Thinking *for* Change Fieldbook

Techniques and illustrative cases for fostering critical and creative thinking and reflective practice developed by Thinking *for* Change associates in courses and other forums

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- Guidelines for Dialogue: For the Dialogue process to work, there needs to be a "container" which states the guidelines for the group. If a conscious effort is made by members of a group to follow these guidelines, a special environment will emerge which will allow the Dialogue process to take place.

- More Assessment, Less Grading: a system that helps teaching/learning interactions stay focused on the student's process of developing through the semester.

- Multiple Intelligences: The language people use to communicate ideas, particularly verb choices, are indicators of which intelligences they may prefer to use. An instructional model is presented that demonstrates how such language can be utilized to design lessons that promote thinking and understanding through eight different intelligences.

- Problem-based Learning in Science: Conversations with leading biomedical scientists are catalysts for students to conduct their own interest-based inquiries using a ten step instructional model for guiding them in the process of problem-based learning.

- Small Group Roles: that don't divert participants from participating and ensure everyone reflects on the activity.

- Suspending Judgement: How Critical and Creative Thinking can lead to more effective business communicatin and decisions.

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Thinking *for* Change

A resource center for critical and creative thinking and reflective practice (Home page)

"working to develop people's capacity to make a difference in schools, workplaces, communities, and organizations for social change"

Notes on Founding Associates

Allyn Bradford (M. Div, Yale) has a strong background in organizational and human resource development. A Congregational Minister for 12 years, he worked at Synectics Inc. for 6, and then became an Independent Consultant and Trainer. In addition, he is currently teaching at both the college and graduate levels, using a highly innovative approach which makes extensive use of group process and action learning.
Among the education centers where he has designed and conducted training are the American Management Association, the American Society of Training Directors, the Association of Field Service Managers, the Mecuri Institute in Sweden and the Accelerated Management Institute in England.
In the private sector he has designed and conducted training for such companies as Block Drug, General Foods, Avon Products, Honeywell, Digital, Stop & Shop, Johnson & Johnson, Warner Lambert, Monsanto, New England Electric, Telex, Fidelity Trust, Kodak, New England Nuclear, Burger King, FW Faxon, Becton Dickenson, Semicon, The First Years and Matritech.
In the public sector he has designed and conducted training for the Personnel Commission of the State of Idaho, the Massachusetts Rehabilitation Commission, the Office of Personnel Services of the United Nations, the Boston Neighborhood Development and Employment Agency, and Massachusetts Half-Way Houses, Inc.
Publications: He is the author of "Freedom of Information Changes the Rules" published in the Journal of Management Consulting,"Team Communications" in the Honeywell USMG Mgr. "Suspending Judgement: How to Build Teams Through Critical and Creative Thinking" in The New England Non-Profit Quarterly Journal, "Modern Art and Modern Organizations" in Context, an on-line publication and co-author of Transactional Awareness, a book published by Addison-Wesley.
Allyn teaches Leadership and Management and Effective Team Building at Wentworth Institute of Technology and Dialogue at U-Mass, Boston and the Cambridge Center for Adult Education.

Nina L. Greenwald (Ph.D., Boston College) is an educational psychologist with over 30 years of teaching experience from elementary through special (M.Ed., Special Education) and graduate education. Her specializations include: staff and curriculum development for teaching

thinking, creative problem solving, problem-based learning; gifted education and teaching to multiple intelligences.

A national teacher trainer, keynote speaker and business consultant, Nina is the author of articles on teaching thinking and problem-based learning (PBL), teaching gifted children, and teaching thinking through multiple intelligences. She has written major thinking-based curricula for The National Institute of Health, The American Medical Association, the Massachusetts Society for Medical Research, The New England Aquarium, and NOVA. In Spring 2000, a new book being released by Allyn and Bacon contains an article she has co-authored on teaching for creativity. Her current book, on problem-based learning (PBL) in science for secondary students, features interviews with leading biomedical scientists and a PBL model for guiding students in the use of this material. Beginning in Spring 2000, The Pennsylvania State Department of Education, in collaboration with The Pennsylvania Society for Biomedical Research will utilize this book as a basis for promoting instructional reforms in science education.

A faculty member in the Graduate Program of Critical and Creative Thinking at the University of Massachusetts, Boston, Nina teaches the core courses in creative thinking and critical thinking, has taught several other major courses in the program and introduced courses on humor and thinking. For ten years she was Adjunct Assistant Professor of Developmental and Educational Psychology, Boston College and in 1992, elected to the Danforth Associates of New England, an organization of selected higher education faculty distinguished for excellence in teaching.

Nina is former director of Critical and Creative Thinking programs for a Massachusetts educational collaborative, and advisor for the Museum of Science, Boston, on the development of innovative exhibits that engage visitors in thinking and problem solving. She is a founding member and two-term past president of The Massachusetts Association for Advancement of Individual Potential (MA/AIP), an advocacy organization in behalf of education for gifted students.

The service base Nina brings to T*f*C includes consultation/facilitation for multi-level problem solving in education and business (e.g., program, curriculum and professional development, marketing, interpersonal and public relations strategies that address a wide range of existing and emerging needs within school and workplace settings.

Arthur Millman (Associate Professor of Philosophy) teaches in the Philosophy Department as well as in the CCT Program. For CCT, he regularly teaches "Critical Thinking" (CCT 601) as well as "Foundations of Philosophical Thought" (Phil 501). He is in the process of developing a new course called "Seminar in Critical Thinking," a follow-up for the Critical Thinking course, which explores recent developments and controversies and relates critical and creative thinking to applied and professional ethics. Arthur's research is in both the philosophy of science and applied ethics, and he has worked to help students with the integration and application of critical and creative thinking in a wide range of areas including elementary and secondary education and business.

Peter Taylor (Assistant Professor, CCT Program) joined the Critical and Creative Thinking

(CCT) Program in the Graduate College of Education at UMass Boston in the fall of 1998 and is enjoying new challenges teaching experienced educators, other mid-career professionals, and prospective K-12 teachers. His approach in his specialty--teaching critical thinking about science--is for students to explore the two-way interaction between science and social contextualization of science as a way to enlarge their sources of ideas about what else could be or could have been in science and in society. The larger goal is to promote a vision of critical science and environmental education that extends from teaching concepts and methods of science to students to involving citizens in community-based research. Working towards this goal has involved the kind of learning, sharing, and collegial support that he hopes T*f*C will foster. Over the last six or so years his own learning as a teacher has focused on writing through the curriculum and promoting student-teacher dialogue around written work, attention to learning and writing preferences, and designing opportunities for small group, co-operative, experiential, and problem- or project-based learning. The ideas and tools he brings to facilitating participation in groups and workshops have also been expanded through connections to Re-evaluation Counselling, and, more recently, the International Society for Exploring Teaching Alternatives, the Institute for Cultural Affairs and the International Association of Facilitators, the school of Sense-Making that builds on the work of Prof. Brenda Dervin of the Department of Communication at Ohio State, and the BioQuest Curriculum Consortium. CCT's emphasis on reflective practice allows him to build on perspectives developed in the context of environmental studies (ES) and social studies of science and technology (STS). He has come to see complex ecological or environmental situations and, similarly, the social situations in which the environmental research is undertaken, as "intersecting processes" that cut across scales and involve heterogenous components. (See his contributions to a recent book he co-edited, Changing Life: Genomes, Ecologies, Bodies, Commodities.) These situations cannot be understood from an outside view; instead positions of engagement must be taken within the complexity. Knowledge production needs to be linked with planning for action and action itself in an ongoing process so that knowledge, plans, and action can be continually reassessed in response to developments--predicted and surprising alike. In this spirit, ES, STS, and critical pedagogy/reflective practice have come together for him in a project of stimulating researchers to self-consciously examine the complexity of their social situatedness so as to change the ways they address the complexity of ecological and socio-environmental situations. T*f*C is already helping him further this work.

Five Design Elements of Active Learning Experiences in Art Museums

By: Shari Tishman

What is active learning and why encourage it?

Active learning experiences are experiences that challenge people to engage with and transform information, feelings, and ideas. In the context of the art museum, the main purpose of these experiences is to help visitors construct thoughtful and meaningful understandings of works of art.

How can museum learning experiences be designed to encourage active learning?

Research in educational and cognitive psychology suggests that there are 5 design elements of learning experiences that are especially powerful from the standpoint of active learning:

1. Orientation
2. Attitude adjustment
3. Choice and personalization
4. High-level cognitive experiences
5. Reflection and connection

1. Orientation

As museum educators know well, visitors learn best when they are well-oriented to the upcoming museum experience. In

particular, they like to feel reassured that their museum visit and museum experiences will be comfortable and non-embarrassing. This may seem trivial, but it is consistent with findings in educational research. Risk-reduction, novelty-reduction, and comfort-level are important preconditions of successful learning.

Museum maps, pre-museum videos or pictures, logistical information about the upcoming museum visit, can all help with orientation. Although orienting experiences such as reading a map or a list of museum exhibits donít in and of themselves involve active learning, they are part of its foundation.

2. Attitude adjustment

Active learning often involves an intentional act of attitude adjustment that occurs either prior to the learning experience, or in its early stages. In terms of looking at art, it might involve consciously committing oneself to an attitude of openmindedness, adopting a particular cultural or personal perspective, or consciously giving oneself license to find pleasure in an artwork. Attitude adjustment is an aspect of what cognitive psychologists sometimes call "self-regulated learning," because it is a way that people to take charge of their own learning. It also reflects a "dispositional" view of cognition, put forth by several contemporary intelligence theorists, that emphasizes the cognitive contribution of attitude and mindset. For young learners, props and physical experiences can be a key resource. For example, children can put on a costume or a hat to symbolize the taking on of a certain attitude. Similarly, kinesthetic and dramatic activities can invoke attitudes, such as adopting a certain bearing as one walks into an exhibit of sacred art.

3. Choice and personalization

Active learners make choices about the direction and character of their mental effort. For instance, they make choices about what to look at, which questions to ask, which ideas to investigate, how to

organize their time, and how to organize their environment. Choice-making opportunities in museums invite visitors to reflect on their individual preferences and styles, and, in doing so, substantially strengthen motivation and intellectual investment. This can seem like an add-on or a frill, but research shows that even seemingly trivial choice-making has a strong effect on learning. For example, when students are given a choice which of two chapters in a text to read first, rather than being told which one to read first, their motivation and retention of information significantly increases. This has implications for the design of learning experiences in general, whether they occur in schools or in museums: The activity of choice-making helps create a mindset for active learning, even when the choice itself seems unimportant.

Personalization also occurs when learners are helped to make connections between their own prior knowledge and the current learning experience. Much has been made in contemporary learning theory about the importance of activating prior knowledge. It is worth noting that activating prior often happens whether we want it to or not. When confronted with a new learning experience, it is natural to look inside oneself and ask, "*What do I already know about this*?" Seeking personal connections can strengthen learning, but it can also block learning, particularly when what one "knows" involve misconceptions or biases. For example, students often know that Van Gogh was "that guy who cut off his ear." This is true, but unless students are helped to go beyond the "crazy artist" bias, they can miss much of what is wonderful in Van Goghís work. The challenge from the standpoint of active learning is to design learning experiences that help people make generative personal connections that open them to works of art, rather than connections that narrow or constrain their perceptions.

4. High-level cognitive experiences

At the heart of active learning are high-level cognitive

experiences that challenge learners to interact with works of art in ways that develop and transform their perceptions. Such experiences contrast with low-level cognitive experiences in which learners passively receive visual (or aural) information and donít probe or reach beyond their first impressions. Even something so seemingly simple as challenging yourself to invent 10 questions about a work of art while standing in front of it involves high-level thinking, because it forces you to look deeply at an artwork and seek out non-obvious relationships and puzzles.

In addition to asking questions, high-level cognitive experiences include making predictions, exploring relationships, constructing explanations, formulating and testing hypotheses, making decisions, inventing stories, solving problems, identifying and probing assumptions, and exploring new perspectives.

5. Reflection and Connection

Active learning experiences are enhanced by three kinds of reflection, all of which typically occur towards the end of a learning experience. They are (1) metacognition, which is critical self-reflection on oneís own learning process, (2) consolidative reflection, which involves reflecting on the big messages and understandings from the learning experience, and (3) active connection-making, which involves actively seeking connections between newly learned information and existing knowledge. This may sound complicated in theory, but it can be quite simple in practice. For example, the following questions touch on all three of these areas: What went well for you in this experience? What big ideas or questions do have now that they didnít have before? What connections can you make between what you just learned and other things you know about?

Adapted from a presentation given at the NAEA Museum Education Division pre-conference Seminar, March 23, 1999. Washington, D.C.

