions, Reflections, Questions:

I strongly agree with the following research conclusions identified in Part I:

I have questions about the following research conclusions identified in Part I:

I am especially interested in learning more about the following instructional design questions presented in Part II:

III. Research-Based Action Steps and Related Strategies Proven Effective in Promoting High Levels of Student Achievement:

A & S Design Question 1: What will I do to establish and communicate learning goals, track student progress, and celebrate success?

- ❑ For learning to be effective, clear targets in terms of information and skills must be established and understood by the learner.
- ❑ Students should be actively involved in tracking their own progress in relationship to these learning goals/targets.
- ❑ Student engagement and ownership of the learning process increases when they are given opportunities to celebrate their successes in relationship to mastery of identified learning goals.
- ❑ This design question addresses the research-based conclusion that formative assessment is a critically important way for students to acquire and integrate new knowledge and to make adjustments as they move toward conceptual understanding and independent transfer: i.e., students need ongoing feedback so that they can adjust and improve their use of knowledge, skills, and understandings in relationship to performance targets and evaluation criteria.
- ❑ Marzano emphasizes the research-based distinctions of extrinsic motivation (i.e., some tangible token or payment for success) vs. intrinsic motivation (i.e., behaviors for which there is no apparent award except the activity itself). Marzano concludes that “positive effects are reported when the measure of intrinsic motivation is students’ interest.” The more a student is intrinsically motivated, the greater the likelihood they will retain what they are learning and use it with growing levels of conceptual understanding and transfer.

Action Step 1: Make a distinction between learning goals and learning activities or assignments.

- ❑ A learning goal is a statement of what students will know or be able to do; an activity describes things students do as a means to accomplishing stated learning goals.

Action Step 2: Write a rubric or scale for each learning goal.

- ❑ Marzano recommends a maximum of 20 measurement topics per course or grade level subject.
- ❑ He suggests that students and their instructor build consensus about levels of performance for each learning goal using a scale: (a) Score 4.0: In addition to 3.0, student demonstrates in-depth inferences and applications that go beyond what was taught; (b) Score 3.0: No major errors or omissions regarding any of the information and/or processes (simple or complex) that were explicitly taught; (c) Score 2.0: No major errors or omissions regarding the simpler details and processes but major errors or omissions regarding the more complex ideas and processes; (d) Score 1.0: With help, a partial understanding of some of the simpler details and processes and some of the more complex ideas and processes; (e) Score 0.0: Even with help, no understanding or skill demonstrated.

Action Step 3: Have students identify their own learning goals.

- ❑ Ask students to identify something that interests them beyond the teacher-identified learning goals.
- ❑ When students have identified their personal goals, they should write them in a format similar to the one used by the teacher. For example: (1) When this unit is completed, I will better understand _____. (2) Students might use a simplified scale to keep track of their progress: 4=I did better than I thought I would do; 3=I accomplished my goal. 2=I didn't accomplish everything I wanted to, but I learned quite a bit. 1=I tried but didn't really learn much. 0=I didn't really try to accomplish my goal.

Action Step 4: Assess students using a formative approach.

- ❑ Instructor designs assessment items and tasks that apply to levels 2.0, 3.0, and 4.0.
- ❑ Students are given feedback (based upon their patterns of response as measured by the scale/rubric).
- ❑ Effective formative assessment ensures that students understand how they are progressing toward achieving each learning goal—and what they need to do to progress toward 3.0 and 4.0 levels of performance.

Action Step 5: Students chart their progress on each learning goal.

- ❑ Students are encouraged to self-evaluate and monitor their own progress relative to each learning goal and their related achievement scores.

Action Step 6: Recognize and celebrate growth.

- ❑ Knowledge gain is the currency of student success in a formative assessment system.
- ❑ Acknowledge students in a way that promotes their self-regulation.

Observations, Reflections, Questions:

The following action steps and related strategies seem especially promising for establishing and communicating learning goals to our students:

The following action steps and related strategies seem especially promising for improving our ability to track student progress:

The following action steps and related strategies seem especially promising for improving the way we celebrate success with our students:

A & S Design Question 2: What will I do to help students effectively interact with new knowledge?

- ❑ As students interact with new knowledge (including information and skills and procedures), they benefit from carefully constructed input experiences.
- ❑ Key design principles associated with effective “critical-input” experiences include: (1) using a variety of modalities (visual, dramatic, verbal); (2) previewing; (3) presenting information in small, “brain-compatible” chunks (i.e., not overwhelming students with too much initial information); (4) active processing using “macro-strategies” (e.g., summarizing and note-taking, non-linguistic representations, higher-order questioning, student reflection and self-regulation, and cooperative learning)

Action Step 1: Identify critical-input experiences.

