Develop Effective STEM Teachers via Mentor-Assisted Enrichment Projects

by

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Although any **undergrad** can carry out a STEM-focused Mentor-Assisted Enrichment Project [MAEP] with small groups of young proteges, by sharing their particular expertise as a course assignment – and earn course credit for this – my 300 undergrads at the University of British Columbia (UBC) were preparing to become **teachers** (mostly of STEM subjects).

My wife (Marilynne Miles Gray) and I did research on these mentors and found that, by their third meeting with proteges, they were able to identify and respond appropriately to individuals within their small group of proteges – so that they became effective teachers.

Because mentors submitted a Weekly Mentor Report describing how they responded to individual learners in their small group of proteges, we discovered that mentors reached Stage 3 of Frances Fuller's "Concerns of Teachers" by the third meeting:

1. Stage 1 Concern for "**Self**" (Do I know my subject well enough so I can teach it? Can I control my class so I can teach?)
2. Stage 2 Concern for "**Them**" (their class or a smaller group)
3. Stage 3 Concern for "**Individuals**" (how to ensure maximize learning for each individual)

[Reference: Frances Fuller, Concerns of teachers, *Educational Research Journal*, Vo. 6, No. 2, pp. 207-226.]

Mentors skipped Stage 1 because each MAEP involved that mentor sharing an existing expertise with a small group of interested proteges.

Mentors started with a Stage 2 Concern for their small group, and quickly reached the Stage 3 Concern for maximizing learning for each individual.

This is significant – because Fuller and her graduate students replicated this type of research over six years and consistently found the same thing: pre-service teachers do not reach Stage 3 on any practicum while teaching entire classes, but got stuck at Stage 2. So did many first year teachers.

My undergrads reported that they learned more about working effectively with individual learners while carrying out a MAEP over a 10-12 week semester than they had learned through coursework or student teaching during a 5-year B.Ed. program.

Future elementary teachers, who tend to be student-oriented, became more subject-oriented. Future secondary teachers, who tend to be subject-oriented, became more student-oriented.

This and many other benefits motivated my 300 undergrads to stay in university during the semester they carried out a MAEP. An especially important reason was this: "If I drop out, I'll disappoint my proteges."

When the **Student Teaching Office** at UBC heard about what we had discovered, we were asked to replace the initial practicum for future secondary teachers with our MAEP concept. For several years the dropout rate had increased, until it reached 40%, because these beginning student teachers observed the regular teacher for several hours and were then introduced as "student teachers." They were expected to teach the entire class or smaller groups, with little instruction in classroom management or in their academic major, and typically with no prior experience speaking in front of any group. It's a tribute to these idealistic student teachers that more did not drop out.

My wife and I did more R&D on this new application of MAEPs as the initial practicum and found the same thing: all student teachers reached the Stage 3 Concern for "Individuals" by the third meeting. We decided to investigate whether

this also occurred when these student teachers taught entire classes on their next practicum, and found that 50% to 70% reached Stage 3 (depending on the semester we investigated this).

Over the eight years of our R&D, most of the MAEPs focused on some aspect of STEM (Science, Technology, Engineering, Math), such as: building a robot, designing a model for a light rapid transportation system, growing cells in the biochemical lab, developing software for a computer game, building a wind tunnel to explore the aerodynamics of airplane wings, doing rat learning studies in the psychology lab, discovering how different arches throughout the history of architecture enabled construction of different kinds of buildings, comparing horses throughout history and their impact (e.g., race vs. farm vs. hauling horses).

I trained mentors to use both Didactic Instruction and Open Inquiry, and to involve STEM professionals (who were too busy to be mentors), so that proteges connected "learning about" STEM concepts with "learning how" they are applied in real world situations.

This created a **STEM Pipeline** of Motivated Youth, who wanted to become STEM Majors in college, who wanted to become STEM Professionals as an occupation.

For example, Arthur Erikson, Canada's foremost architect, gave proteges extra time because they had so thoroughly prepared interview questions based on visits to, and photos of, his major works. Such as: "What problems did you have to solve when you decided to let large trees grow through the roof of the underground library at the University of British Columbia? What challenges did you have to resolve when you designed Simon Fraser University as a single structure to sit on top of Burnaby Mountain?"