Computers in Education

Professional development for teachers (and teachers of teachers) should not simply assume that computers and other new technologies are good for education and then try to maximize the software tools you master in the time available. Instead, in learning about computers and technology in education, the thoughtful and responsive educator needs to:

A. Make educationally justified and sustainable choices of when and how to integrate technologies, and

B. Plan to learn through ongoing Professional Development how to use the technologies you decide to adopt or adapt.

In this spirit, your efforts should be addressed at becoming acquainted with specific computer-based tools, the ideas behind them, evaluating their effectiveness, and developing guidelines about **specific situations and specific ways in which specific technologies can be of significant educational benefit**. These notes emphasize the following general ways that college faculty, teachers and/or students use computers and other technologies as tools in education:

1. To extend thinking

2. To facilitate group interaction by freeing teacher from the bookkeeping part of class simulations and activities

3. To enhance communication of knowledge (a.k.a. Presentation tools)

4. To organize a personal workstation (or virtual office)

5. To occupy students' attention while the teacher focuses on other students (you should try to minimize this!)

It is important to acknowledge the context in which educators are having to develop their capacity to use technology effectively in education. Although the information potentially available to anyone with internet access is rapidly

expanding, knowledge, as the poet T. S. Eliot observed, can be lost in information. We need to provide tools for ourselves and for students that genuinely enhance learning. Among other things this meansóas always in educationóaddressing the diversity of students' intelligences, backgrounds, and interests. In this multi-faceted endeavor, teachers trying to keep up with best practices will find many unevaluated claims and unrealistic expectations, controversy, uncertainty, and rapid change. In the area of educational technology, thereforeóeven more so than in others areas of educationóteachers need to:

C. Develop Learning Communities in which we help each other to learn about learning and think about change

D. Understand and Respond to the Push for Teachers to Use Educational Technology

E. Examine the Wider Social Changes Surrounding Computer Use Technology

In summary, professional development in the area of technology in education should enable educators to better fulfill the needs of your school, community, or organization; address the information explosion; adapt to social changes; and collaborate with others to these ends.

Draft Guidelinesósuggested additions or revisions welcome

With respect to Objective A. -- Make educationally justified and sustainable choices of when and how to integrate technologies -- consider each of the following general ways (from most important to least) that computers can be used as tools in learning and teaching:

1. To extend thinking

1a. Use computers first and foremost to teach or learn things that are

difficult to teach or learn with existing (not computer-based) pedagogical approaches. E.g., the unanticipated consequences in systems of feedback where there is time delay; virtual plant and animal breeding.

1b. Make sure that learning/knowledge-construction is happening, especially when asking students to use the internet. Note that most existing websites are designed more to transmit information than to ensure learning.

1c. Model computer use on best practices to ensure learning without computers. E.g., if you have ways to get students to read actively, try to incorporate them in assignments that involve accessing information from the WWW. If you have ways to maintain the interest of girls in traditionally male-identified areas of science and technology, then use them in maintaining the interest of girls in computers.

1d. Incorporate activities that identify constraints and keep alternative ways of thinking in mind, remembering that computers, like all tools, constrain at the same time as they enable. Included in such activities is looking at the history and possible future changes that computers have brought in thinking about thinking.

1e. Without discounting the social and inter-personal dimensions of supporting learning (see guideline 1c), consider whether software and/or its use meet the principles of Universal Design for Learning (see http://www.cast.org).

2. To facilitate group interaction e.g., by freeing teacher from the calculating and bookkeeping part of class simulations and activities.

1a-c apply here as well. These guidelines are evident in software from Tom Snyder Productions, whose slogans are "teaching in the one-computer classroom," and "software for teachers who love to teach."

1d also applies, because pre-programmed software tend to inhibit exploration of pathways and questions that deviate from what the

designers anticipated.

2a. "Take away the toys." If students remain seated in front of a computeróas is the case in computer labsóthey are easily distracted from discussion and other group activities. Ways need to be found to physically separate the computer use from the group interaction.

2b. Provide an explicit structure for small group interaction and peer coaching. Training may be needed. This contibutes to the learning community.

3. To enhance communication of knowledge (a.k.a. Presentation tools)

Guidelines 1a-d also apply. E.g., Powerpoint eliminates the time it used to take to write material on a chalkboard, but chalkboards are better for making connections during class and acknowledging students' contributions.

4. To organize a personal workstation (or virtual office)

4a. Identify and address bad work habits before seeking a technical fix.

4b. Assessóeither in advance or after experimentingówhether a new use of technology will be sustainable.

4c. Take stock of the tendency towards "Continuous partial attention" (a.k.a. multi-tasking), set limits, and make unrushed time for sustaining/sustained synchronous, face-to-face human interactions.

4d. Hold yourself to high collegial standards. E.g., Do not use email or voicemail to communicate something you are avoiding doing face to face, or that you would not be prepared to do face to face.

5. To occupy students' attention while the teacher focuses on other students.

5a. When a teacher has insufficient resources to sustain teaching/learning interaction with students, the first step should be to mobilize additional human resources.

Critical Thinking Manifesto

When teaching a graduate course on Critical Thinking for the first time, I added a requirement for an end-of-semester "manifesto." The stated goal was for students "to finish the semester with a synthesis of elements from the course selected and organized so as to inspire and inform [their] efforts in extending critical thinking beyond the course." Early in the semester a number of students expressed anxiety about this requirement—"what exactly do you want"—and more generally asked for clear definitions of and procedures for critical thinking—"I was never taught this at college; I'm not a critical thinking kind of person."

Because the manifesto was a new assignment and we had no examples from previous courses, my co-instructor and I simply reassured them that that they would have something to say by the end of the semester. This advice paid off. The manifestos that resulted from students exploring their anxieties and taking increasing responsibility for their own learning were more powerful and personally reflective than even we had hoped.

For example, the student who thought she was not the "critical thinking kind" began her manifesto with perceptive advice: "If there is one basic rule to critical thinking that I, as a novice, have learned it is DON'T BE AFRAID!" She continued: "Don't be afraid to ask questions and test ideas, ponder and wonder... Don't be afraid to have a voice and use it!... Don't be afraid to consider other perspectives... Don't be afraid to utilize help..." She finished, "Above all, approach life as an explorer looking to capture all the information possible about the well known, little known and unknown and keep an open mind to what you uncover."

Another student wrote a long letter to her seven year old: "To give you a few words of advice, yes, but mostly to remind me of what I believe I should practice in order to assist you with your growth." To arrive at the self-awareness reflected in these manifestos, the students had taken risks and required support, experienced more than they were able at first to integrate, and ended up seeing themselves differently.

The Novice Sage Manifesto

Spring 1999

If there is one basic rule to critical thinking that I, as a novice, have learned it is **DON'T BE AFRAID!**

Don't be afraid to ask questions and test ideas, ponder and wonder. There are no wrong questions...but some questions are better than others. Pose questions that further thinking, give you a clear perspective, look for alternative ideas and open doors. Formulate questions that allow greater conversation and additional thinking and give reasons. Find ways to take another avenue when you think you've come to a dead end.

Don't be afraid to have a voice and use it! Listen to all the voices you have and give each of them a chance to be heard. Really hear what each voice has to offer you and the wisdom that comes from each. Give your voices the opportunity to listen to other voices and learn, explore and ask questions.

Don't be afraid to consider other perspectives and put yourself in some one else's shoes. Empathy with the world around you will create greater understanding for yourself. The more information you acquire the greater your knowledge base to forge ahead with new ideas and new thinking.

Don't be afraid to be open to the composite of ideas that surround you (if you look for them). Learning to really understand and empathize with other perspectives will give you a greater knowledge base from which to interpret your own world and formulate thoughts. Never rule anything out until you have sincerely thought it through and made decisions about it.

Don't be afraid to utilize help when you need it. Create a support system that is safe and encouraging. Share ideas in a nonjudgmental, creative and nurturing

environment. Go to the 'experts' when you get stuck.

Don't be afraid to question the experts. Ask yourself questions about the expert's paradigm or agenda, but don't become completely skeptical. Learn to balance what you doubt with what you believe or you will find yourself going nowhere fast.

Don't be afraid to gain knowledge through reading, investigating and experiencing. Be as broad as possible so as to have the advantage of knowledge of many sides.

Don't be afraid to listen to the stories being told everyday. Suspend your biases and judgments and listen to those speaking. Encourage those who are not speaking to do so. Facilitate them to find their own voices and to speak freely about their experiences and emotions. Their knowledge becomes your knowledge and all of our knowledge collectively is worth more than any of us singly.

Don't be afraid to recognize your assumptions. Know that every person comes from his or her own unique point of view and learn be cognizant of yours. Allow yourself to confront and challenge your presuppositions in a constructive manner. We can never get away from having biases but confronting them creates a more conducive enviromnent for critical thinking.

Don't be afraid to seek order through strategic thinking. Amidst all of this idea searching, open mindedness and novelty, create concrete ways to strategize, stay focused and clarify. Allow your self to have inner dialogues that reflect and evaluate.

Don't be afraid to re-conceptualize what you know to be true. Relish the epiphanies that will come to you as you begin this process of critical thinking. Tie yourself to your beliefs but allow the changes that will come to enhance your understanding rather than abandon it completely. Then again, if it makes sense to, discard old ideas and adopt new ones.

Do all of this in an atmosphere of reason and reflectiveness. Learn basic principles of logic and inference and learn to apply them to daily life. State arguments that are valid and sound and make connections to give credibility. Understand the difference between cause and correlation and always remember that correlation does not equal causality.

Without a solid and broad basis of knowledge you will be hard pressed to think critically about your environment. Allow your anxieties to explore truer meaning and then work with that new meaning to subdue the anxiety and to move to a next level of learning.

Above all, approach life as an explorer looking to capture all the information possible about the well known, little known and unknown and keep an open mind to what you uncover!

Dialogue Around Written Work

From "dialogue around written work" to "taking initiative"

When students are defining and refining the direction and questions for individual research projects, I encourage considerable intrapersonal exploration. An important part of this exploration comes through dialogue around written work. Yet for many students, exposing their work to others and dialogue are fraught; some strongly resist being weaned away from the familiar system of "produce a product and receive a grade." What follows is a report on some teacher research I undertook to illuminate the gaps between my ideals and the actual teaching-learning interactions.

This research consisted of two "questionaires," one completed by students in week 5 of a semester, the other during the last class. Both questionaires had 3 parts:

1. review of relevant material from the syllabus, course packet, and, for the second questionaire, responses to the first survey;
2. guided freewriting (not submitted; see Elbow, P. 1981. Writing with Power. New York: Oxford U. P.); and
3. formulation of five statements or questions.

Material in the syllabus and course packet described the ideal of "dialogue around written work" and the requirement for students to "revise and resubmit" in response to my written comments on the many assignments I ask them to submit during their projects. The guided freewriting was intended to allow students to acknowledge distractions but eventually to expose some thoughts about the topic that had been below the surface of their attention. The first questionaire asked for five "statements, questions, or reservations about working under the revise and resubmit system as a student this semester." The second questionaire asked for "five statements about: working under the revise and resubmit system this semester; ways the system could be developed/improved; and/or different ways to achieve comparable objectives."

Such questionnaires were not intended to result in objective summaries of

responses, or in a simple before and after comparison. Not only did the responses need to be interpreted, but they needed to be digested by me and my students and worked into our on-going teaching-learning interactions. To this end, dialogue with colleagues in a faculty seminar, students in the course, and other colleagues was pursued in spoken, email, and other forms.

Colleagues in the seminar helped process the responses to the first questionaire in the following manner. Each person read the concerns, questions, and comments of all the students about working under the revise and resubmit system. We brainstormed individually about what might characterize an improved system or experience for students and expressed these ideas on large post-its. Together we grouped related suggestions on the wall and gave the five resulting clusters themes. These were:

ACKNOWLEDGE AFFECT

NEGOTIATE POWER/STANDARDS

BE HERE NOW

DEVELOP AUTONOMY

HORIZONTAL COMMUNITY

I gave students copies of the complete brainstorming and the compilation of their original responses. We discussed what was for me most striking from the responses and brainstorming, namely, the tensions among the different clusters, e.g., between "Develop autonomy" and "Negotiate power/standards." We continued to refer back to these themes and tensions during the course. At the end of the semester, I formulated the following (sent out as an email):

> "Yesterday I asked for help finding a replacement term for autonomy and independence, both of which some students interpret as going their own way and not responding to comments of others, including those of the professor.
>
> The term my wife suggested last night was "taking initiative." That is, don't wait for the professor to tell you how to solve an expository problem, what must be read and covered in a literature review, or what was meant by some comment you don't understand. Don't put off giving your writing to the

professor and other readers or avoid talking to them because you're worried that they don't see things the same way as you do.

