FIVE PHASES TO PBL: MITA (MULTIPLE INTELLIGENCE TEACHING APPROACH) MODEL FOR REDESIGNED HIGHER EDUCATION CLASSES

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On January 24, 2000 at UCLA's Higher Education Research Institute, surveys of more than 260,000 full-time college freshmen reported boredom, drudgery and disengagement in class. This paper reports several reasons for lack of interest in higher education, and introduces a PBL model to address and help resolve this problem. The MITA (Multiple Intelligence Teaching Approach) model is applied to resolve problems of student passivity in higher education classes. We show how MITA can help more students in diverse populations to solve complex problems in authentic learning situations. In phase one, we welcome questions and dialogue to solve key problems around tables. Phase two identifies clear goals that illustrate minimum learning all students should achieve. In phase three, rubrics are created to identify specific criteria for evaluation of any real work problems and events. MITA's fourth phase requires learning and assessment tasks to relate to real world problems, students' interests and abilities and content requirements. Finally, in phase five, students and faculty reflect on knowledge gained and on the learning process itself, to accommodate more student participation; explore topics for deeper understanding; motivate disengaged students; or integrate several fields of knowledge to solve a complex problem.

INTRODUCTION: MITA RENEWAL FOR ENHANCING PBL PROCESS

To engage diverse students actively in higher education classes is to understand and interact within their unique worlds. Traditional colleges and universities tend to neglect active student involvement, and so fail to tap their rich wells of diversity in class. When lessons do not accommodate students' interests and abilities as tools to achieve, learners lose interest and feel disengaged. Because PBL involves student-centered learning, faculty and students look for guidelines that prevent chaos while stimulating ideas relevant to a given curriculum. As use of PBL expands in higher education, we consider increased student participation through use of multiple intelligence ideas about how people learn best. To investigate authentic problems, linchpin frameworks help learners to lock in ideas, as axles keep wheels from slipping off essential tracks.

MITA or multiple intelligence teaching approaches for PBL is presented here as one response to enhance vibrant learning opportunities for more university students. To illustrate, this paper provides problems related to the lesson theme, "photosynthesis," and outlines how MITA actively involves students from varied backgrounds and unique perspectives. Designed to create a challenging learning environment and to enhance learning within diverse communities in higher education, MITA offers catalytic practices through five phases. All five transcend mere teacher talk in class. Students take fuller responsibility for formulating and solving real life problems. In return, they discover inner interests and abilities that promote personal learning success. This paper identifies five distinctive phases of MITA and illustrates each phase. In addition to exploring MITA's five distinctives, the paper also identifies teaching strategies that enhance deeper understanding of any topic for diverse learners. Finally, the paper identifies key questions that typically emerge when MITA provides a reform model for higher education classes.

At their core PBL and MITA share four common features:

- They both start with a question or problem to generate curiosity and wonder for deeper understanding of complex issues
- Faculty function as facilitators rather than disseminators of facts
- Learning outcomes are holistic rather than narrowly based in any one discipline
- Assessments are authentic, performance based, and varied according to the outcomes required to solve particular problems. Students and faculty often negotiate information required to solve complex problems, and together they decide what process will achieve the best solution

Since higher educational institutions have begun to recognize that some student groups are poorly represented PBL with MITA input could increase learning opportunities through engaging more voices, and offering multiple solutions for real world problems.

Lasting reform begins with a clear vision that incites passion, purpose and planning. MITA's five implementation phases evolved from a vision for deeper inquiry and a quest for diversified approaches to identify problems and plan solutions. In phase one, students and teachers form a question to explore required content. Good questions help students to map their interior worlds and motivate learners to explore new lands. In phase two, students and teachers identify specific learning objectives. When they know exactly where they are headed students are more likely to arrive there successfully. In phase three, the class creates a rubric which identifies exactly how each assignment is assessed. Rubrics create signposts and light pathways so that students can reach new destinations. In phase four, teachers assign an assessment to encourage multiple approaches to any destination by creating choices along converging highways. In phase five, teachers and students reflect to adjust particular approaches in order to improve learning achievement. Through regular reflection we note what strategies work well in order to promote learning success for more students. Reflection is a regular commitment of a MITA lesson, much like inspecting airplanes to adjust for each new flight's success.