- ❑ Design learning experiences that present new content (declarative or procedural) to students in such a way that they are “hooked” and engaged—and clearly understand both what they are learning and why they are learning it.
- ❑ Use a combination of modalities (visual instruction, dramatic instruction, and verbal instruction) to reinforce students’ understanding and ownership of new content.

Action Step 2: Preview the content prior to a critical-input experience.

- ❑ Help students to start thinking about new content and why they are learning it.
- ❑ Ausubel (1998) and others recommend using “advance organizers” to help students understand the purpose of learning new knowledge and how it is organized (e.g., outlines, syllabus, essential questions).
- ❑ Use cueing strategies, providing students with direct links between new content and content previously taught and learned.
- ❑ Specific previewing strategies include: (1) What Do You Think You Know? (2) Overt Linkages (3) Preview Questions (4) Brief Teacher Summaries (5) Skimming (6) Teacher-Prepared Notes.

Action Step 3: Organize students into groups to enhance the active processing of information.

- ❑ Cooperative learning allows students to experience content from multiple perspectives.
- ❑ Group interaction not only facilitates knowledge development but also creates awareness that is difficult if not impossible to achieve without interaction.
- ❑ According to Marzano, pairs and triads are most effective in processing information.
- ❑ Help students to acquire, integrate, and apply operating rules essential to group success, e.g., (1) Be willing to add your perspective to any discussion. (2) Respect the opinions of other people. (3) Make sure you understand what others have added to the conversation. Be willing to ask questions if you don’t understand something. (4) Be willing to answer questions other group members ask you about your ideas.

Action Step 4: Present new information in small chunks and ask for descriptions, discussion, and predictions (esp. using “macro-strategies”).

- ❑ The most effective teachers use “small steps” in presenting new material. Our working memory—where we process new information—is small and can handle only a few bits of information at one time—Too much swamps our working memory.

Presented by Dr. John L. Brown, Based upon Robert Marzano’s The Art and Science of Teaching (2007), Published by ASCD (Association for Supervision and Curriculum Development)

- ❑ Students need to actively process new content using such processes as describing, discussing, and making predictions.
- ❑ Part of this active process should involve “macro-strategies” designed to increase students’ abilities to (1) cumulatively review information read, (2) sequence information, (3) summarize paragraphs and issues, (4) state main ideas in as few words as possible, and (5) predict and check outcomes. (Barley et al., 2002, p. 84 [Marzano, p. 35].
- ❑ Additional macro-strategies include summarizing and note taking, esp. three-column notes: (1) running notes; (2) summaries and highlights of big ideas, terms, and questions; and (3) non-linguistic representations.
- ❑ As part of their work with macro-strategies, students should be encouraged to encode information in non-linguistic and visual form (e.g., mental images, graphic organizers, physical models, pictographs), including student-constructed mnemonic devices.
- ❑ Macro-strategies also include: (1) various forms of higher-level questioning (e.g., inferential, elaborative interrogation, predictive) and (2) student reflection (e.g., reviewing critical-input experiences and identifying points of confusion and levels of certainty).
- ❑ Marzano also reinforces the value of the following: (1) reciprocal teaching, (2) cooperative learning JIGSAWS, and (3) concept attainment.

Action Step 5: Ask questions that require students to elaborate on information.

- ❑ Throughout *The Art and Science of Teaching*, Marzano reinforces the value of higher-order questions, including: (1) general inferential questions (e.g., default questions requiring students to use their own background knowledge and (2) questions requiring students to reason logically with information presented.
- ❑ Elaborative interrogations extend initial inferential responses to include: (1) Why do you believe this to be true? and (2) Tell me why you think that is so. They can also include: (3) What are some typical characteristics or behaviors you would expect of _____ ? (4) What would you expect to happen if _____ ?

Action Step 6: Have students write out their conclusions or represent their learning non-linguistically.

- ❑ As students extend and refine their knowledge of new content, they can more deeply process new information by using one of five strategies: (1) three-column notes (running notes, summaries, visual representations); (2) graphic organizers (e.g., characteristic patterns, sequence patterns, process/cause patterns, problem/solution patterns, and generalization/supporting detail patterns); (3) dramatic enactments, (4) mnemonic devices employing imagery (e.g., symbols and substitutes, rhyming pegwords, link strategies); and (5) academic notebooks (a compilation of entries that provide partial records of instructional experiences a student had in her or his classroom for a certain period of time, Ruiz-Primo, Li, and Shavelson, 2001, P. 56 of Marzano).

Action Step 7: Have students reflect on their learning.