Interaction with others doesn't mean bowing down to their views, but taking them in and working them into your own reflective inquiry until you can convey more powerfully to them what you're about (which may or may not have changed as a result of the reflective inquiry).

Carrying this idea of "taking initiative" further, it is not a substitute for "developing autonomy" in the list above, but applies to all five aspects:

Take initiative in building horizontal relationships, in negotiating power/standards, in acknowledging that affect is involved in what you're doing and not doing (and in how others respond to that), in clearing away distractions from other sources (present & past) so you can be here now. Perhaps "developing initiative" would be better, recognizing that for each of us there's a long process towards the goal of fully taking initative.

Of course, finding the term for the goal doesn't solve the problem of teaching/supporting students to take progressively more initiative, nor of expressing it in a grading rubric. Maybe that can be the focus on my teacher-research next time. In the meantime, I have still more to digest from this semester's surveys on the revise & resubmit system."

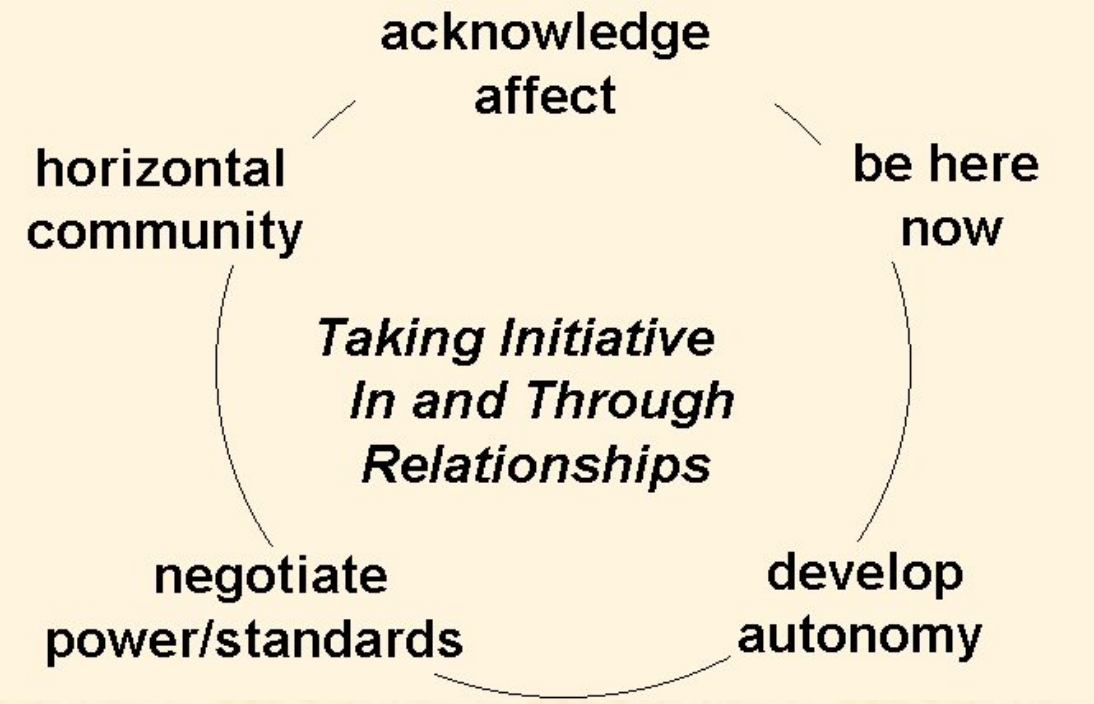
One member of the faculty seminar emailed back to say: "I like the notion of developing initiative. My only concern is the term, by itself, can seem to represent an individual attribute rather than something that's socially-situated--that people learn to do in different ways in different social contexts." Peter Elbow (UMass Amherst; see reference above) also responded with his current formulation:

"The reader is in charge; the writer is in charge. That is, the reader always gets to say how s/he responded and what s/he thinks; no fair arguing. But the writer is always in charge of what to do about that feedback--and keeping control of the paper.

These guidelines are designed for peers. They become tricky when we're talking about teacher response. Because (unfortunately? trickily?) when it

comes to teacher response, the teacher often DOES want to insist on taking some control AWAY FROM the writer and insist on certain changes. I cannot pretend I don't do this as teacher sometimes. But I think it is part of what disempowers students as writers. The main way I handle it these days is with a grading contract where, as teacher, I insist on substantive revision--but the student doesn't have to revise the way I might imply--doesn't have to agree with my reading or advice."

Reviewing the students' responses to the end of semester questionnaire and referring back to their earlier answers, I saw almost all of them "developing initiative" (see http://omega.cc.umb.edu/~ptaylor/citreport.html). I think the mandala we created captures the tensions people face in learning to take themselves seriously as lifelong learners. The teacher's conundrum is the experience will be more powerful if each cohort of students discovers this for themselves rather than have me present it to them.



Why competitive individualism needs to be replaced by teamwork

By J. Allyn Bradford

In todayís workplace project leaders need to solve intricate problems and to take ideas from an initial stage through a series of complex processes to a successful completion. This kind of work cannot be done alone. There are just too many demands, task requirements and varied sources of information required to do it without the support of others.

The following incident illustrates the limitations of competitive individualism and how it can be replaced by teamwork:

Jeannie was a highly efficient, aggressive, competitive Vice President. But her project team was in disarray. Though he had an MBA from a prestigious university on the East Coast, she knew nothing about teamwork. Her attitude was that she was the boss and others were expected others to comply. They didnít.

One Monday morning she was called into the CEOís office. "Get them to work together or youíre fired!" was what Jeannie heard. Upon hearing this, Jeannie was bright enough to find ways to completely re-orient herself and her team. The results were astonishing.

She and her team learned how to listen with empathy, build ideas together and support each other in achieving individual goals. She made an 180 degree turn from the old, command and control model to one which was interactive, supportive and cooperative. As a result, her team became number one in the company.

Though it has a happy ending, this brief account of an actual experience indicates how an obsolete model of leadership can alienate the best resource we have: the people who work cooperatively with us.

"In our present time, we must begin to celebrate collective entrepreneurship", says Robert Reich, the economist, in an article describing how the team, not the individual, is the hero. To make our corporate systems work, he says, we need "endeavors in which the whole of the effort is greater than the sum of individual contributions. We need to honor our teams more, our aggressive leaders and maverick geniuses less." (Reich 77-78)

According to Reich, the "myth of individualism" came into our culture through the popular stories of Horatio Alger in the last century. Ragged Dick, the hero of these stories, rose from a lowly station in life by dint of individual effort to earn a respectable job and the promise of a better life. The heroic individual became our cultural ideal.

The dominant corporate culture still promotes the tradition of heroic individualism in which the boss gets credit for what others have done. The strong focus we have on individual achievement in our culture discounts other people and how we need them to accomplish our goals. No wonder so many people feel depressed in the workplace today! They are, as Reich indicates, overburdened by the weight of an outworn cultural myth.

In her insightful book about contemporary organizations Margaret Wheatley says that: "Loneliness has pervaded not only our science, but whole cultures. In America we have raised individualism to its highest expression, each of us protecting our boundaries, asserting our rights, creating a culture that ëleaves the individual suspended in glorious, but terrifying isolation.í" (Wheatley 30)

We have all learned at home at school and on the job to compete as individuals for awards, attention and prizes. But the reality is that, more often than not, it is through teamwork that we get things done.

Though the myth of individualism proclaimed that the key to the great "American Dream" was to be found through individual competition, it is really not so. To be a lone individual without support, surrounded by adversaries, in the corporate culture is more like an American Nightmare.

Working Together

Team skills are quite different from those of competing individuals. They involve cooperation, mutual support and accountability to the team. These skills are needed in families for members to support and encourage each other. They are also needed at school for students to learn together. And they are needed on the job in managing projects, making informed decisions and solving intricate problems.

These skills can expand limited resources, develop new ideas and to build viable relationships An individual alone has but a limited perception of the range of possibilities in a situation. A team taps into a variety of perceptions and so widens the scope of available information, options and ideas. When various heads come

together in teamwork--which means listening, developing ideas and building on each otherís insights--not only are more ideas generated but also a mutual acceptance and trust builds among the participants through the interaction.

The quality and effectiveness of individual strategies is also greatly enhanced when team members constructively question each othersí thought process. A team can help clarify hidden factors, such as the nature of the resistance or the level of trust in a particular situation. The interaction that comes from working and thinking together in a team also helps an individual avoid making assumptions that are not reality based. Team members do this by asking questions such as: "Is the data sufficient?" "Is it accurate?" or "What is the source?"

For example, a Customer Education department I worked with in a Midwestern corporation assumed quite naturally that their teaching was up to date. That was until one member of their education team happened to overhear some customers questioning whether they were getting the right information on how to run the expensive, new equipment they had just bought. At this point questions, like those indicated above, were raised. When they checked it out, they were shocked to find that their instructions were out of date.

Consequently, with the help of upper management, they set up an interdepartmental team to keep them current in their presentations about company products consisting of representatives from engineering, marketing and production. If any of their educational materials were inaccurate or out of date, it would show up at these meetings, not in presentations to customers.

Team Learning

Of course not all teams are well organized. Nor do all team members understand

the real meaning of teamwork. A poorly organized team probably functions worse than a collection of competing individuals.

Teams need to learn certain skills as a team to function effectively. Peter Senge coined the phrase "team learning" to show how teams go through the steps in the learning process together, not just as individuals. That means they are willing to experiment and learn from their results by sharing insights, reflecting on outcomes and really listening to each other.

According to A. J. Chopra, an expert in innovative team process, "If you use peopleís heads in a good way, theyíll let you borrow their hearts." You do this, Chopra says, by really listening for what is of value in what they say. "New ideas rarely come to mind fully formed, so they are vulnerable to attack. To voice such ideas is to risk being ridiculed or thought impractical or even irresponsible. If people feel that they can take such risks with you in a way that is not only safe but productive, then working with you becomes a positive experience." (Chopra 10-12)

Teams learn to function effectively when they provide much needed guidance and support to individual members. Teams can fill the gap left by the downsizing of middle managers. As teams fill this gap, they give individuals a place to belong in the organizational system.

How Teams Fill the Gap

According to the book, Wisdom of Teams "a real team autonomously develops it own common purpose, performance goals, working approach and methods for

mutual accountability" In other words, they organize themselves. This stands in contrast to "pseudo teams" which call themselves teams but are really just competing individuals." (Katzenbach and Smith 61-64)

Team members can help each other by developing a system for supporting their individual goals. After setting their team performance goals a self-organizing team can set then cooperate in achieving their individual goals. If team members really do learn how to develop and train each other, their competence will improve and so will their morale and their performance as well.

Real teams provide the support individuals need to manage their way through the complex problems and issues that confront them. It is a lot easier to get recognition and help from the members of your team than it is to try to get the attention of a boss that is too busy to give you the time.

Becoming a "member" of a team is important to new people, in an organization too. New hires are keenly sensitive to signals that indicate how they will be treated by others. They carefully watch how others respond to what they say and do because they know that the way they get treated will largely determine their success in the organization

A well functioning team interacts directly with its members in an intermeshed set of relationships based on trust that constantly gives support and guidance to the individuals involved. When this happens, individual performance in the team exceeds what any one of them could do alone.

Professionals

The role of people at work today has shifted from a passive one in which they followed orders, to an active one in which they take informed risks. Those once known as "Workers" in the old bureaucratic system, have become "Professionals" in todayís complex workplace. That calls for the use of initiative by well informed people who can make intelligent decisions. (Hammer 1-15)

These professionals need teams to manage complex processes, to network with a variety of resources and to do creative problem solving. Teams provide the means, as well as the practice and coaching required to achieve competence in doing these things, as noted before.

Teams do not replace the traditional organizational structure. Rather they work within it to offer individuals a more dynamic process and a creative energy flow throughout the organization.

For example, the administrative personnel of a mid-sized company I worked with on the East Cost created an innovative new process in their organization system: a problem solving support group. These administrators were people who work as secretaries and receptionists. They had never before met as team. But, in the midst of a training program, they used a little creative imagination to create a new entity. Now they meet once a week with their supervisor to help each other solve the problems they have with indifferent bosses, irate clients and unreliable suppliers. They fine tune their problem solving skills as they work together on their own real issues.

Synergy

As noted above, synergy can multiply a teamís resources far beyond the limitations of the individual contributors. It happens when team members work cooperatively to share ideas, recognize the value of each member's contribution and jointly craft those ideas into viable options.