MITA incorporates Howard Gardner's wider family of intelligences and relies on the human brain's optimum potential for success. Students are encouraged to consider questions about photosynthesis, for instance, through engaging up to eight identified intelligences.

QUESTIONS FOR CURIOSITY AND WONDER: MITA PHASE ONE

While there is no one formula to generating good questions, we engage students in a process which encourages motivation to use unique personal strengths to solve problems. Exploring photosynthesis questions through Gardner's Eight Intelligences, MITA calls for student interests and abilities to explore significant questions. For example, consider any problem concerning photosynthesis as it relates to:

- **Musical inquiry** - a musician might be interested in questions about vocal sound distinctions, lyrics, musical compositions, instrumental work, background music, cultural distinctives
- **Bodily-kinesthetic inquiry** - a gymnast, dancer, builder or actor might be interested in questions about movement, dance, role plays, constructed mock-ups, building projects, games
- **Interpersonal inquiry** - a debater, teacher, salesperson or politician might ask questions about team work, inter-cultural projects, group problem solving, cooperative activities, pair-sharing
- **Intrapersonal inquiry** - a reflective or wise person might ask questions about journal entries, letters written, self-management, moral judgments
- **Naturalistic inquiry** - an environmentalist or anthropologist, or farmer might ask questions about crop-management, dairy farming, animal, tree or plant population, moral judgments about agricultural and animal interests
- **Logical-mathematical inquiry** - a mathematician or scientist might ask questions about data, logical sequencing of events, problem solving stages
- **Linguistic inquiry** - a poet, speaker, writer or lawyer might be interested in questions about brainstorming activities, written words, debates, speeches, media reports
- **Spatial inquiry** - an artist, sculptor or navigator might ask about visual representations, graphs, geometric designs, diagrams, artistic displays, maps, or sculpturing

Diverse questions help students to break complex problems into manageable pieces that awaken their proclivities to identify its parts without going wildly astray. Throughout the term, students identify and develop their own unique individual questions as tools to identify and solve complex problems. They are better equipped to transfer new facts to solve authentic problems when they use personal strengths to accomplish this task. In the process, MITA roundtables invite community experts to share wisdom and professors learn new concepts alongside their students. Each participant remains accountable to her learning community so that collegial relationships are forged, cooperation increased, and students' unique abilities and interests frequently celebrated.

Following a theme listed by the professor and student-created questions, learners focus their investigations and begin to integrate facts that address real life problems. Explorations on themes related to photosynthesis might include:

- Musical demonstrations for the question: If photosynthesis were a musical composition, what would it sound like or what song would it be?

- Bodily-kinesthetic demonstrations for the question: How would you create a pantomime or tableau to illustrate photosynthesis?
- Interpersonal demonstrations for the question: How does the transformative role of chloraplasts resemble an aspect of a close friend's life?
- Intrapersonal demonstrations for the question: What are your feelings about a personally transforming experience similar to photosynthesis processes?
- Naturalistic demonstrations for the question: Using words, photographs, art or other appropriate means, how would you compare and contrast photosynthesis processes among three distinctive plant families?
- Logical-mathematical demonstrations for the question: How would you outline the stages of photosynthesis using scientific principles, laws or theorem?
- Linguistic demonstrations for the question: How would photosynthesis be described in an essay written to mature students who wish to deeply understand and apply all of its key components to their own scientific works
- Spatial demonstrations for the question: How would you represent all the processes of photosynthesis in sketches, images or structures, without using words

To demonstrate a deep understanding of questions and solve problems posed, students might apply five of Gardner's eight domains to demonstrate understanding of photosynthesis. Diverse approaches to expressing knowledge about a lesson topic allow students to engage their unique abilities and interests such as art, physical activity, musical composition, scientific formulas or teamwork to promote deeper understanding of photosynthesis.

