Rediscovering Idea Generation in a Scientific Discipline

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ABSTRACT
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A teaching method that challenges students to freely generate original ideas is described for use in plant pathology courses. Students are asked to submit 17 idea papers throughout the course. The ideas need not be related to the course or even good. No limits are placed on content, and the ideas are not judged on their perceived value or practicality. Rather, the emphasis is on stimulating freethinking and creativity, two qualities that are essential if science is to break new ground but that are too often suppressed in a field that seems preoccupied with recycling ideas and timeworn approaches to problem solving. The assignment is not a graded exercise in the traditional comparative sense but is required to pass the course.

Beware of a man with a single idea.—Anonymous

Plant pathologists are becoming half-brained. We are too logical, too content to think only with our left brain and recycle old ideas and timeworn approaches to problem solving. We have neglected our right brain and are not using its intuitive and creative capacities to innovate ways to apply science. We have become shackled to the status quo like a monkey chained to an organ-grinder's music box. In our thinking we have become content to dance the steps of weary routine when we should be running wild through the trees. Nowhere is this fact more evident than at an American Phytopathological Society annual meeting, where redundancy of idea usage is the order of the day and the answer to the question "What's new?" is often "Very little."

Justus von Liebig, the innovator who delineated agricultural productivity in terms of a law of a limiting factor, might, if he were alive today, look at plant pathology and wonder what the factor limiting growth in our field has been. He might guess that it is related to a lack of creativity and germinal ideas. In short, we are stuck in a rut because we have forgotten how to think creatively, and we are passing this bad habit on to our students. If we plant pathologists are not strong in generating germinal ideas, is it still possible for us to encourage original thinking among our students? I believe we can, as long as we realize that idea generation is a natural and abundantly available talent that should be nurtured and promoted, not crushed under the heel of conformity.

In 1987, chemical engineering professor James Christensen (1), in his lecture entitled "Reflections on Teaching Creativity," remarked, "I have demonstrated many times that the best way to enhance creativity is to have more ideas. If ten ideas give one creative idea, then twenty ideas will give two creative ideas. What we need are more ideas, whether bad or good, in order to find the good ones." Christensen was using both halves of his brain when he made that statement, and I contend the field of plant pathology can benefit from this whole-brained approach.

The following describes a teaching method I have developed wherein students begin, and continue, to generate original ideas. Ultimately, some of these ideas appear to be usable.

Idea generation

New ideas are the catalyst for creating fresh, innovative solutions to problems in the field of plant pathology studies. Twelve years ago I started a teaching method in my plant bacteriology course that requires students to use a creative thought process to produce original ideas. The ideas themselves are not important. It doesn't matter if the ideas are practical or relative to anyone's reality, although some of the ideas are in fact practical, even patentable. The point is that in generating the ideas, students experience a creative process and conceptualize and describe new ways to solve problems. For some students, this is their first taste of the creative freedom inherent in applying intuitive thought to problem solving. This idea-generation exercise can be incorporated into any course or research project.

Methods for idea generation

The format is introduced on the first day of class. Students are told they will be expected to hand in 17 original ideas, generated from whatever problem in the field they desire to tackle. The assignment counts a weighty 25–30% of the total course grade. The guidelines for meeting the requirement are simple and clear: Ideas are to be self-generated; they are to be described concisely in one page or less; idea papers are numbered 1 through 17 and can be submitted anytime before the last week of the course. The instructor will not evaluate or judge the papers other than to verify that each idea is sufficiently independent in content from others and from ideas submitted by other students. The emphasis is placed on the generation and submission of 17 original ideas that aim to solve a problem, not the evaluation of the ideas, and especially not on comparisons of one student's ideas with another's.

Student reaction

Students' initial reaction is usually one of a sense of freedom, followed by uncertainty as to the kinds of ideas or problems they think I might have in mind. For the first several weeks I am purposefully vague when asked to clarify the assignment. I want the students to take the initiative. In the third or fourth week of the course I press them to submit a few ideas, explaining that it is important for them to spend some time experiencing idea generation before the course ends. This first request prompts bolder students to test the waters by submitting a few idea papers. When the seemingly unstructured and, for some students, unprecedented nature of the assignment no longer appears to threaten them, the majority of students begin generating ideas and handing in idea papers.