In a recent book on biology and social systems, Kevin Kelly points out how a single honey bee can do nothing by itself. But in the hive it becomes part of a highly productive operation to make honey. There occurs in this process, Kelly says, "a hive mind" consisting of many individual bees working together collectively. (Kelly 11).

Synergy multiplies the resources of team members through the interaction of a variety of contributors who see a problem from diverse perspectives. When this happens the collective brain, or what Kelly would call the "hive mind", of the team takes on an enriched and enlarged life of its own which is exciting to all involved and can produce highly innovative results.

"Our team is like a blueberry pancake" a member of a creative team on the West Coast once told me during a training session. He was speaking of how leadership operates in his team. "Itís flat", he said. "Weíre all equal. But there are the blueberries. They are the ones who get the action going." Taking initiative in setting a goal and making a commitment to bring about constructive results puts a person in a leadership role, like those "blueberries".

Peter Block, a prominent organizational consultant, describes this kind of leadership in terms of commitment to a personal vision: "The essence of political skill is building support", he says. "This takes place through dialogue and the most compelling dialogue we can have is about our vision. Leadership is keeping others

focused on our vision and this means we have to get comfortable talking about it." (Block 121)

A New Model for Leadership

A model invented and promoted by Synectics, Inc., a Cambridge consulting firm, works effectively for the kind of leadership Block describes.

The Synectics model actually requires dual leadership to make their process work: one person facilitates the process, the other is committed the to the pursuit of a vision or a goal. The team members work together to generate ideas to help the one with the goal create a viable achievement strategy to implement his or her vision.

In this model individuals readily set goals that are aligned with team and organizational objectives. Even though most new ideas are incomplete and easily destroyed, as noted previously, skillful facilitation can manage the process to create an environment that allows creativity to flourish.

This process works best if the facilitator rotates from one meeting to the next. That way fresh energy comes with each new process leader. Of course it can be quite a challenge for some team members to facilitate the process for the first time, but with help from the team they can readily acquire the needed skills, as in the previous example of the administrative personnel team.

A group of engineers in the Department of Public Works I worked with in a small town in Eastern Massachusetts exemplified how well this process can work by the

way they embraced it. They were all union, with the traditional attitudes of that group. None of them had ever conducted a meeting before. But when they learned how to work this process, their productivity soared because they realized they could solve their problems by themselves better than management could do it for them.

Conclusion

With the support of management, and by working cooperatively, effective teams can readily help individuals adapt to new situations, solve intricate problems, multiply their resources and create constructive change in the workplace. Individuals are most effective when they do not work alone but with others on a team.

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Gallery Walk

As participants in a course or workshop arrive at the first meeting, they can be grouped in twos or threes, given marker pens, asked to introduce themselves to each other, and directed to one of a number of flip chart stations. Each flip chart has a question. Participants review the answers already contributed by any previous groups and add their own, then move on around the stationa.

As the first groups returns to where they began, volunteers are asked to summarize the main themes and contrasts on one of the flip charts. They present these to the whole group, with the aid of an overhead transparency or simply as they stand by the flip chart in question. A sheet listing the questions can be distributed for participants who want to take notes.

To me this activity exemplifies the principles that people already know a lot, including knowing what they need to learn, and, if this knowledge is elicited and affirmed, they become better at learning from others. Here are the specific reasons for using the Gallery Walk given by the hosts of the workshop where I first experienced this activity:

"A useful classroom practiceó

1. Breaks the ice and introduces students who might otherwise never interact.
2. Begins the community-building process so central to cooperative learning and emphasizes the collaborative, constructed nature of knowledge.
3. Suggests to students their centrality in the course, and that their voices, ideas, and experiences are significant and valued.
4. Allows for both consensus and debate - two skills essential to knowledge-building - and facilitates discussion when the class reconvenes as a larger group.

5. Enables physical movement around the room, an important metaphor for the activity at the course's core.

6. Depending on the gallery walk questions, provides one way for the instructor to gauge prior knowledge and skills, and identify potentially significant gaps in these.

7. Depending on the gallery walk questions, provides a way to immediately introduce students to a central concept, issue or debate in the field.

8. Through reporting back, provides some measure of closure by which students can assess their own understandings. "

Here is an example of gallery walk questions. These are ones I used at the start of a year long professional development course for math and science educators to promote inquiry and problem-solving in a watershed context.

1. **What factors (big & small) are involved in maintaining healthy watersheds?**

2. **What watershed issues might translate well into math. and science teaching?**

3. **What pressures & challenges do you see facing teachers wanting to improve math. and science teaching?**

4. **What has helped you in the past make improvements successfully (+), and what has hindered you (-)?**

5. **What things would tell you that positive educational changes had happened?**

6. **What kinds of things do you hope will come from this course/ professional development experience?**

Guidance Requested

Two weeks ago Devon R, 33, a woman of color who lives with her husband in State X (in the USA) waited in the clinic for State Y of IVF Inc to have embryos placed in her uterus by Dr. Lucielle N. The embryos were produced in the clinic three days earlier by mixing Devon's eggs with her husband's sperm, a procedure called in vitro fertilization (IVF). Daisy F., a white woman from State Y, was also at the clinic for Dr. N to implant embryos produced in vitro from her eggs and her husband's sperm. In the waiting room, the husbands, Raymond R. and Ralph F. made small talk, while down the hall a new approach to their becoming fathers proceeded without them.

One week ago Dr. N's laboratory technician informed her of a slip upóthree of Rs' embryos has been placed in Daisy F's uterus along with several of the Fs' own embryos. Dr. N realized the potential seriousness of the situation and consulted her advisors on the board of IVF Inc. The board realized that they needed confidential guidanceóIVF Inc. were experts in the biomedical technique of IVF, but not in probability, law, ethics, counseling, public relations, intercultural mediation, and other issues that might need to be addressed. One of the board had heard that some professors in biology education at the State University of Z (far from States X and Y) used ill-defined problems to teach about biology in its social context. After some discrete inquiries, the IVF Inc board agreed to let me, your professor at SUZ, ask if you would produce a report for them in two weeks. At that time, the women will come to the clinic to confirm whether or not they were pregnant. Your mission, should you decide to accept it, is not to recommend to IVF Inc how to (re)solve the problem. Instead, IVF Inc want a compilation of short briefings to help the board, the couples, and other parties who may come to be involved think about the issues and what they could do.

This case has been adapted by Peter Taylor from a real-life situation presented in "Whose embryo is it anyway?" by Deb Allen, Valerie Hans, Barbara Duch, and Steve Fifield (fifield@UDel.Edu) at the University of Delaware.

See Fieldbook entry by Nina Greenwald on how to run a PBL unit.

In the Dialogue process "meaning" evolves collectively through mutual understanding and acceptance of diverse points of view.

To master the Dialogue process requires learning a variety of communication skills including a tolerance of paradox (or opposing views), the suspension of judgment and empathic listening. It also requires making the entire thought process visible, including tacit assumptions. In this process, instead of imposing our views on others, we invite others to add new dimensions to what we are thinking. We also learn to listen to the voice of the heartóour own and others--and strive to find ways to make that voice articulate.

The purpose of Dialogue is neither to agree nor to determine who is right. Rather, the purpose is to discover the richness of diverse perceptions that create a shared meaning that emerges from a group through inquiry and reflection. The meaning that evolves is dynamic as it moves through many diverse phases. If others contradict, the challenge is to learn from what they have said.

The origin of Dialogue goes back to the ancient Greeks. It is also found among preliterate Europeans and Native Americans. More recently David Bohm, the renowned physicist introduced the Dialogue process into the scientific quest for knowledge and also used it to address social problems. Bohm said that "when the roots of thought are observed, thought itself seems to change for the better." Dialogue he said, "is a stream of meaning flowing among and through and between us". Dialogue is now being used in schools, corporations and government to develop rapport, resolve conflict and build community.

Guidelines for Dialogue

1. **You don't have to agree.** Listen with the expectation of learning; that is, assume that the speaker has something new and of value to contribute to your comprehension and then stretch your mind to find out what that is.

2. **None of us has the whole truth.** Seek to comprehend the many facets of meaning that emegerge from the group. Appreciate how the diversity of perceptions enrich the quality of the dialogue. In your responses do not problem solve, argue, analyze, rescue, nit pick or give advice. Rather, try to understand how the diverse views connect with each other.

3. **Pay attention to your listening.** Listen for the :"voice of the heart" as well as the mind--yours and others'. Tune into the language, rhythms and sounds. Listen as you would to hear the themes played by various instruments in an orchestra and how they relate to each other. That's what makes the music. In Dialogue, that's what makes the collective meaning.

4. **Free yourself up from a rigid mindset.** Stand back and respond, rather than reacting automatically or defensively. Balance advocacy (making a statement) with inquiry (seeking clarifications and understanding). In advocating do not impose your opinion, rather simply offer it as such. In inquiry seek clarification and a deeper level of understanding, not the exposure of weakness.

5. **Communicate your reasoning process,** i.e. talk about your assumptions and how you arrived at what you believe. Seek out the data on which assumptions are based, your own and others. Bring tacit (hidden) assumptions to the surface of consciousness.

6. **Suspend, rather than identify with, your judgements.** Hold these away from your core self, to be witnessed or observed by yourself and made visible to others.

More Assessment, Less Grading

Assessment of a student's work need not be equated with grading it, even when a final course grade must be assigned. Let me describe the practices I have developed over several years. In each course I require a journal/workbook and set a variety of written assignments, including steps towards a final project report. For each assignment submitted I make comments on a cover page that show students their voice has been heard and reflect back to them where they were taking me. After the overall comments I make specific suggestions for how to clarify and extend the impact on readers of what was written. I usually ask students to *revise and resubmit* the assignment, sometimes more than once if I judge that continued *dialogue around written work* can still yield significant learning. This process departs from most students' expectations of "produce a product one time only and receive a grade." Moreover, most students are uncomfortable exposing their work and engaging in extended dialogue over it. They are apt to misconstrue amd resist this revise and resubmit requirement and need to be coaxed along (see fieldbook entry, "From 'dialogue around written work' to 'taking initiative'"). I have certainly won over many students, but I cannot yet say how many have been able to implement an equivalent system in theor own teaching.

Grades come in only at the end of the semester. I assign an automatic B+ for the written portion of the final grade for satisfactory completion of 80% of the assignmentsósatisfactory meaning no further revision and resubmission requested. (The 20% slack allows students to make tactical decisions around competing priorities in their work, lives, and course work.) I make clear that my goal is to work with everyone to achieve the 80% level. Students who progress steadily towards that goal during the semester usually end up producing work that meets the criteria for a higher grade (described below). Students who do not reach that goal are pro-rated from B+ down to C for 50% of assignments saisfactorily completed. (I have cross-checked the pro-rating procedure by grading individual assignments for these students and the results have always been the same.)

Not grading each assignment during the semester helps teaching/learning interactions stay focused on the student's process of developing through the semester. It keeps time and space for students and myself to appreciate and learn

from what each other is saying and thinking.

Let me spell out some additional details of this assessment and grading system to help anyone interested in adapting it to their own situation.

1. I keep copies of the comments (using carbon paper!) and assignments so I can refer back to previous versions and review the student's overall development to date.

2. Usually the written assignments count for two-thirds of the final grade, with participation and contribution to the class process making up the other third. An automatic B+ is given for the participation/process portion of the final grade if they fulfill 80% of a list about 20 participation/process items, where 13 or 14 items correspond simply to "prepared participation and attendance" at the class meetings. Another two items are "minimum of two in-office or phone conferences on your assignments and project," which ensure that students' responses to my written comments can be aired before they fester.

3. A rubric is used to determine whether a higher grade is earned. Student who show half of the qualities in the rubric earn an A-. Students who show almost all of these earn an A. Qualities in my rubric include:

- A sequence of assignments paced more or less as in syllabus, often revised thoroughly and with new thinking in response to comments.
- Project innovative, well planned and carried out with considerable initiative, and indicates that you can guide others to think critically about the use of numbers in society.
- Project report clear and well structured, with supporting references and detail, and professionally presented.
- Active, prepared participation in all classes.
- Completion of most preparatory and follow-up homework tasks
- Process Review that shows deep reflection on your

development through the semester and maps out the future directions in which you plan to develop

4. Although I do not emphasize this way of looking at the course, students can tally their grade along the way. If there are 10 written assignments, each one satisfactorily completed earns 10 points up to a maximum of 80 or a B+. Similarly, participation items fulfilled would copunt as 5 points. The student would then have to combine their points giving 2/3 weighting to writing and 1/3 to participation.