Motivation in MITA roundtables comes from the fact that whenever the brain poses meaningful questions, learners are more likely to explore and apply significant answers. Our sample lesson on photosynthesis illustrates application of the MITA possibilities in phase two to link questions with goals for solving problems. As illustrated later, problem solving includes both the flexibility of exploration and the clear vision of goals, even goals that change and develop over the course of a problem solving task. In MITA, students are taught to set and follow clear goals as a central feature for problem solving. Through discussion and practice, students gain an awareness of goals that improve their problem solving abilities.

LEARNING OBJECTIVES FOR FOCUS AND VISION: MITA PHASE TWO

In phase two of the MITA lesson on photosynthesis, students and teachers identify specific learning objectives, stated in do-able and measurable terms. Examples of clear and specific learning objectives include the following: The learner will:

- List all phases of photosynthesis processes
- Write a 500-word essay describing all phases of photosynthesis
- Create a poster comparing photosynthesis to three similar scientific processes
- Interview an expert on the relevance of photosynthesis to environmental stewardship

The key here is to list specific objectives that students are expected to meet. These objectives over time will extend into learning and assessment tasks for students. For instance, if an objective states "create an interactive written dialogue or journal with two other students," a

list of related topics might be generated as springboard ideas for students' journal entries. Requirements might include:

- Brainstorm new approaches to solving a problem
- Enlist a specialist's help for researching some aspect of the problem
- Sequence one possible response to an identified problem
- Contrast pros and cons of a controversial issue related to photosynthesis
- Raise three probing questions about a discussion, reading or project proposal on photosynthesis
- Communicate any confusion about some aspect of the material being studied
- Demonstrate the feasibility of an experiment or hypothesis
- Generate a progression of critical thinking exercises
- Draft an outline for a critical essay for a scientific journal on photosynthesis
- Outline detailed helps sought for locating specific resources on this topic

Through outcomes obtained from journal inquiries like those illustrated here, students are empowered to activate their unique proclivities. They use personal abilities and interests in order to meet real world challenges which they perceive as meaningful.

We cannot assume that students will create clear goals for their solutions simply because they identify meaningful problems. Goal setting must be taught explicitly as an integral component of problem solving. Toward this end, MITA suggests strategies and illustrates practical tasks that tether goals to content understanding at one end, and students' interests at the other. Students help to create goals in a roundtable fashion to ensure motivation and learning opportunities are included for more students in any class.

With questions posed and goals set, students help to create checklists for meeting goals and solving problems. Checklists serve not only to help students remain on task, but also as rubrics or guides to help faculty assess accurately. In MITA, the key is to provide specific criteria within rubrics given to students prior to tests and evaluations, to ensure intelligent fair assessment. You could say that rubrics help students reach forward to solve problems while reaching back to awaken and engage past knowledge and experiences.

RUBRICS FOR ACCURACY AND FAIRNESS: MITA PHASE THREE

Phase three of MITA lessons requires the class to create a rubric which shows exactly how assignments will be graded to ensure that specific objectives are attained and content understood. As students work together to identify key criteria for evaluating and grading assignments, they also create stronger learning communities. As students build team cooperation and collaborative skills together they draw on one another's strengths and assist each other in weaker areas.

Faculty and students brainstorm to identify overall purposes of photosynthesis as a starting point to create specific rubrics. Overall purposes one class concluded were to:

- Ensure that you have thought deeply about research on photosynthesis
- Enable you to apply readings to real life problems

- Prepare you to discuss reading and actively contribute to class discussion
- Reflect on your own ideas and insights regarding photosynthesis
- Assist you to incorporate theoretic ideas into practical applications
- Encourage you to make meaningful inquiries as a method of personal learning
- Indicate diverse intelligences used to draw conclusions from ideas researched

Figure 1 illustrates one assessment rubric created in a sophomore college class.