This involvement of youth, undergrads and professionals is important because it enables young proteges to overcome their fear of science and math courses, on the one hand, while exposing them to the possibilities and realities of STEM careers, on the other hand. Younger proteges easily identify with undergrads (because there is not a large "age gap") and they learn about "best-fit" careers (from professionals) and reject unsuitable ones. (If I had such experiences, I would not have spent a year in dental school discovering that I did not want to practice dentistry as a career.)

For example, two female proteges thought they wanted to become fashion models and chose to do a MAEP that focused on what models and modeling agencies do – until they realized how "sex" was being used to sell products. Then, their project focused on critiquing the advertising industry.

Over 16 semesters of doing R&D, we discovered that neither simplistic "**Announcements**" encouraging mentors to "do your own thing" nor partially planned "**Initiatives**" will produce intended outcomes, because essential components have not been properly defined, designed, aligned, and delivered. Only a thoughtfully planned "Program" does all this. Such as training everyone to fulfill essential Roles and Responsibilities so everyone benefits.

Many proteges decided to attend the university where I taught because my undergrads conducted MAEP activities on the UBC campus (e.g., grew cells in the biochemical lab), and introduced proteges to their professors. I also benefited, by receiving higher course evaluations because my undergrads perceived my courses as more practically relevant, by getting my research on MAEPs published so that I earned tenure and promotion, and by being selected to present at many learned conferences.

In sum, Mentor-Assisted Enrichment Projects provide enrichment experiences that cannot be offered through the regular curriculum – whether STEM-focused or focused on some other kind of mentor expertise (e.g., "Juvenile Shoplifting and the Law" or "The Ethics of Seal Hunting" or "Investigating the Chinatown Area of Vancouver"). When properly structured and implemented for different kinds of proteges, they perceive the project as "theirs" even though it is based on each mentor's expertise, and they learn how to work with others on the team to complete and present what they did and learn so others also benefit.

And, mentors learn how to work effectively with groups and with individuals – to become effective teachers, who can maximize learning for everyone.

Successful mentoring relationships are so "dynamic" and flexible that no one "gets stuck" when ***Situational Mentoring*** is

employed:

- Effective Mentors willingly employ non-preferred Mentoring Styles and behaviors to meet Protege needs. For example, Mentors who believe they should equip Proteges with wisdom and guidance, also empower Protege's ideas.
- Successful Proteges are receptive to different Mentoring Styles and even request non-preferred Styles and behaviors. For example, self-reliant Proteges might prefer confirmation of their ideas, but are willing to heed Mentor guidance to implement these ideas.

I developed the first of 11 versions of my ***Mentoring Style Indicator*** (for Mentoring Youth) because of the R&D I did on these mentoring relationships.

I discovered how the **Informational and Guiding** Mentoring Styles **equip** proteges with what mentors know, and how the **Collaborative and Confirming** Mentoring Styles **empower** what proteges want to do and become.

After making these discoveries, I trained mentors to employ all four Mentoring Styles and 24 associated behaviors in a flexible manner so proteges would accept and utilize needed assistance. This enhanced mentoring relationships and learning outcomes even more.

Gray's Mentor-Protege Relationship Model for Situational Mentoring

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M ——— Mp ——— MP ——— mP ———P

Informational Mentoring Style	**Guiding Mentoring Style**	**Collaborative Mentoring Style**	**Confirming Mentoring Style**	**Successful Protege**

Most learners (proteges) need both **Didactic Instruction** and **Open Inquiry** in order to understand what they are learning, and then remember, and apply this:

- **Didactic Instruction** efficiently teaches what is already known so it does not have to be re-discovered (often by time-consuming trial-and-error), but can be more quickly understood. I trained mentors to use the **Informational and Guiding** Mentoring Styles to provide Didactic Instruction.
- **Open Inquiry** enables acquired knowledge to be applied in practice, new knowledge to be discovered, and difficult problems to be solved creatively. I trained mentors to use the **Collaborative and Confirming** Mentoring Styles to facilitate Open Inquiry.

[Reference: A meta-analysis of research in 1973 clearly indicated that both **Didactic Instruction** and **Open Inquiry** are necessary for maximizing learning. See: John S. Coleman et al, The Hopkins Game Program: Conclusions from seven years of research, *Educational Researcher*, Vol. 2, No. 8, August 1973, pp. 3-7.]

For more information on ***Situational Mentoring***, and how this enables mentors to provide appropriate kinds of assistance that proteges of all ages will accept and utilize, you might want to look at my eBook – available at http://www.smashwords.com/books/view/125079 – where you can download 25% to preview it.