Songs the Dinosaurs Sang

A Model Lesson for Teaching Thinking and Understanding Through Multiple Intelligences

By: Nina L. Greenwald

They sensed it. Then they heard it. The sound of something big was moving toward them. As the lumbering, rhythmical stomp came closer, a heaviness filled the atmosphere. In a harmony of their own, objects trembled and vibrated in the background. Something massive was dragging things in its path as it moved, announcing its approach with sounds that had to travel the length of a great body before finally being heard. Squeals, bellows, snorts, and hurricane-force exhalations swept the surrounds. As it came into view, their hearts pounded in their ears. They stared in amazement.

An apatosaurus was standing in the middle of the room! Ten people-bodies long, it swung its crane-like neck from side to side, up and down, marking time with a reverberating stomp as it eyed a nearby plant.

Any resemblance here to a scene from *Jurassic Park* is purely coincidental, because all this takes place during a lesson I conduct that promotes understanding through musical and bodily-kinesthetic thinking. The creature taking up the middle of the room, whether conceived by students or educators, is a result of having thought about a central question in the lesson in which they are participating. This striking demonstration is one of several ways they communicate understanding, one of many successful outcomes of a specific instructional process.

The Lesson Model

Multiple Intelligence Theory (Gardner, 1983) provides a broader context for identifying and cultivating *many kinds* of gifts and talents in addition to the verbal and mathematical that have been so singularly emphasized in our culture. As Beecher (1996) reminds us, there is growing concern that educators may not be challenging today's students. There is a need for instructional models that develop students' diverse thinking potential and special strengths that lie within it.

"Songs the Dinosaurs Sang" is a model lesson. It illustrates a constructivist approach for developing and challenging students' different thinking strengths. In the contexts of musical and bodily-kinesthetic thinking, interpretation of the *sounds* ("songs" as they might be considered) and movements the dinosaurs made as they negotiated their primitive environments can be a basis for understanding how they adapted and survived.

The following lesson, designed for elementary students, includes a discussion of teaching/learning objectives and the process by which students use musical and bodily-kinesthetic thinking to construct understanding:

The Teaching/Learning Objectives

1. **Primary Thinking Contexts:**

   Musical - specifically, auditory imaging of sound, sensitivity to rhythmical patterns, vibration pitch, tone and beat

   Bodily-Kinesthetic - specifically, moving the body to represent size, gait and appearance; balancing, coordinating and synchronizing movements

2. **The Key "Understanding" Question:**

   What sounds and movements would different dinosaurs have made and what can these tell us about how they adapted and survived?

   In this lesson, *understanding* is based on two levels of problem solving. First, students need to determine what sounds and movements were made by dinosaurs. Then they need to use this information to make inferences about

adaptation and survival.

What is meant by "understanding" is a deep kind of learning that goes well beyond simply "knowing" or being able to give the definition of something. Perkins and Blythe (1994) describe it as a matter of being able to do a variety of thought-demanding things with a topic such as finding evidence and examples, interpreting information, and analogizing and representing it in new ways. In a Piagetian context, understanding is a process of using what is known as a basis for making sense out of something new. It is the impetus for assimilation and accommodation and a result of it, a robust aspect of learning that is a continuous process of expanding, reorganizing and re-framing ways of knowing. Viewed from an information-processing perspective, understanding is about forms in which knowledge can be represented or presented, such as symbols, language and pictures, and the use of knowledge to solve problems and perform cognitive tasks.

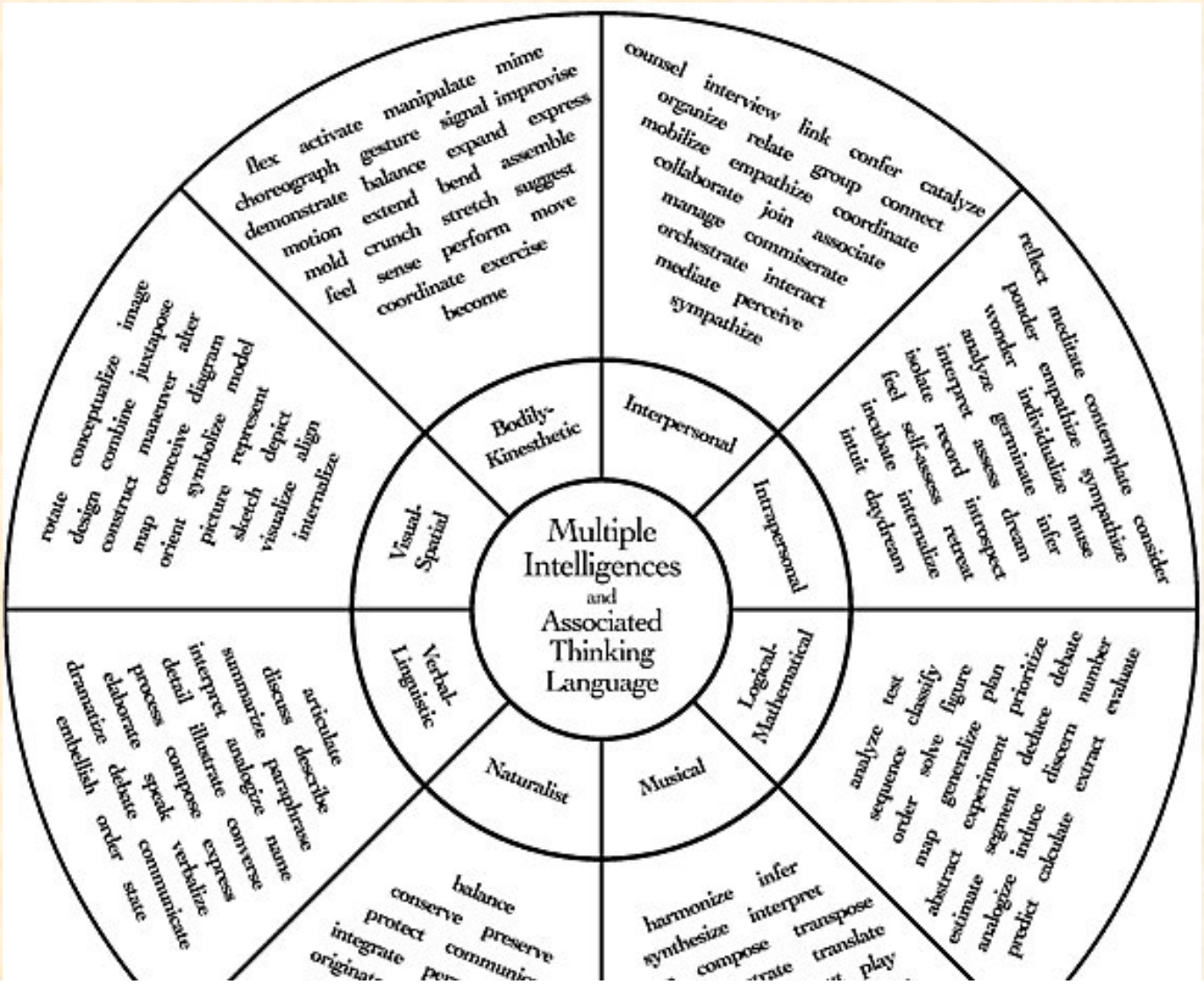
Essentially, understanding is a constructivist or meaning-making process. Caine and Caine (1997) emphasize that "constructivist" is the way the brain "learns", and that educators need to come to terms with this. They stress that the search for meaning is innate, wired into us. It is what drives us to make sense out of our experiences which occurs through discerning patterns and relationships. *The way* students learn needs to be consistent with this, not in contradiction to it, which happens when teachers view their role as information dispensers and students' roles as recipients or "vessels". According to Caine and Caine (1997) the latter is a widely held (and practiced) belief set among educators that impedes students' capacities for higher-order functioning and creative thought.

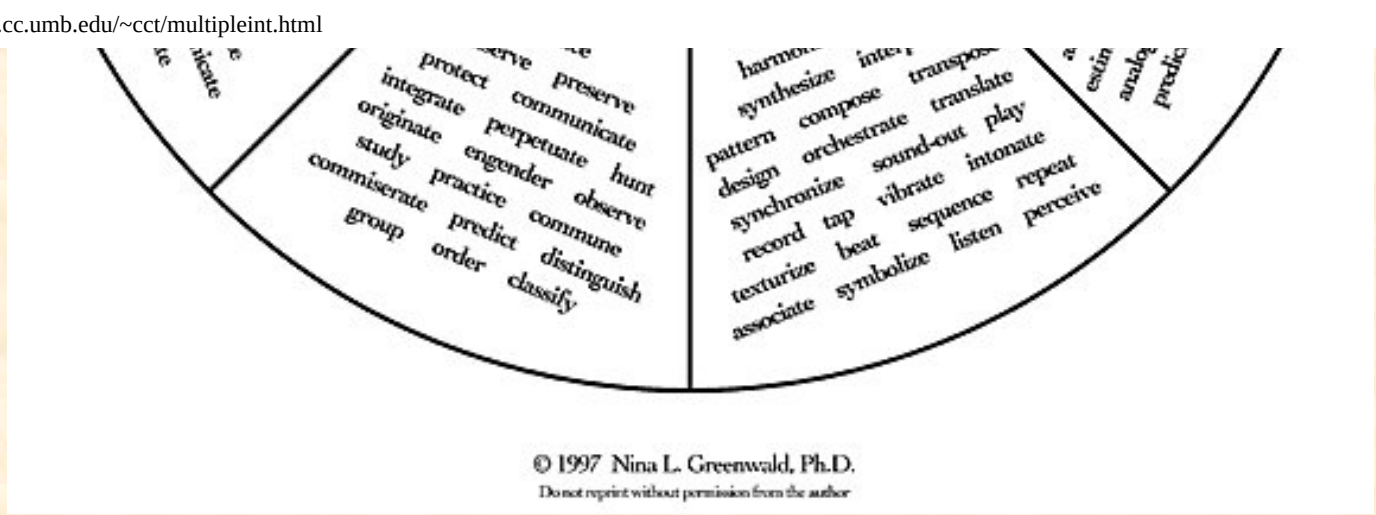
The tools for constructing understanding are critical and creative thinking. The goal of understanding is growth, depth and transfer of learning. All students, including those who are more talented, can improve their abilities to use the tools of thinking and become more adept at applying what they learn to their lives. This is best accomplished by integrating teaching thinking directly into the study of content, to which constructivist approaches naturally lend themselves.

3. **Thinking Language:**

When I place people in groups according to their thinking strengths and ask them to solve a problem, their *thinking process language* typically *reflects* that strength. For example, people with musical thinking strengths use words like "compose", "orchestrate" and "transpose" to talk about ideas. I call attention to this and emphasize the importance of being alert to this language as an indication of these different thinking strengths at work. Often, students give us clues or instructions about how they prefer to think by their choice of language. I suggest that educators listen for these and make use of them to improve learning and teaching.

Attention to language led to my developing the wheel entitled "Multiple Intelligences and Associated Thinking Language" (Figure 1). Each of these eight ways of thinking can be predisposed to or characterized by particular *kinds* of critical and creative thinking. The wheel provides examples of thinking language for each and can be the basis for developing in-depth learning experiences.





Each kind of thinking enables a particular way of understanding. Students need to make use of the unique *problem solving* engine each one is and come to understand themselves as individuals who have a variety of thinking strengths they can apply to learning. There is a huge difference between students simply *practicing* singing, movement and drawing for example, and their being challenged to *think and problem solve* through the systems that underlie these capabilities. It's the latter that addresses the real function of thinking strengths and what needs to shape learning and teaching.

The lesson model presented here incorporates key aspects of teaching thinking, beginning with establishment of the focal thinking skills through which students will construct understanding. This is consistent with Type II learning which Renzulli (1977) describes as the development of students' thinking and problem solving skills and says is essential for all students, including the gifted and talented.

For this lesson, the following thinking skills are drawn from the musical and bodily-kinesthetic sections of the wheel:

associatephysical characteristics of a dinosaur with sounds and movements

interpretthe meaning of a dinosaur's sounds and movements for adaptation and survival

compose a story about dinosaur adaptation and survival based on interpretations of sound and movement

perform movements and behaviors of a dinosaur through presentation of

a "soundscape"

4. **Multiple Ways to Demonstrate Understanding**

Students demonstrate understanding on several levels: through the creation and presentation of a "dinosaur soundscape" that is a result of problem solving through musical and bodily-kinesthetic thinking; through examination of the thinking processes they used to develop their soundscape (metacognition); through discussion of ways to apply (transfer) this thinking to novel situations; and by creating concept maps (webs) that show key themes and related ideas about dinosaur adaptation and survival.