Rubric guideline for MITA assignments on photosynthesis:

A Grades on this assignment would:

- Indicate deep thought from readings
- Illustrate practical applications of ideas learned
- Result in enthusiastic contributions in class, based on questions completed
- Include your personal ideas and insights concerning each reading
- Show ideas as they might augment environmental stewardship
- Illustrate how personal inquiry assisted your own learning
- Use diverse intelligences to problem-solve in original ways

B Grades on this assignment would:

- Indicate some thought from readings
- Illustrate some applications of ideas learned
- Result in participation in class, based on questions completed
- Include your personal ideas concerning ideas read
- Identify areas as they might augment environmental stewardship
- Illustrate how research ideas assisted your own learning
- Use several intelligences to problem-solve accurately

C Grades on this assignment would:

- Indicate understanding readings
- Illustrate some connection to real life experiences
- Result in class participation
- Include your ideas and insights concerning some part of the readings
- Show some ideas as they might influence the environment
- Illustrate how learning this topic assisted you
- Use at least two intelligences to problem-solve accurately

Figure1. MITA rubric to guide student assignments and provide faculty assessment guide

Rubrics are not always the same for all students in a class. Students sometimes create their own rubrics in small groups at the beginning of an assignment so that mutually expected criteria create a contract of sorts between students and their teacher. Or classes can create one common rubric to represent general criteria expected for all assignments. This will depend on the nature of assignments and on specific criteria expected from the work.

MITA allows students to participate in their assessment process since it helps them to explore important aspects of lesson topics and provides advanced organizers. Many students enjoy using such rubrics as a checklist to guide their progress as they complete any assignment. Rubrics remove the guesswork about what is expected from students' work. In other classes, though, rubrics are created by the teacher for a particular assignment. If for example, teachers are concerned about lack of factual accuracy or writing ability in a class, they build benchmarks for evidence of accuracy and writing skills into the rubric given to students at the beginning of an assignment. So from their initial plans to finished products, students observe the emphasis on accuracy and writing skills. Whether students create rubrics or teachers distribute them, rubrics should act as a signpost for excellence and help students to light clear pathways toward new learning heights.

MULTIPLE ASSESSMENTS FOR ONE BENCHMARK: MITA PHASE FOUR

In phase four, students choose an assessment task that allows them to demonstrate multiple approaches to expressing deep understanding of their topic. How do we determine what to understand about any topic? One way might be to observe application of related ideas to solve world problems. For instance, students might identify three natural processes which use energy from the sun to convert one substance into another form, as does photosynthesis.
Assessment tasks chosen by students to demonstrate their understanding might include a mix of multiple intelligence tasks such as:

- Guided student discovery through hands-on activities
- Models that show the process
- Interviews with scientists, other teachers and parents
- Advanced organizers to show overview of new work
- Small group work, including shared inquiry and peer teaching
- Conferencing with members of the community
- Student presentations, teacher presentation, and mini-lectures
- Detailed visuals to describe each stage of photosynthesis
- Experience charts to show students' relationship to the topic
- Games and simulations created by students to teach photosynthesis
- Computer-assisted demonstrations
- Centres that students create for eight ways of expressing knowledge about the topic
- Experimentation and investigation results and records
- Performances, role-plays, and theatrical techniques
- Practical and applicational activities that use multiple intelligences to illustrate photosynthesis
- Field trips and community involvement
- Creative problem solving
- Independent studies and research projects
- Semantic mapping and related discussions
- Student-designed projects
- Portfolios that show one month's progression

- Learning logs
- Interest and ability inventories for each aspect of photosynthesis
- Building backgrounds for a story or narrating a play on the topic
- Exploratory talk and discussion
- Problem solving in groups and individually
- Transformation from one form to another
- Cooperative learning in groups of three
- Observation activities in which students observe and report back
- Audiovisuals to report learning
- Dioramas or mock-ups on the topic
- Manipulatives created to show resolutions
- Visualizations and imagery to reflect on information

When professors employ a wider variety of strategies in their teaching, students usually employ more ways of knowing any content. The above list of activities is best generated through student input, so that curiosity is raised for a topic and learners remain active in their unique constructions of knowledge. Not surprisingly, students often succeed in learning new knowledge when their unique mix of abilities and interests is engaged in the process. A sample activity for generating students' input into the lesson progression might be as simple as asking questions posed before the unit that open windows into students' prior knowledge on the topic to be learned:

- Photosynthesis to you is _____?
- How does photosynthesis influence your life?
- What key question would you like to ask a famous scientist about this topic?

