Making a Graduate Education Program Effective

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Drawing from Experience, ±

- What characteristics of a graduate program lead students to become independent, creative scientists or engineers?
- What characteristics *hinder* this?
- What will make little difference?

To induce independence,

- Open pathways and offer challenges early
- Start independent research early, even if the student doesn't yet have the tools and background
- *Use "warm-up" problems* to build confidence

What about courses?

- Yes, some formal courses are probably necessary
- But the courses that best educate students to become independent researchers include some opportunities for independent thought--e.g. new proofs or derivations or unsolved problems, in addition to “exercises”

Are there negatives to courses?

- Unless carefully designed, courses may hold students back from undertaking learning on their own
- The ideal “student product” is a person who can learn by reading and studying alone at least as well as from courses
- The best courses have some “learning on one’s own”

An alternative to formal courses

- The topic-focused study seminar!
- Faculty-planned and organized, but conducted with presentations by participants of material the group has set out to learn, maybe supplemented by invited visitors
- Especially effective beyond the most basic level

Encourage sharing information and collaboration

- Identify areas of overlapping interest and stimulate collaborative research and study between and among students with these overlaps
- Encourage students to teach one another what they are learning in and for their research

Stimulate exploratory thought and creativity

- Use discussions and seminars to raise open questions and new ideas
- Use these to stimulate open, speculative discussion, in which “no idea is too dumb to be examined”
- The faculty leader can set the example and the style for this

Value criticism highly!

- Create an atmosphere in which criticism and questioning are viewed as the most effective ways things are improved
- Criticism must be seen as an aid, not as an attack
- Devote some time in each class to responding to questions from previous classes

Help students learn to criticize and to respond to criticism

- It helps to articulate how to express criticism so it will be interpreted as constructive
- It helps to articulate how to respond to criticism to assure it is being taken as constructive

Help students learn to write!

- Clear writing requires clear thinking
- Fuzzy thinking makes writing prolix and undirected
- Writing drafts reveals areas of incomplete understanding
- Go through drafts with students to point out such areas

Introductions and Summaries are the most important

- Don’t hesitate to insist on many revisions and redraftings
- But be supportive by asking the student what he or she to tell *you* what they want to say in their text
- Let (and encourage) students to read each other’s writings and comment on it

Stimulate creativity with collaboration

- Have students present work in progress, explaining their objectives, achievements to date, next goals and the obstacles they are encountering
- Group seminars are ideal vehicles for this, either single groups or seminars with two or three research groups together

Another vehicle: the “séance”

- Not a seminar, but a weekly open discussion of collaborative work underway and projected
- A group of faculty, students and postdoctorals are doing this regularly now at Chicago--our weekly “protein séance” with experimentalists and theorists, chemists, molecular biologists and computer scientists

Keep boundaries between fields and departments fuzzy

- Make cross-disciplinary collaboration easy, or, even better, a win-win activity, by providing stimuli and rewards
- Encourage joint appointments between departments
- Even enable faculty to work in departments other than their own “home” departments

Use outside advisors regularly

- But select these people carefully
- Choose people willing to speak candidly, whose standards are ones you admire
- Don’t try to get consensus from advisors; if it happens, fine, but disagreement can open insights

Ensure that the faculty know what one another is doing

- Departmental (and interdepartmental) seminars are important
- Establish an expectation that faculty and students will attend and participate in these
- Invite speakers from other institutions and from your own, both within the Department and outside

An ideal faculty

- Is harmonious
- Is candid and eager for criticism
- Enjoys interaction and collaboration
- Is composed of people who respect the intellects of their colleagues, whether or not they agree with them

An ideal student body

- Carries away a clear awareness of the values, standards and working characteristics of the faculty with whom they studied,
- And hopes to surpass them!

Thank you!
Questions, challenges, discussion?