The Process

The lesson begins with a discussion of a *wide range* of characteristics and skills associated with musical and bodily-kinesthetic thinking. Cultivating this broader vision helps students to recognize aspects of these strengths in themselves, as distinguished from tendencies to think of them in narrow or stereotypic ways, or believing they simply do not possess them. For example, appreciating music, the ability to hear music without actually being in its presence, and singing in the shower are all aspects of musical thinking. Playing charades, model-building, and making "angels in the snow" are all related to bodily-kinesthetic thinking strengths. I ask students for examples of their own musical and bodily-kinesthetic strengths, emphasizing the nuances, and that *everyone* has *degrees* of these strengths and is capable of developing them further.

Next, students practice some musical and bodily-kinesthetic thinking. For example, I might ask them to imagine and imitate certain sounds, and use their bodies to demonstrate size, weight and length. After these "warm-ups", this question is presented to them:

What sounds and movements would different dinosaurs have made, and what could these tell us about how they adapted and survived?

Now students are placed in groups and given anatomical drawings (or pictures) of a particular dinosaur or dinosaur group, plus a bag of assorted

objects (junk) for creating sounds. I ask them to think about what *kinds* of *sounds and movements* they would ***associate*** with this dinosaur and then, based on their conclusions, to ***compose*** and ***perform*** a story about how it adapted and survived. As an example of how physical characteristics can be suggested through sound and movement, I ask students to recall the "T-Rex" scene from the movie *Jurassic Park* -- the sounds of muffled thunder and accompanying vibrations in the ground and puddles of water, suggesting the approach of something huge and powerful!

This sets the stage to clarify their thinking challenge. First, each group will determine how their dinosaur adapted and survived based on sounds and movements they associate with the pictures. Next, they will compose and perform a "soundscape" to demonstrate this using their voices and bodies, the junk, and other things in the room. Tape-recorded sounds of the rain forest playing in the background will help evoke a "dinosaur ambiance".

To reinforce the thinking emphases, the following ***guiding questions*** are written on the board. The highlighted thinking processes are defined and students are asked to give examples of how they have used them:

ï What sounds do you ***associate*** with physical characteristics of your dinosaur and why?

ï How would you ***interpret*** the meaning these sounds? What do these sounds tell you about this dinosaur?

ï Based on your interpretations, what is a story you can ***compose*** about how this dinosaur adapted and survived?

ï How will you ***perform*** your story?

We also talk about how these thinking processes are part of musical and bodily-kinesthetic intelligences: for example, how music can be *associated* with ideas, such as peacefulness, action and mystery; how music is a way of *interpreting or explaining ideas*; how people *compose* tunes to express feelings and ideas; kinds of compositions that have been created by well-known composers like Mozart, John Williams, Carly Simon; how actors, dancers and gymnasts use their bodies to *perform* ideas. This discussion invites students to contribute

what they know and to elaborate on one another's ideas.

As students proceed with their thinking task, teachers have an important role to play. Through modeling and coaching, they help students assume the role of problem solver, then require them to take on the responsibility of using these skills on their own. For example, posing questions like these help students shape their thinking strategies: What are you thinking about? What's another question you might ask about this? What hunches do you have about this? What could help you understand this better? Modeling is also a primary way teachers foster a *culture or climate of thinking* in their classrooms. All students can grow intellectually in this climate. Gifted and talented students need and are especially responsive in such a climate.

After each soundscape is presented students think about this question: **based on this presentation, what do you think you know about this dinosaur?** The guiding questions serve as a focus for discussion and students' ideas are recorded on chart paper. Again, the role of the teacher is as facilitator, guide or metacognitive coach, in contrast to "information dispenser" in charge of what students learn. The teacher continuously raises questions that challenge students' thinking and shape *self-directed* learning so that they can acquire appropriate information and develop ideas on their own. Questions like "What do you **K**now or think you know?", "What do you **N**eed to know?", and "How can you **F**ind out?" help students sort through potential interpretations and structure understanding. To help them re-evaluate their thinking processes, students can keep an ongoing "K-N-F" chart which they can continuously revisit.

Following these discussions, I ask ***metacognitive and transfer questions***. These questions re-direct students back to the focal thinking skills to reflect on how they used them and can apply them to new situations. For example:

> (M) What kinds of thinking helped you understand the sounds your dinosaur would have made? (making associations)
>
> (M) How did these sounds help you understand how your dinosaur survived? (making interpretations)
>
> (M)In what other ways could you present your dinosaur story?

(perform)

(T) How can music help you learn about other things you are studying?

(T) What other things, what else might be better understood through sound?

Based on their own thinking plus ideas from the discussions, each group creates a concept map or web of ideas about dinosaur adaptation and survival. The maps clarify key themes that have emerged for students and also help teachers to identify broad themes that can be studied across curriculum: for example, "relationships between characteristics of living things, adaptation and survival", "the importance of maintaining a sound ecosystem for the preservation of contemporary species" or "unsolved mysteries in our world".

In the thinking classroom, any activity is a potential bridge for further exploration. For gifted students, who need opportunities for extended learning, creating a concept map can be a catalyst for individual and small group investigation, or what Renzulli (1977) defines as Type III learning. The student becomes a self-directed, first-hand inquirer and pursues an area of interest in depth, from problem definition, to solution generation, to the presentation of findings to real audiences. The process is constructivist, the role of the teacher facilitative, about which Renzulli (1982) says: "The students' teachers also become experts, but ***not in the content*** that their students are studying. ***They become expert facilitators*** and learn how to ***guide*** students through the process of a Type III study. It is a challenging role to play and requires a transition from being 'sage on the stage' to 'guide on the side'."

Hats off to the music-makers!

At the heart of the model lesson presented here is an instructional strategy for turning on eight different "engines of the mind" in students. As the model illustrates, the *language* of critical and creative thinking associated with each of these thinking systems can be integrated into lessons and become the key vehicles through which students construct understanding. As the "music-makers" will attest, (the many

students, teachers, and their students, who have participated in this model lesson) a result is learning that goes well beyond simply "knowing".

Along with gaining a better grasp of how different thinking perspectives work to solve problems, people realize that within each there is rich potential for possessing many kinds of gifts and talents. For this reason especially, our concept of what it means to be gifted and talented needs to be open and continuously expanding. Our hope must also be that *all* students, when given opportunities to think through their many intelligences, will learn far more than we yet know how to teach.

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Ill-Defined Encounters Are the Right Kind!

(guiding problem-based learning in science classrooms)

The best way for students to learn science is to *experience* problems that challenge science, and the thought, habits of mind and actions associated with trying to solve them. This implies opportunities for authentic, inquiry-based learning. Problem-based learning (PBL) is a powerful vehicle for this, in which a real-world problem becomes a context for students to investigate, in depth, what they need to know and want to know (Checkly, 1997). It is a robust, constructivist process, shaped and directed primarily by the student, with the instructor as metacognitive coach.

PBL is not just another iteration of what many science educators already use in their classrooms. To be truly "problem-based", Gallagher (1995) emphasizes, *all three* of these key features must be present: *initiating* learning with a problem, exclusive use of *ill-defined* problems and *teacher as metacognitive coach.*

The nature of ill-defined problems

At the heart of true PBL is an ill-defined problem, an unresolved "murky" situation. This is presented to small groups of students who have been given a stakeholder role which is the "hook", says Gallagher (1995), that propels and invest students in the ill-defined situation.

To better understand what is meant by an *ill-defined* problem it is helpful to examine what is meant by a problem. Although problems can differ in many ways, they all can be considered as having three characteristics. First, there is an initial or present state in which we begin. Second, there is a goal state we wish to achieve. Finally, there is some set of actions or operations needed to get from the initial

state to the goal state.

While all problems have these components, they often differ in how well-defined they are. Problems can vary on a continuum from relatively well-defined to ill-defined along each of these components. In PBL, the problem is *ill-defined* with respect to *all three* characteristics, which is typically how problems present in science (and life!). The "problem" is unclear and raises questions about what is known, needs to be known and how to find out. This opens the way for finding *many* problem possibilities, the nature of which are influenced by one's vantage point and experience.

In typical classroom problem solving approaches, students encounter problems *after all information is taught,* giving the misleading impression that problems only arise in circumstances where all information needed for solution building is available. In PBL, Gallagher (1995) emphasizes, the order of learning is *inverted* to reflect real life learning and problem solving. Learning begins *after* students are confronted with an ill-defined problem.

Science, learning, and problem-based learning

The theme of science education reform is to understand science as ways of thinking and doing as well as bodies of knowledge. Emphases are thinking and problem solving and habits of mind that promote exploration and discovery such as curiosity, questioning, openness to ideas, learning from errors and persistence. Learning needs to occur in the context of real investigation through inquiry and reasoning, which means teaching for understanding not memorization of facts (AAAS, 1989; NSTA, 1992).

Learning specialists concur. Wiggins and McTighe (1998) advise that learning is best, much more takes place, when the *learner* is the one who looks deeper to create meaning and develop understanding. Understanding, Perkins and Blythe (1994) explain, is deep learning that goes well beyond simply "knowing", such as being able to do thought-demanding things with a topic like finding evidence and interpreting information in new ways. Wiggins and McTighe (1998) stress that students need to "uncover" content for meaning, to question and verify ideas if

they are to be understood, and Caine and Caine (1997) emphasize that the mind needs to be understood as purposive, self-reflective, creative, and requiring freedom to create meaning. For these reasons, advise Wiggins and McTighe (1998), a priority in teaching for understanding is shaping content in ways that engage students in making sense out of it through inquiry and application.

In PBL there is a shift in roles for students and teachers. The student, not the teacher, takes primary responsibility for *what* is learned and *how*. The teacher is "guide on the side" or metacognitive coach in contrast to "sage on the stage", raising questions that challenge students' thinking and help shape self-directed learning so that the search for meaning becomes a personal construction of the learner. Understanding occurs through collaborative self-directed, authentic learning, characterized by problem-finding, problem solving, reiteration and self-evaluation. This, says Barrows (1997), is what distinguishes *true* PBL from "same-name" methods that use a problem of *any sort* somewhere in the teaching/learning sequence.

In PBL, Gallagher (1995) explains, students encounter a problem as it occurs in the real world, outside the classroom. There is insufficient information to develop a solution, no single right answer or strategy, and a need to redefine the problem as new information is gathered. Ultimately, students can't be sure of their solutions because information will still be missing. This also characterizes science, which one scientist I interviewed describes as *"a process of thinking about problems then designing means of approaching them... **not necessarily to solve the problem you outlined**, but to make an inroad or a start, asking what further approaches can I use to get a handle on this problem?"*

Connecting students with scientists

An exciting way to launch students into the process of science is to link them with practicing scientists and their work. This led to my interviewing six prominent biomedical scientists, during which each was asked to describe a difficult, especially challenging research problem. They were also asked to discuss their concept of science and important thinking behaviors for scientists. Students need to learn, first hand, about this "private side" of science, the essential habits of mind

and thought processes that promote exploration and discovery.

These conversations by four men and two women, physicians and Ph.D.s, are intended as catalysts for students to conduct their own interest-based inquiries through a model I developed for problem-based learning. Each scientist discusses perplexing aspects of their particular research which may be on cancer, organ transplantation, heart disease, AIDS, the treatment of wounds and burns, substance abuse, or human response to environmental toxins. Embedded in these talks are many possible problems students can unearth, then choose from to investigate using the *"Steps in PBL"* model. The model follows, with examples of thinking by a group of high school biology students who applied it to one of the conversations.

Guiding students in PBL

This ten-step approach (Figure 1) is based on the original medical school model (Barrows, 1986). It involves students in constructing understanding through critical and creative thinking and promotes collaboration and autonomy in learning:

1. ***Encounter an ill-defined problem:*** Students can encounter real-life, ill-defined problems in many compelling contexts. As stakeholders in a situation they might be environmentalists investigating a pollution problem or scientists confronting a puzzling research finding. In the following scenario, biology students are a special interest group attending the presentation, **"*Programmed to Die*"** (text from one of the scientist interviews):

   Picture ID's identify you as invited guests to a cancer research presentation in the hospital conference room. Your organization, Science in the Public Interest , does more than report medical research findings to the public. It questions them and actively explores further meaning for public consideration. You listen carefully as "Programmed to Die" begins...

   Metastasis... cells dividing out of control. **That's what kills us.** Finding a cure for cancer is a difficult problem because all cancers aren't alike. I'll make the analogy to infectious diseases like HIV and influenza. Their

treatment and how they cause disease differs. Colon cancer behaves different than melanoma, which behaves different than prostate cancer. While some things are similar, like cells dividing out of control, they behave differently. Melanoma likes to go from the skin to the brain and liver, not to bone or lung. Colon cancer goes to the liver, breast cancer to lung, bone and brain. It's like these cancers have zip codes. There's selectivity as to where they go and set up shop. So it's been ***a*** cure versus ***cures***. There's a 95% cure rate for testicular cancers. Hodgkins disease once had a bad prognosis, now 90% survive. But this doesn't apply to breast cancer or other important diseases.