Straightforward reflective questions, posed before any new topic, raise students' interests and create curiosity for new content. Questions also increase students' recognition of barriers to learning and help them to probe into new research to extend their thinking on a problem. Awareness of their own unique approaches to explore new topics learned will enable students to explore multiple intelligence ideas. Through collage constructions or posters, students show their brains' diverse expressions on a topic. According to Gardner (1991), intelligences are always expressed in the context of specific tasks, domains, and disciplines. Questions transform a classroom, where teachers talk for the most part and students mostly copy notes, into a vibrant learning community where teachers and students investigate new topics together. Reflective Inventories used with MITA are illustrated in Weber's 1999 book, "*Student Assessment that Works: A Practical Approach,*" p. 10. In the same way it introduces active learning and teaching practices, MITA invites student reflections about assessment tasks. Ford et al. (1996) described the roles of university assessors as custodians of academic standards. Academic staff are given the second role of providing students with reflective opportunities and formative feedback on their progress.

REFLECTION FOR ONGOING RENEWAL: MITA PHASE FIVE

The success of student reflection is closely linked to and catalytic to successful student learning. In the MITA approach students are assessed in a variety of ways to accommodate

their various proclivities for knowing specific curricular content. But it should be noted here that reflection within university classrooms typically involves more than faculty responses written in margins of student papers. In MITA classes, for instance, reflection involves new information about the brain's power to optimize each person's ability to perform well through reflection. After initial mistakes are revisited and students reflect on specific errors made, subsequent performances usually improve.

At this time, the MITA approach has been used successfully in several courses at McGill, University of Toronto, University of British Columbia, York University, University of Hawaii, Houghton College, and in several other countries. In each case, MITA relies upon Multiple Intelligence Theory as developed by Gardner (1983), constructivist teaching and learning approaches put forward by von Glasserfeld (1995) and Weber's practical model for addressing diversity through engaging students actively in PBL tasks. MITA, in this sense, is like a hologram with three distinctive images or functions. For instance, through multiple intelligence ideas, students engage gifts and interests; through constructivist ideas, students mine their past knowledge and experiences; through MITA ideas, students dare to dream about extended possibilities for solving problems.

Through regular contributions of graduate students, researchers and teaching faculty, MITA has continued to evolve in undergraduate and teacher education courses. The MITA approach for higher education in the US, Canada and within several international schools, including schools in South America, Mexico, and Europe, has generated several key questions that invite further consideration to ensure the model's continued development beyond current embryonic stages. Regular formative and summative feedback will ensure that MITA will both capitalize on the success of these strategies and benefit from innovative and ongoing evaluations and fine-tuning in its contribution to PBL curriculum practices.

MITA-GENERATED INQUIRIES

The following considerations require further exploration, if MITA is to contribute more widely to ongoing PBL reforms at college and university. Questions which have emerged from the work so far include inquiries about collaborative practices, integration issues and assessment policies. How does collaboration within MITA learning and teaching benefit both students and busy professors? If as Caine suggests (Pool, 1997), the brain is a social organ, the questions arises: "How can collaborative learning create scholarly communities which genuinely benefit both teachers and learners?" And how will collaborative endeavors be valued within a system which has emphasized individual competition? How can a MITA approach provide key learning and teaching opportunities within subject specific classes? Jacobs (1989) and Fogarty (1991) make a case for curricular integration based on the brain's search for connections. This integration, for the same reasoning, is supported by Sylwester (1995).

Accompanying new knowledge about brain functions are further questions about how to integrate learning at college and university. How can performance-based assessment be negotiated authentically at university? MITA supports the idea that we are intelligent in many different ways, thus making a case for departure from many traditional assessment practices. So, using MITA, how can reformed assessment approaches be integrated within existing assessment models in order to reflect new knowledge about assessment as an integral part of the learning process? These questions serve only as a starting point for further development

of MITA's role as a tool for higher education reform. We owe it to our public to further research and develop learning and assessment practices that reflect current discoveries into brain research, and further insights into inclusion for all student groups. We also share a responsibility to create practices that include interests of a multiplicity of learners and to accommodate students from intercultural backgrounds, for instance.