What is unusual about this assignment is its shift in emphasis from a primarily logical process or focus to balance with, or be provisionally secondary to, intuitive operations. DeBono (2) differentiated between logical (left-brained) and intuitive (right-brained) thought. Conjoining the left and the right, Norris (5) asserts that the "ability to employ both the intuitive and logical aspects of thinking" determines one's skill at conceptualizing new approaches. Norris also believes that "Creative thought is a whole-brained process. Although it requires a continual alteration between the separate thinking modes, it is at the same time cyclical." I suggest that the challenge to promote new thought requires a *new* balance or shift toward

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increased intuitive or right-brained thought. In trying this new balance, students invariably press for my opinion, seeking structure or limits for the assignment or validation of their ideas before they submit them in writing. I am consistent in my approach when responding to students: I praise them for having ideas but am careful to avoid judging any particular idea and thus discourage creative thinking.

The teacher as model rather than judge

Some students will profess to *lack* ideas and may need the help of a one-on-one session where the teacher as model generates a number of ideas in problem areas. The technique of free association is another tool the teacher can use to liberate the student's mind from conventional logical thinking processes that can obstruct or hinder new thought. It is important during the session that the teacher defer value judgments or censorship of new ideas. The free-association technique is used to access unconscious thought processes that function best without imposed limits. Moriarty (4), in her work refuting the myth that creativity *cannot* be taught, asserts that in brainstorming we must defer judgment. After an idea-prompting session with the teacher, the student returns to his or her own natural creative abilities, being reassured that not all days are equal in terms of idea generation. The most effective method is one that is gentle to the student's ego.

All students will have handed in at least 17 ideas by the end of the course. Prompted by this exercise, many of these students will develop the habit of writing down their ideas. Most students appear to have learned to generate ideas independently.

Individual research projects

The same general format is used to provoke creative thought among students who are interested in pursuing individual research projects. The student and instructor mutually agree on a general scientific problem the student will research. For example, the simulation or modeling of a plant disease epidemic might be selected. The student is expected to generate at least 17 ideas about this project, using the creative thought process to hunt for potential solutions to the problem. Later, the student and instructor sort through the ideas, using the instructor's knowledge of certain real factors in determining the feasibility and desirability of pursuing each idea. This approach gives the student a chance to brainstorm and create his or her own idea that can be further explored. Perhaps people tend to work the hardest and most efficiently on their own ideas.

The bacteriology course

The bacteriology course comprises considerable prelecture preparatory reading in the areas of symptomology, biochemistry, genetics, and microbiology. The readings are designed to present the students with numerous unsolved problems in pathology. Much of the lecture time is spent dissecting the problems, attempting to find solutions or at least approaches to unsolved problems in bacteriology or in pathology in general. The lectures include definition of problems, generation of solutions by analogy, and open and free discussion. Criticism of ideas is tempered with the understanding that all ideas are fragile constructs needing some positive reinforcement. Although the 17 independently generated ideas are not necessarily shared with the class, the process of idea generation is shared in classroom discussions of problems in agriculture.

Relationship of ideas to plant pathology

The instructor places no limit on the content of the ideas, yet approximately 50% of the submitted ideas pertain to the course material and another 35% pertain to biology or agriculture. The lectures are in phytobacteriology, and many ideas submitted by students explore alternative approaches to problems in this field. Students suggest vast numbers of ideas relating to biocontrols, gene cloning, diagnostic probes, and new therapies. The diversity and novelty of these ideas are encouraging.

Teaching evaluations

Students have recorded no negative comments about the idea-generating exercise in the instructor evaluation process. Most students report that the course, including the idea-generation theme, was a positive experience. And it's an experience that, for some, becomes a life skill. Alumni returning to campus have expressed appreciation for this teaching process and have said it enabled them to generate a greater number of novel ideas for grant writing. Some ideas arising from the course appear to be patentable. For example, one student proposed an irrigation system that employs biogas for lifting water into rice paddies. Another suggested that farmers form organizations to control specialty markets for their produce. Several students have suggested methods for inserting foreign DNA into plant cells. Others have proposed novel ideas for developing hybrid systems, implanting microchips into nerve cells, and building auto-tracking systems for cars.

But practical or patentable or not, a new thought may have its own intrinsic value.

Within our field, we extract and gather supportive proofs and ideas while culling nonsupportive or "nonrelevant" information. In this process of permitting and discarding ideas, I maintain that we also overlook or fail to encourage fresh new material or approaches. We may be the victims of our own selectivity by stifling new movement. Goodell (3), in her book *The Visible Scientists*, refers to Marshall McLuhan's assertion that "our time is a time for crossing barriers, for erasing old categories—for probing around." Because of our absolute requirement for new thought in the scientific community, I must argue that innovation is as important as our expertise in biochemistry and genetics. Even if we have not been strong in idea generation, it is certainly possible for us to initiate the process of original thinking from the students in our classrooms and in our laboratories.

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