- ❑ At the completion of critical-input experiences, ask students to actively process information learned.
- ❑ Useful reflective questions (Cross, 1998; Ross, Hogaboam-Gray & Rolheiser, 2002, p. 57) include: (1) What were you right and wrong about? (2) How confident are you about what you have learned? (3) What did you do well during your learning experience and what could you have done better?

Observations, Reflections, Questions:

We need to use the following strategies to enhance students' critical-input experiences:

Our students might benefit if we did more with the following previewing strategies:

We should explore the following strategies for organizing students into groups to enhance their active processing of information:

The following strategies seem promising for presenting new information in small chunks and asking students for descriptions, discussion, and predictions:

We should expand our emphasis on the following elaborative questioning strategies:

Our students need to do more with using the following strategies designed to help them write their conclusions and represent their learning non-linguistically:

Our students can improve their ability to reflect on their own learning by:

A & S Design Question 3: What will I do to help students practice and deepen their understanding of new knowledge?

- ❑ Actively processing information is the beginning point of learning.
- ❑ Students should be engaged in the active construction of knowledge and understanding via: (1) schema development (accretion and tuning, i.e., gradual accumulation or addition of knowledge over time and the expression of that knowledge in more parsimonious packages) and restructuring (Piaget's accommodation, i.e., reorganizing knowledge so that it might produce new insights).
- ❑ Students deepen their understanding of procedural knowledge (i.e., skills, procedures, processes) through a process of initial modeling followed by shaping (guided practice involving rehearsal and correction of missteps and misunderstandings) and eventual internalization (i.e., automaticity, i.e., independent application and automatic conceptual transfer).
- ❑ Students deepen their understanding of declarative knowledge (i.e., information such as facts, concepts, generalizations, rules, theories, principles) through reviewing and revision via the processes of constructing meaning, organizing information mentally, and storing key information in long-term memory.
- ❑ Homework can be extremely useful in helping students to practice and deepen their understanding of new knowledge when it is designed to help students extend and refine their learning (with reasonable time requirements, clear purpose, clear alignment with identified learning goals, allowance for independent performance, and assurance that it is commented upon and used as part of the teaching-learning process when it is due).

Action Step 1: Provide students with tasks that require them to examine similarities and differences.

- ❑ Have students identify and analyze similarities and differences using such strategies as: (1) sentence stems; (2) visual organizers (e.g., Comparison Charts, Venn Diagrams, Double Bubble); (3) classification activities (e.g., classification charts and matrices); and (4) creating metaphors and analogies.

Action Step 2: Help students to identify errors in their thinking.

- ❑ Teach students to analyze and evaluate faulty logic (e.g., contradiction, accident, false cause, begging the question, evading the issue, arguing from ignorance, composition/division).
- ❑ Teach students to analyze and evaluate "attacks" (e.g., poisoning the well, arguing against the person, appealing to force).
- ❑ Teach students to identify, analyze, and evaluate the impact of weak reference (e.g., sources that reflect biases, sources that lack credibility, appealing to authority, appealing to the people, appealing to emotion).
- ❑ Teach students to identify and evaluate the impact of misinformation (e.g., confusing the facts, misapplying a concept of generalization).

Action Step 3: Provide opportunities for students to practice skills, strategies, and processes.

- ❑ Initially provide structured practice sessions spaced close together.
- ❑ Provide practice sessions that are gradually less structured and more varied.

- ❑ When appropriate, provide practice sessions that help students develop fluency (including a fairly wide array of exercises so as to expose students to different contexts in which the procedure might be executed. Additionally, the teacher should consider accuracy and speed in these practice sessions along with further shaping of the procedure).

Action Step 4: Determine the extent to which cooperative groups will be used.

- ❑ Use a variety of cooperative learning structures that allow for varied roles and both individual and group accountability.
- ❑ After individual students have worked through a practice activity, have them meet in small groups to check their work for accuracy and describe their personal approaches to the exercises.

Action Step 5: Assign purposeful homework that involves appropriate participation from home.

- ❑ Use homework for three interrelated purposes: (1) to help students deepen their knowledge, (2) to enhance students' fluency with procedural knowledge, and (3) to introduce new content.

Action Step 6: Have students systematically revise and make connections in their academic notebooks.

- ❑ Ensure that students have multiple exposures to content, allowing them to shape and sharpen their knowledge.
- ❑ Have students make new entries in their notebooks after homework has been corrected and discussed.
- ❑ Students can reexamine the entries at any point in time—to encourage review of what they have recorded, emphasizing identification of those things about which they were accurate initially and those things about which they were inaccurate initially.
- ❑ Use notebook entries to capture students' awareness and insights they may have not recorded before.
- ❑ Have students compare entries in their notebooks. Members of a review group identify what they agree on as a group, what they disagree on, and questions they still have about the content. In turn, groups can report out to the whole class, with instructor addressing common agreements, disagreements, and questions.