Implementation of MITA in existing higher education courses is not without difficulties. Given the traditional formation of higher level curriculum courses, standardized college requirements and traditional teaching approaches rewarded, some professors are understandably reluctant to attempt new methods of learning and teaching. Rather than risk new approaches which sometimes involve creating paradox or ambiguity highly valued in traditional learning roles, approaches and habits, faculty simply retain outmoded practices. Curriculum change is always difficult but is especially complex at higher level learning institutes. PBL remains relatively new. Birthed in a medical school at McMaster University, its first class graduated in 1972, and since then has spread to many medical and health-related programs schools across North America. Generally, when introduced it spread quickly, and brought successful student achievement. For instance, PBL came to the University of Missouri, School of Medicine in 1993, and currently represents more than 50% of curriculum in the first two years of the four-year program.

MITA, created in 1996, has so far indicated through evaluations with different populations around the world that students seem to prefer collaboration, content integration and criteria development for negotiated assessment. There is a concern, however, that while enthusiasm for MITA learning and teaching is high at the student level and in spite of the crisis that exists to reform higher education, that teacher-centred practices, often more rewarded within traditional universities, impede renewal. Practical concerns include a whole range of problems such as "Will scholarship money be denied to students involved in non-traditional learning environments? Will students meet requirements for more traditionally designed approaches, should they transfer or apply to graduate schools?" and, "How does using real world problems and a MITA inquiry method of learning ensure adequate developmental skills in one's entire trajectory of studies?" Until these questions are addressed, creative teaching and learning innovations may well continue to be the exception, rather than the norm.

A FINAL NOTE

MITA adds practical response to brain-compatible learning recommendations for higher education renewal. The model responds to a need to theorize about best practices on the one hand, and to extend current theory to provide practical guidelines for a higher education class, on the other. What would it look like if we had one? Beneficial learning outcomes facilitated by MITA include possibilities provided for students related to their unique past experiences, present interests and abilities, and future plans. The model guides students to validate past knowledge, engage present talents and dare future dreams within each learning enterprise. MITA relies on students' interests, abilities and past experiences to give ownership to problems presented as illustrated in the paper. The model is brain-compatible in that each of the model's five phases relate to significant facts about brain capacity, as explored by Caine and Caine (1991). The model's first phase responds to the fact that search for meaning is innate in human brains. Phase two responds to the fact that learning is enhanced by challenge and inhibited by threat. Phase three of the MITA model responds to the fact that learning is developmental. Phase four responds to the fact that each human brain is uniquely

wired, and different from other brains. Phase five of the model responds to the fact that the brain/mind is a complex dynamical system. In one way the model reaches forward to include new facts about the brain's optimum capacity to learn well as described in this paper, and transfers to curriculum tasks for higher education across disciplinary classes. In another way the MITA model reaches back to adopt a problem-based approach to learning, found in constructivist and multiple intelligence ideas.

As a bridge between separate paradigms about what it means to learn and teach well, we transform classroom climates into centres that welcome more diverse perspectives on any topic. At MITA's learning roundtables, we create places for learner participants much in the same way von Glasersfeld suggested students draw upon prior knowledge and experiences to solve authentic problems. Through relevant, thought-provoking questions, students prepare and use their minds at a learning banquet. Our recipe for specific learning outcomes shows students precisely what knowledge outcomes we expect. Rubrics identify ingredients that ensure more students' success in achieving these outcomes. Assessment tasks create interactive exchanges where all students draw water from their own, and from one another's unique wells. Finally, MITA's final phase, reflection, opens our minds and hearts to consider new ideas and strategies that inspire meaningful new insights for solving real life questions.

As illustrated in this paper, a typical MITA lesson for problem solving opens with key questions and presents real life problems. Each MITA lesson concludes with reflections that motivate ongoing and transformative investigations about the student, the lesson and the methods. One typical MITA reflection considers a lesson from a student's perspective and poses the question, "How are you smart?" This reflective inquiry differs from the question, "How smart are you?" which guided higher education in the past, and resulted predominantly in lectures, memorized text and paper-pencil tests. The former question enables MITA lessons to reach back to students' past, value present abilities, and project toward future dreams.

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