We've been studying metastasis by looking at genes that are expressed in a tumor cell versus its metastatic components - to understand the molecular differences between the original tumor and one that went to the liver. En route, we discovered a new gene that keeps a melanocyte in its normal state and tends to prevent its progression to melanoma. As melanoma develops, this gene is no longer "expressed". In science, you often pursue directions that are different from your primary focus and wind up discovering things that might be related, like a gene that's important in the fruit fly or worm that's also found in humans. In the worm, we discovered something we call "programmed cell death", which is an exploding area of cancer research.

In the development of the worm there are certain cells. When cells divide in twos, one gets discarded and dies. It's meant to die. If not, it's a problem. If a cell's DNA is damaged and isn't repaired it's *supposed to* die. If not, it leads to cancer. Not all cells produced are meant to continue to be produced. Normally, you divide the two. Each one should have a function. We did experiments to interfere with that and the animal's whole system became abnormal. If cell death is important in a worm, what about in humans when cells that should die don't? Normally, when a cell is damaged, there's a mechanism for repairing it. or getting rid of it. A cell dying by this mechanism looks *different* from one dying from other causes.

A connection between AIDS and cancer is the immune system, "the national guard that protects our shores". Cancer cells are probably being produced all the time, but there's a lot to suggest that the appropriate immune cells get rid of them. When the immune system is suppressed and the national guard troops have gone from thousands to ten, invaders come ashore and set up

shop. There aren't the natural killer cells and macrophages that get rid of cancer cells, resulting in malignant tumors that metastasize. The immune system is important but not the whole story in understanding metastasis.

In the future, we'll be better able to determine the behavior of tumors through molecular testing. A cancer cell grows out of control. Through gene therapy, which is being tried now, we'll try to put those controls back in by reintroducing genes that either were lost or non-functional to regain behavior. Meanwhile we're searching for other solutions.

2. ***Ask IPF questions*:** As *stakeholders*, biology students begin to examine this information by asking, "What's **I**nteresting here?" "What's **P**uzzling, curious, problematic?" "What's important to **F**ind out?" (Figure 2)

3. ***Pursue problem-finding:*** Embedded in *"Programmed to Die"* are many problem possibilities students can unearth by probing the information more deeply for meaning, which IPF questioning initiates. To promote this, teachers can suggest varied problem finding strategies, for example:
    - draw a problem; even crude drawings can convey a lot of information
    - ask a series of "why" questions to reveal possible causes of something
    - create a flow map to sequentially link aspects of a situation
    - uncover possible false assumptions about information
    - minify or magnify a situation to understand its essence or scope

4. ***Map problem finding; prioritize a problem:*** Next, students organize problem finding results to show patterns and relationships among ideas. Again, teachers guide but do not make decisions for students. This process needs to be *a construct of the learner* as illustrated by the cluster map (Figure 3) created by the biology group. Their map helps them identify "lifestyle factors and cancer" as a problem to investigate.

5. ***Investigate the problem:*** To help the group strategize, teachers might ask: "How will you organize your overall plan?" "What responsibilities will each group member have?" Inquiry guiding questions might be, "Since you have decided to interview people, *who* will you interview?" "How will you find them?" "What information is needed?" "How will you record this?"

6. ***Analyze results:*** Responsibility for analyzing information again lies with students. Guiding questions for the biology group might include: "Would it be useful to compare people you interview for similarities or differences?" "How would you show this?" "What's more important to find out: how people are similar or how they differ?" In the process, teachers might also introduce students to basic data analysis methods.

7. ***Reiterate learning:*** Reiteration is a distinguishing feature of PBL in which students present what they have learned *to each other* (Barrows, 1997). They actively apply learning *back to the problem* to gain new understanding by re-entering it from the beginning, critiquing and refining their original problem statement, thinking strategies, sources and goals. They relate what they learned to understanding other problems and try to extract concepts that have broad applicability. Metacognitive guiding questions might be, "How do your results help you understand the problem you investigated? "Should you investigate this again, what would you do differently and why?"

8. ***Generate solutions and recommendations:*** Students need to revisit outcomes of the previous two steps to determine what direction they take. For example, biology students' data might point to prevention/intervention. Teachers can suggest idea-generating strategies such as:
    - ask "how?" each time a solution is proposed to clarify possible strategies and implementation steps
    - propose improvements by substituting, combining, adapting or modifying ideas (Eberle, 1971)
    - use a metaphor to highlight aspects of something that might not ordinarily be perceived

9. ***Communicate the Results:*** As stakeholders in a real-world situation, students need to communicate what they have learned. For example, biology students consider creating a public information message emphasizing the relationship between certain lifestyle factors and cancer. Guiding questions might be: "What general themes were discovered in your research?" "What conclusions can be reached?" "Who gains from this and how?

10. ***Conduct self-assessment:*** Assessing one's performance progress is an important life skill that PBL develops. Students assess their own problem

finding, problem solving, knowledge acquisition, self-directed and collaborative learning skills and share this with their group. Authentic assessment methods include journal writing, lab notebooks, self-rating scales, peer interviews, and conferences with teachers for which students develop discussion criteria. Teachers also provide their own assessments based on students' application of the 10 step model.

Encounters of the right kind

In science, questions answered lead to more questions. Understanding occurs in fits and starts, characterized by derailments, blind alleys and shifts in focus. Problems change as they are being solved, resulting in constant changing relationships between problems and solutions.

From the outset, PBL engages students in these important learning experiences. As illustrated, scientists' conversations about the challenges of their research is grist for launching students into pursuits of their own that replicate the process of science. Within the larger curriculum, this can be the basis for structuring a major piece of learning agenda over an extended period of time, or for special study to enhance a part of curriculum.

PBL gives students opportunities to be self-directed while maintaining cohesion in the classroom. It is effective with students of varying abilities because *students* are the ones who choose the problems and methods of study based on development level and interests. Above all, Gallagher (1995) emphasizes, PBL is a curricular and instructional approach which successfully resolves the seemingly contradictory demands of science education reform in a way that is true to the discipline of science, its process, and the larger goals of educating an independent reasoning citizenry.

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Small Group Roles

There are many ways for teachers to assign roles when they ask students to collaborate in small groups. The virtues of the system below are that the roles don't divert participants from participating in the activity and everyone, not only a reporter, gets to reflect and synthesize what happened.

Roles: *Assume roles according to alphabetical order of last names.*

1. Facilitator of Participation
2. Orienter for the Activity
3. Timer
4. Reporter

Phases of Small Group Activity:

Phase I. Getting Together to Begin Activity

1. **Facilitator of Participation**
   - Choose a space and set up chairs so everyone can face each other and hear comfortably.
   - Bring everyone into the group, not off to one side or facing the group on an angle.
   - Make sure everyone in the group is introduced to others they don't

know.

2. **Orienter for the Activity**
    - Give your version of the activity and goals, invite others to revise this, and check that everyone knows what's going on and why. If it's not clear after that, call for instructor's attention.
    - [Teacher inserts here a description of the Activity, specifying time allocated for each phase.]

Phase II. Activity

1. **Facilitator (cont.)**
    - Insure everyone gets a chance to speak.
    - Bring people back into the group when they have withdrawn (on their own or in a 1on1 discussion).
    - Ask for time out for a check-in when withdrawal recurs/persists.
    - Take notes to aid synthesis and reflection by yourself and for the group.

2. **Orienter (cont.)**
    - Call for instructor's attention when group needs more guidance about where they are going.
    - Take notes to aid synthesis and reflection by yourself and for the group.

3. **Timer**
    - Watch time, prompting group to move onto next task or prompting facilitator to make space for people who haven't had time to speak.
    - Insure that clear time is left at the end for synthesis and reflection.
    - Take notes to aid synthesis and reflection by yourself and for the group.

4. **Reporter**
    - Take notes to aid synthesis and reflection by yourself and for the group.

Phase III. Synthesis and Reflection

1. **Facilitator**
   - Check in quietly with anyone who has stalled in their synthesis and note-making.
   - Digest the content and process of the discussion and make notes on your own conclusions and open questions.

2. **Orienter**
   - Digest the content and process of the discussion and make notes on your own conclusions and open questions.

3. **Timer**
   - Digest the content and process of the discussion and make notes on your own conclusions and open questions.

4. **Reporter**
   - Ask everyone to mention one highlight, appreciation, or issue needing further work from the content or the process of the discussion. Make notes.
   - Prepare to report back, either spoken to the class as a whole or given to instructor.

Phase IV. Report

4. Reporter

- gives report, either spoken to the class as a whole or in written form for the instructor to disseminate.

How to Build Effective Teams through Critical and Creative Thinking

by J. Allyn Bradford

Just beneath the surface of polite behavior in most meetings there lurks a primitive---even savage---struggle for turf and power. Emerging concepts get lost in hidden, underground conflicts. Good ideas are attacked and destroyed even before they are understood. Useful thoughts are prematurely cut off by interruptions unconnected to previous statements. Most of what happens in meetings is a colossal waste of time and energy.

One exasperated manager told me recently that in most of the meetings she attends, 95% of the time is caught up in jockeying for power and other such activities unrelated to the purpose of the meeting. "All this stuff just gets in the way," she said. Another told me, "So often we spend more than half our meeting time just wandering. It's a wonder anything ever gets done !"

When people learn how to think intelligently together, a transformation takes place. Instead of wasting time in subversive power struggles, they begin to interact with mutual respect and stay focused on the purpose of the meeting.

This issue is of sufficient importance in the business world that several major colleges and universities are now gearing up to offer programs in Critical and Creative Thinking specifically tailored for the business community. UMass Boston has even created a special committee to bring the resources of their Critical and

Creative Thinking Graduate Program to the greater Boston business community.

Critical and Creative Thinking

What is Critical and Creative Thinking ? According to Robert Ennis, a leading authority on the subject, "Critical thinking is reasonable reflective thinking that is focused on deciding what to believe or do" (Ennis p.10). Richard Paul, another prominent leader in this field, says, "The elements of thought are clarification of purpose, use of probing questions, establishing a frame of reference (or point of view), verification of assumptions, stating implications and drawing inferences or conclusions" (Paul pp. 208-210). As for creative thinking, George Prince, one of the masters of this art, says that to have creativity take place we need to "be optimistic, assume valuable implications, protect vulnerable beginnings, give early support, share the risk, deal as an equal, temporarily suspend disbelief, share the burden of proof, focus on what is going for an idea and assume it can be done" (Prince and Prince p.12). Creative thinking is really an integral part of critical thinking and vice versa. They are like two sides of the same coin.

When people actively apply critical thinking concepts and constructively use creative behaviors, they develop more ideas, make fewer mistakes and reach better decisions. But when people act on beliefs they have not carefully thought through, they will shoot down ideas even before they are understood, or take action based on faulty assumptions. The result is often a business disaster.

We have all seen the business located in the wrong spot, the product nobody wants, the specially designed commercial real estate now empty and up for sale and the results of other bad decisions which came from lack of careful thought. When we see them we wonder, "How could anyone make such a foolish mistake ?" The solution to problems of this kind can be found in teamwork which allows

for plenty of open and honest give and take, along with imaginative and free interplay of ideas, plus challenging responses which sharpen insights, clarify assumptions and test beliefs.

Teams Can Learn to Think

Teams, as well as individuals, can learn how to think more effectively. Of course, changes or improvements in the way teams think do not happen overnight. But with sufficient coaching and practice, teams can gradually change as they learn to apply really sound thinking concepts in meetings and in everyday situations. We have all seen how this can happen in team sports, as a team goes from the awkwardness of early training to high performance later in the season.

When such a transformation occurs in a business team, one realizes that good thinking requires good listening. That means not just listening for the flaw or weakness in another person's idea, but listening with empathy to understand the thoughts another person is trying to develop. When his or her ideas are fully understood, the strengths and weaknesses can be sorted out and perhaps built up into viable and useful strategies to the benefit of everyone involved.

Good thinking can hardly take place in an atmosphere that is rife with conflict and antagonism. If people shout accusations at each other, there is little chance for a reasonable approach. And though conflict usually happens more subtly than in a shouting match, the effect is the same. For reason to prevail, it is essential to have an environment which is conducive to critical and creative thinking. This requires a process which encourages high quality thinking and also prevents it from being stifled.

An Environment for Thinking

There are, of course, many methods to create such an environment. Here's an example of one which was used with a key group at a major art museum in Boston. The purpose of the meeting was to find ways to increase the museum clientele and to gain additional interest and support from the community. The process I used was designed to help this group think critically and creatively as a team.

I started by asking the members of this group to identify their goals and concerns by putting them on Post-it pads--you know, those little yellow "stickies"--writing with heavy, black pens so the words could be easily seen. The team members had many goals and concerns to write down. We then put them up on a board for all to see.

That process set out everyone's thoughts clearly before us. There was no nit picking or put-downs. As the inputs of each individual in the group became understood, an image of the total problem started to fall into place. We began to establish a point of view for this group.

The next step was to put the Post-it "stickies" together in natural clusters. At first the group's leader began to take charge of this part of the process, but I intervened and asked the whole group to get involved.

We then, as a group, named each of these clusters as they appeared in the constellation on the board and indicated with arrows how each part related to the others. Suddenly, there emerged a map of where we saw this organization going

and how this group would like to bring about constructive change. In line with principles of critical and creative thinking, implications could then be clearly seen, assumptions checked out and ideas developed which were based on informed beliefs.

Keeping in mind--and we could see it right there on the board--how important it was to maintain balance and harmony among the many interconnected parts of the organization, we then chose one of the identified clusters to start working on with a structured problem solving process.

The group chose to focus on one specific area. This was finding ways to reach out and bring in an important ethnic sector of society which was not currently visiting the art museum. One person volunteered to take responsibility for on-going work with the area chosen. I then asked the group to create "an environment of wishes" regarding this issue. The wishes gave us new perspectives on the problem.

Here we were following such creative minds as George Prince who said, "Giving myself permission to wish puts to sleep my judgment and negative caution and activates my courage to dare", and William Blake, the poet, who said, "What is now proved, was once only imagined".

We then selected the most promising wishes and looked for examples of how they have been fulfilled in other times and places. This activity led to new insights and new approaches and opened up new lines of speculation. From the early ideas, which emerged by dint of careful and constructive listening and building, we developed several new strategies. Among these were specific ways to open up lines of communication within the organization, develop support from community leadership outside and find methods for training mentors and guides to help bring in the potentially interested clients.

The implementation of these plans was to be spearheaded by the one who had agreed to take responsibility for the problem. Group members offered to lend their support to that person and stated specifically what they intended to do.

All this would not have happened without empathic listening and a systematic process designed to help people think together rationally and creatively.

Validation Builds Team Rapport

Productive meetings don't just happen. They require leadership which is sensitive to the need for a climate in which a rational and creative group process can take place. A team needs such leadership just as in a family, a parent is needed to keep the bigger kids from squelching the littler ones.

No matter how politely they are done, put-downs are put-downs and have a negative effect. These occur when people subtly pull rank, quietly disapprove, offer veiled threats, and so on. Negative responses reduce motivation and commitment. For example, when someone says, however nicely, "Tom, I'm afraid you just don't understand" Tom will resent it and withdraw because he feels invalidated.

When a team learns how to work together well by using behaviors that support a rational process, trust builds and along with it a sense of mutual acceptance, validation and support. Teamwork can then become meaningful---and even fun---because members feel accepted and valued. Creative and rational activity expand when people feel safe from ridicule and know they no longer have to keep a low

profile for fear of getting shot down.

A Device for Suspending Judgment

One of the most effective ways to encourage good thinking in meetings was shown to me by Lori Kent, a graduate of the Critical and Creative Thinking Program at UMass Boston. It is a simple, but highly effective device that helps people suspend judgment in meetings so they can listen better. Anyone can put one together. It is made with a wire coat hanger, a piece of string, a block of wood and a strip of cardboard. You simply write the word JUDGMENT on the strip of cardboard in large, bold letters. Attach a piece of string to it. Straighten out the coat hanger and cut it, so it's a wire shaft about two feet in length. Bend the piece of coat hanger so it has a hook at the end of the wire shaft. Drill a hole into the block of wood and insert the bottom of the shaft into it. The sign is then suspended from the hook.

I keep one of these devices on my desk to remind me of the need to listen carefully and without premature judgment to my own thoughts as well as to thoughts expressed by others. I also bring these devices to meetings I facilitate and give these graphic reminders away to participants and friends.

Of course, "suspending judgment" does not mean "withholding judgment". It just means holding judgment back long enough to be able to understand what's being expressed. Good judgment has to be used in making intelligent, informed decisions. Tough decisions have to be made. But good judgment is most effective after issues have been clearly stated, fully explored and rationally understood, not before!

Perhaps at your next meeting (if you're willing to suspend judgment on this idea) you might bring out one of these devices and explain that you are asking your team members to "suspend judgment" as you place the sign on the wire hook. It's kind of fun, and it does a lot to prevent good ideas from being prematurely shot down as the message dangles before your team.

The use of critical and creative thinking enables teams to develop the positive insights and ideas that become the constructive basis for action. Not only will your team be happier and more motivated if you use these concepts and behaviors, but you will also have shorter and more productive meetings.

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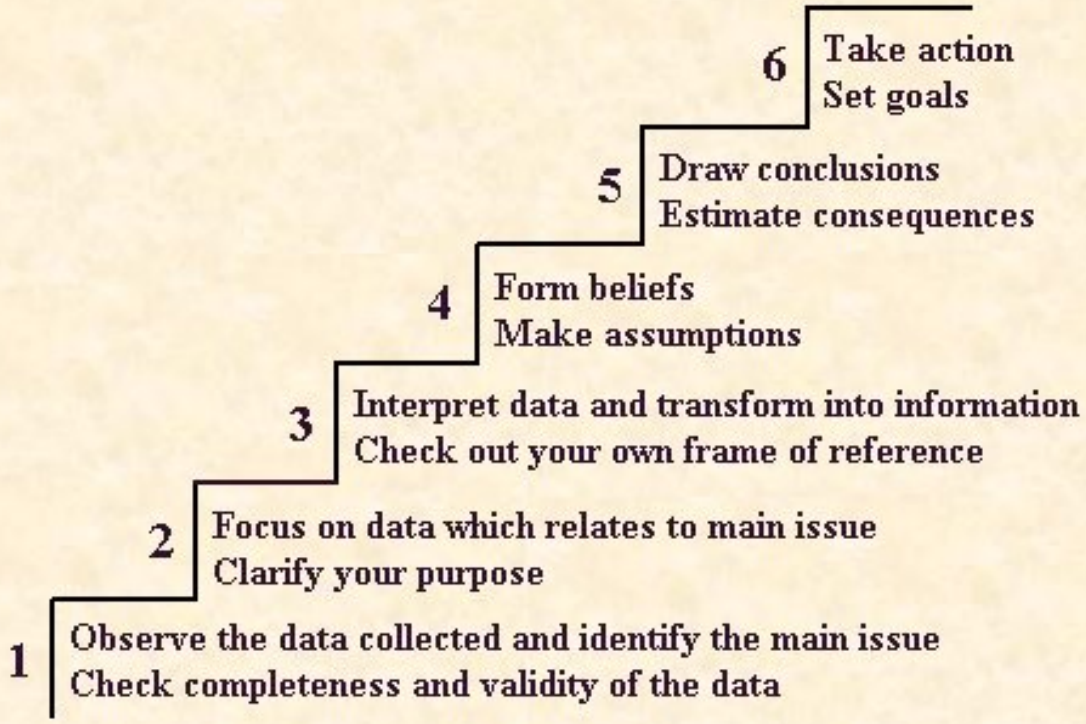
Thinking Steps



Thinking Process

- In steps 1 - 3 suspend premature judgement. Use mature, informed judgement in steps 4 - 6.
- As indicated by the curved arrow, starting with beliefs and assumptions, and then skipping to taking action, short circuits the thinking process.
- Share as much of your thinking process as possible with others when you present your ideas and opinions.
- To get the results you want, you do not have to follow each step precisely or even in order. But the more thoroughly you do them, the more you will improve the quality of your decisions.
- Be aware of how the different steps affect each other. For instance, beliefs may lead to new data or new data may lead to new beliefs.

Based on The Ladder of Inference by Chris Argyris

What Produces Re-seeing?

Can We Escape the Forces That Keep Hold On Us? How?

By: Peter Taylor

In the mid-1980s, as a new faculty member at a non-traditional undergraduate college, I began a course on ecology with a brief review of our place in space. This was prelude to moving down to earth and mapping our geographical positions and origins. One student, however, remained in her own thoughts. Some minutes later "K" raised her hand: "I always knew the sun, not the earth, was the center of the solar system, but do you mean to say... I'd never thought about the sun not being the center of the universe." From her tone, it was clear that K was not simply rehearsing a new piece of knowledge. She was also observing that she had not thought about the issues before but, now that she did, the answer she realized was obvious. What other retrospectively obvious questions had she not been asking? What other re-conceptualizations might follow? These questions pointed her exactly along the path I hoped my students would takeógrappling with issues they had not been aware they faced and generating questions beyond those I presented.

I had known since my childhood about the sun's place in the Milky Way, but some years after the class with K I discovered my own equivalent obvious question after reading Sally Ride's book on the space shuttle to my son. She conveyed the idea that astronauts regained weight as they descended because they got closer to the earth. But weightlessness is not a result of distance from the earth. Where the space shuttle orbitsó300 kilometers upóthe earth's gravity is still 90% of what it is on the surface. I thought about how to explain weightlessness to children correctly. Try thisóthink of swinging an object around on the end of a piece of string. To make it go faster, you have to pull harder; if you do not hold on tight, the object flies off into the neighbor's yard. Astronauts are traveling around the earth fastóat 7.5 kilometers per second. They feel weightless because all of the earth's gravitational attraction on them goes to keep them from flying off into space. The earth's pull on the astronauts is like your pulling on the stringóbut, while you may

let go, gravity never stops acting. When the astronauts in the space shuttle *slow down*, less of gravity's force is "used" keeping them circling the earth and what is "left over" is experienced as weight regained.

After rehearsing this explanation a few times, it occurred to me that the sun's gravitational attraction was keeping me circling around it (at 30 kilometers/second). On the earth I feel "weightless" with respect to the sun's gravity, but that force is acting nevertheless. I had never thought about this; I had considered myself a passenger on the earth, which the sun's gravity was keeping in orbit around it. I then realized that we are also zooming around the Milky Way galaxy, not as passengers on a planet in the solar system, but because the galaxy's gravitational attraction keeps us orbiting around its center (at over 200 kilometers/second, it turns out). It still makes me feel woozy to think of the sun and the rest of the galaxy "paying attention to me" all the time, keeping me moving at enormous speed through space. Is every molecule in the galaxy attracting every molecule of my body every moment, or is there some other way to think about gravity? Perhaps a further radical reconceptualization awaits me, probably involving curved space-time and other Einsteinian concepts.

I have told this two-part story in recent years to start graduate courses and workshops on critical thinking. It points to a profound issue. If students are going to take critical thinking beyond the cases introduced by their teachers, they have to generate questions about issues they were not aware they faced. Lacking any general resolution to this paradox, I usually follow the story with a guided freewriting exercise (see Elbow, P. 1981. Writing with Power. New York: Oxford U. P.), which aims to bring to the surface students' insights. Starting from this lead off: "When I entertain the idea that I haven't been asking some "obvious" questions that might have led to radical re-conceptualizations, the thoughts/ feelings/ experiences that come to mind include...", the students write for ten minutes. They then pair up and describe situations in which they "saw something in a fresh way that made you wonder why you previously accepted what you had." We list on the board short phrases capturing what made the re-seeing possible. The factors are diverseó"relaxed frame of mind," "annoyed with this culture," "forgetting," "using a different vocabulary," and so on. As with many other questions in education, the challenge is to acknowledge and mobilize the diversity inherent in any group.

When I first told the gravity story, some students construed it as a science lesson. I

had to clarify my message, which I did when using this course-opening story to practice lesson-plan remodeling. It did not matter whether students understood my weightlessness explanation, provided they puzzled over how questions that retrospectively seem obvious ever occured to them and provided they considered their susceptibility to recurrent reconceptualizations. I ventured that critical thinking was like a personal journey into unfamiliar or unknown areasóinvolving risk, requiring support, creating more experiences than could be integrated at first sight, yielding personal change, and so on. This metaphor differs markedly from the conventional philosophical view of critical thinking as questioning the reasoning, assumptions, and evidence behind claims. Instead of the usual connotations of "critical" with judgement and finding fault according to some standards, journeying draws attention to the inter- and intra-personal dimensions of people developing their thinking. I look forward to hearing from other teachers their stories of learning how to provide the space and support for students to move along their critical thinking journeys.