Observations, Reflections, Questions:

Our students might benefit if we placed greater emphasis upon the following strategies designed to help their “schema development,” ensuring that they organize and store what they are learning in cohesive ways:

Our students might benefit if we placed greater emphasis upon the following strategies designed to help them construct meaning about, organize, and store declarative knowledge:

Our students might benefit if we placed greater emphasis upon the following strategies designed to help them construct meaning about, organize, and store procedural knowledge:

Our students might benefit if we placed greater emphasis upon the following strategies related to our use of homework to enhance learning:

As we conclude our discussion of this action step, I would suggest that we follow up with more discussion of the following strategies: (1) examining similarities and differences; (2) error analysis, including faulty logic, attacks, weak references, and misinformation; (3) practicing skills, strategies, and processes; (4) cooperative learning:

A & S Design Question 4: What will I do to help students generate and test hypotheses about new knowledge?

- ❑ As students progress beyond basic levels of knowing, they should be engaged in tasks that require them to experiment with the new knowledge, i.e., generating and testing hypotheses about it.

Action Step 1: Teach students about effective support.

- ❑ Help students to understand that valid claims must be supported (grounds); the support should be explained and discussed (backing); and exceptions to the claims should be identified (qualifiers).
- ❑ Teach students to recognize and assess the impact of limits when analyzing statistical information: (1) regression toward the mean; (2) errors of conjunction; (3) keeping aware of base rates; (4) understanding the limits of extrapolation; and (5) adjusting estimates of risk to account for the cumulative nature of probabilistic events.

Action Step 2: Engage students in experimental inquiry tasks that require them to generate and test hypotheses.

- ❑ Encourage students to make a prediction based on observations and design an experiment to test that prediction—and then examine the results in light of the original prediction.

Action Step 3: Engage students in problem-solving tasks that require them to generate and test hypotheses.

- ❑ Ask students to use knowledge in a highly unusual context or a situation that involves constraints. Challenge students to determine what must be done differently given the unusual context or constraint.
- ❑ Prior to engaging in a problem-solving task, students should predict how the new context or constraint will affect the situation.
- ❑ At the conclusion of a problem-solving task, students should restate their predictions and then contrast them with what actually occurred. They should describe their conclusions with well-structured support.

Action Step 4: Engage students in decision-making tasks that require them to generate and test hypotheses.

- ❑ Decision-making tasks require students to select among equally appealing alternatives.
- ❑ Ask students to begin by identifying alternatives to be considered.
- ❑ Next, students address the criteria by which alternatives will be judged.
- ❑ With alternatives and criteria identified, students complete the decision-making process (e.g., using a decision matrix).

Action Step 5: Engage students in investigation tasks that require them to generate and test hypotheses.

- ❑ Investigation is the testing of hypotheses about past, present, or future events.
- ❑ Historical investigation involves answering questions about what really happened or why did “X” happen?

- ❑ Projective investigation involves answering questions such as: “What would happen if _____?”
- ❑ Definitional investigation involves answer questions such as: “What are the important features of _____?” or “What are the defining characteristics of _____?”

Action Step 6: Have students design their own tasks.

- ❑ As students demonstrate growing proficiency and independent understanding of new knowledge, the teacher can encourage them to design their own tasks, asking: (1) Is there a particular experiment you would like to conduct using the information we have been studying? (2) Is there a particular problem you would like to examine using the information we have been studying? (3) Is there a particular decision you would like to examine using the information we have been studying? (4) Is there a particular concept you would like to examine, past event you would like to examine, or hypothetical event you would like to examine using the information we have been studying?

Action Step 7: Consider the extent to which cooperative learning structures will be used.

- ❑ Information gathering for hypothesis generation and testing can be conducted in small groups.
- ❑ Groups can also work together to organize information, take a position, or related complex processes involved in hypothesis generation and testing.

Observations, Reflections, Questions:

The following are areas in our school and curriculum where students are already being asked to generate and test hypotheses about new knowledge:

We need to emphasize more the following strategies related to our students’ construction of effective support for claims and assertions:

We might enhance our students' performance by having them engage in experimental inquiry tasks in the following grade levels and content areas:

We might enhance our students' performance by having them engage in problem-solving tasks involving generating and testing hypotheses in the following grade levels and content areas:

We might enhance our students' performance by having them engage in decision-making tasks involving generating and testing hypotheses in the following grade levels and content areas:

We might enhance our students' performance by having them engage in investigation tasks involving generating and testing hypotheses in the following grade levels and content areas:

We might consider the following grade levels or content areas as venues for having students design their own tasks and engage in cooperative learning structures:
