THE RESEARCH PROPOSITION

DAVID F. OLLIS
North Carolina State University • Raleigh, NC 27695-7905

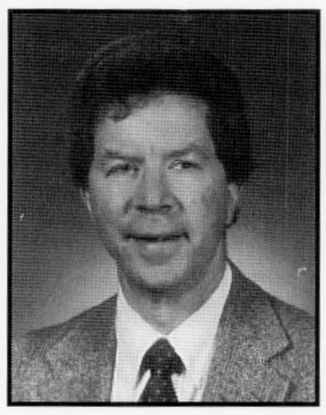
If the defining difference between undergraduate and graduate study is the presence and preeminence of research, why doesn't every department offer a graduate course to define research and to teach the mechanics of writing proposals (hypotheses) and papers (results)? This paper relates the experience of a department that did precisely that.

At North Carolina State University, we jettisoned the PhD written qualifier exam four years ago because the faculty finally discerned what every graduate student already knew: the written qualifier, typically composed by the same faculty who offer the required graduate courses, resulted in a test that looked, smelled, and tasted like a graduate course final exam. The faculty further discovered a logically associated result: qualifier performance is largely predictable from first-year course grades.

Our new-found faculty wisdom is: "The mastery of first-year graduate coursework is but one positive indicator of a student's potential to perform well in the PhD program. Equally important is the ability to apply classroom knowledge to recognize, define, plan, and undertake a research program. The synthesis skills required to do so are typically not exercised in classwork, but are indispensable tools for the conception and execution of independent research."[1]

THE RESEARCH PROPOSITION COURSE

In place of the written qualifier, a formal course on the presentation and oral defense of a written proposal was required of all first-year students seeking the PhD. This "Research Proposition" course is outlined in Table 1.



***David Ollis** is Distinguished Professor of Chemical Engineering at North Carolina State University. He has advised PhD and MS graduate students, coauthored their papers, and edited their prose for more than twenty-five years. This course is dedicated to their research writing and to their advisors' eyes and endurance.*

. . . we jettisoned the PhD written qualifier exam four years ago because the faculty finally discerned what every graduate student already knew: the written qualifier, typically composed by the same faculty who offer the required graduate courses, resulted in a test that looked, smelled, and tasted like a graduate course final exam.

What is a research proposition? It is both a partisan argument and an evenhanded, scholarly inquiry! This requirement to combine apparently opposing stances of bias and disinterest is evident in the individual words "research" and "proposition":[2]

Research: "Careful, patient, systematic, diligent *inquiry* or examination in some field of knowledge, *undertaken to establish facts or principles."*

Proposition: "In rhetoric, a subject to be discussed or *a statement to be upheld."*

The synthesis of the "Research Proposition" is accomplished through meeting a closely scheduled set of reading and writing tasks (see Table 1), with each including feedback from the instructor through either individual discussion or written comments.

GETTING STARTED: SOURCES FOR PROPOSITION IDEAS

"To get a good idea, get a lot of ideas!" advised Linus Pauling. Following Linus' lead, we allowed that "Ideas for the Proposition might originate from a number of sources—for example, seminars, industrial experience, coursework, literature articles, previous PhD theses, or discussions with technical experts." (I dumped this last possibility immediately to preserve the student's independence of effort.) "A Proposition might be:

1. A new experimental or theoretical approach to investigate or solve a scientific or engineering problem.
2. A possible solution to a technological need or problem.

3. A significant process improvement

Whatever the topic, the proposition should demonstrate the student's ability to define a research problem and design a program to determine a potential solution using the fundamental principles of our discipline."[1]

How to get started on the research proposition? "Read in an area of research that interests you."[3] These initial readings should include review articles or chapters—they define the technical vocabulary, indicate the knowledge structure of the topic(s), and often note any outstanding needs or unresolved issues. Such readings lead naturally into the original literature, which provides the scholarly support for the problem proposed.

When have I found a problem? "Calling a collection of words a "Research Problem" does not make it so. Your words must show an understanding of certain phenomena, and your proposal must have some promise of revealing convincing evidence that this understanding is correct."[3]

As a final screening test for each of the potential research problems initially considered, the student should reflect on the questions listed in Table 2. They will help assess both the problem's quality and the student's fitness to attack it.

TABLE 1
The One-Semester "Research Proposition" Course

1. **Scope of Chemical Engineering** (Amundsen report, 1 lecture)
2. **Read and Discuss:** ***Writing a Thesis—Substance and Style***
   - "How to Write a Thesis" chapter and literature searching at NCSU (l hour)
   - "Research Introduction" and "Method" sections (1 hr)
   - "Methods and Results, and Writing with Style (1 hr) (Discussion periods)
3. After three weeks . . .
   - Initial **Literature Search** is due
   - List of articles read is discussed with Instructor (has adequate literature been identified? understood?, etc.)
4. After four weeks . . .
   - Proposition **Outline** is due, including a one-paragraph problem statement and a list of probable headings and subheadings indicating where individual references will be cited.
   - Individual discussions with Instructor.
5. After seven weeks . . .
   - Proposition typed **Rough Draft** is due. The Instructor and a second reader knowledgable in the proposition field review the draft, identify weaknesses, and suggest (through written extended questions and comments) locations for further development. Citations of any additional specific references to be consulted are NOT provided.
6. Eighth week . . .
   - **Revision.** Two lectures, with examples, from *Revising Business Prose,* by Lanham.
   - **Rough Draft** with written comments returned at week's end.
7. Tenth week . . .
   - **Final Draft** is due; reviewed by Instructor only, for format and grammar errors; then returned to student.
8. Eleventh week . . .
   - **Final Proposition** is due; distributed along with Evaluation Form to committee of four (Instructor plus three other faculty—student's PhD advisor may not serve).
9. Twelfth week . . .
   - Prepare **Transparencies;** review them with Instructor.
10. Thirteenth week . . .
    - Practice **Presentations** (20 minutes each) in class, with questions (5-10 minutes) from other students and written comments from Instructor.
11. Fourteenth week . . .
    - **Formal Presentations** to faculty committees: (20-minute presentation; 20 minutes for faculty questions; 10 minutes for completion of proposition evaluations and committee deliberations.)

GETTING ORGANIZED: A PROPOSITION TEXTBOOK

Four years ago, when our department first declared war on the written qualifier and decided upon the campaign for the Research Proposition, I volunteered to be the private first class (grunt) for this proposition instruction experience. I chose the text *Writing a Thesis: Substance and Style*[3] as my combat map for this new teaching terrain, in part due to the opening remarks in Lee Myerson's "Forward" to the book:

> *While serving on students' supervisor committees, I received proposals in which, even in first draft, students offered well-structured, well-reasoned, and answerable questions as the focus of their studies. That experience was strikingly different from others in which students did not explain their research problems or show how the anticipated results might cast light on a problem not then understood. I was curious about what accounted for the difference.*
>
> *It turned out that almost all of the students whose proposals had caught my attention and who seemed well prepared for the research endeavor had taken Professor van Wegenen's course "Expository Writing and Research*

TABLE 2
Questions to Determine if a Satisfactory Research Problem Has Been Identified

- Can the research problem be enthusiastically pursued?
- Can interest be sustained by the problem?
- Is the problem solvable?
- Is the problem worth doing?
- Will it lead to other research problems?
- What is the problem's potential for making original contributions to the literature?
- If the problem is solved, will it be reviewed well by scholars in your field?
- By solving the problem, will you have demonstrated independent skills in your discipline?
- Will the necessary research prepare you in an area of demand or promise for a future in your field?

Heuristics," or they had studied a mimeographed version of this book.

State the Problem Immediately

van Wegenen counsels that the earliest paragraph(s) of a research proposition must present a "problem statement which identifies the proposition's focus," and which reveals the writer's purposes:

- *"to understand a restricted set of phenomena (more restricted or limited than is commonly believed);*
- *"to describe the interrelations between variables that are named in the statement;*
- *"to offer in the problem statement a potential or hypothetical solution to the problem;*
- *"to limit the range of the problem to a single question or issue (set boundaries on the problem)"*

van Wegenen elaborates on the problem statement and the methods proposed for finding solutions in sections dealing successively with an explanatory problem statement (the hypothesis and its supporting literature), an operational statement (identification of the specific system used to test the hypothesis), methods (establishment of the feasibility of finding the solution), and expected results (discussion of possible outcomes and their consequences for verification or refutation of the proposition).

Five of van Wegenen's chapters on thesis writing are well suited to our research proposition course. They are "About You as a Writer," the "how to write" chapters on the Dissertation Proposal, the Research Introduction, and the Method Section, and a closing piece on "Writing with Style." Additional chapters on completed research ("How to Write a Results Section" and "Discussion") are replaced in our course with an "Anticipated Results" and a "Discussion" section.

Structure the Introduction

The introduction should contain two distinct versions of the problem. The longer, *explanatory* portion establishes the problem; it identifies key vocabulary and concepts, states the hypothesis to be tested, and lays out the presuppositions that underlie the hypothesis. This presentation structure invites literature citations primarily in the guise of presuppositions and supporting documentation. It has therefore the advantage of limiting literature cited to only material that is directly supportive of, or relevant to, the hypothesis.

The shorter, *operational,* expression concludes the introduction; it "describes concretely what you as an investigator [will do], and thereby it reveals what particular aspect of the larger problem [will be] attacked. Operational expressions are carefully chosen physical transactions that reveal research strategy."[3]

A simple technical illustration of explanatory and operational statements is outlined in Table 3; the actual version includes references and full discussions.

Two types of propositions are presented. At the outset, students receive a copy of a strong proposal from a previous class, and then during the course, excerpts from faculty research proposals provide illustrations.

Make Methods Convincing

The "Method" section may at first promise to be the dullest of proposition topics. But the proposition is an argument, a persuasive presentation that a problem has been found and that a solution can be constructed or deduced. The method section is the key portion for demonstrating to the reviewer and the reader that the investigator has designed a mechanism of inquiry that can uncover the information needed to test the hypothesis.

The level of detail with which the procedures and methods are presented must convince a reviewer knowledgeable in the area that the investigator is qualified to perform the research indicated, not merely to identify the problem of interest.

While the details of the technique and the specific materi-

TABLE 3
Example Brief Explanatory and Operational Statements

Explanatory Statement

Hypothesis: A chemical oxidation followed by a biological oxidation provides a more efficient and less costly process for remediation of recalcitrant contaminants in water than either process alone.

Presupposition 1. Chemical oxidants, expecially hydroxyl radicals, can oxidize and even mineralize most recalcitrant organic contaminants in water.

Presupposition 2. When either operation can be applied, chemical oxidation is more costly than biological oxidation.

Presupposition 3. Biological oxidations are not effective for recalcitrant contaminants.

Presupposition 4. Partial oxidation of a recalcitrant contaminant yields increasingly biodegradable reaction intermediates.

Thus, the chemical partial oxidation of recalcitrant contaminants followed by a biological completion of contaminant oxidation will provide more effective and less expensive contaminant conversion.

Operational Statement

We will establish that for destruction of trace, multichlorinated phenols in water, a two-step (chemical followed by biological) oxidation sequence can be better than either step alone. We will use ultraviolet-hydrogen peroxide chemical oxidation and an activated sludge biological oxidation, individually and in sequence, to determine the respective process efficiencies and economics for oxidative conversions of mono-, di-, tri-, and pentachlorophenol contaminants. Using simple reactor kinetic models, we will establish the operating regimes within which two-step processes are more favorable than either single-step treatment.

als to be used appear in the method section, these items should have been previously identified in the explanatory section. The reader should know in advance what to expect and look for in the method section.

Anticipated Results: What Do I Expect to Find?

A thesis has results, whereas a proposition can only give expectations (excepting cases with preliminary data). Such a proposition section, however short, provides the writer with an opportunity to indicate how data will be plotted, correlated, or analyzed, and what behaviors are expected or possible. A final discussion should interpret the various possible experimental outcomes and indicate which ones will form support or refutation of the hypothesis. If we are to invest substantial effort investigating the original assertion, the return will be worthwhile only if an outcome is obtained.

Write for the Reader: You Need His/Her Vote!

van Wegenen's final chapter, "Writing with Style," urges the student to consider finer, but important, points:

- ***Take a Reader's Perspective.*** "Give information in direct order of importance." "Success in writing...means that a reader will know all that is important to know in the shortest possible time."
- ***Attack Immediately.*** "Begin with the concept that will give the reader the most encompassing idea." "Do not hold back information in the belief that readers will need background first." "Open with sentences that show intensity...but use temperate words; do not exaggerate."
- ***Use Enough Headings (and Subheadings).*** "Most writers use too few." "Headings reveal organization. Look at the order of your headings and correctly subordinate them." "Make the heading bring out the main concept to follow." "Write headings that are long enough to be understood."

Persuade!

Finally, a proposition is an argument FOR a particular assertion: the hypothesis. It is persuasive, not passive. van Wegenen's closing advice on "Writing with Style" is to be "definite and forceful, make interpretations, use specific language, avoid prolixity, be brief, emphasize the active voice," and, yes, be yourself—create "an honest image."

THE NEED FOR A PROPOSITION ROUGH DRAFT

The 1992 pilot offering of this course required no first draft. Students and faculty subsequently concluded that a mid-course technical evaluation of the structure and weaknesses of each proposition in draft form would allow time for revision and response prior to the final presentation and defense. This technical review, in place since 1993, also gives the writer time to readjust if a problem has not yet been adequately identified and attacked. Further, from instructor and second-reader written comments and questions, the student receives a preview of the style of committee inquiry that will follow the formal oral presentation. Such a review/preview natably improved both the final written proposition and the student oral presentations to their committees.

Revision for content usually requires revision for style as well. The style problem is noted in "Sounder Thinking Through Clearer Writing,"[4] a 1967 attack on technical writing:

> *All are agreed that the articles in our journals—even the journals with the highest standards—are, by and large, poorly written. Some of the worst are produced by the kind of author who conscientiously pretends to a "scientific scholarly" style. He takes what should be lively, inspiring, and beautiful, and, in an attempt to make it seem dignified, chokes it to death with stately abstract nouns; next, in the name of scientific impartiality, he fits it with a complete set of passive constructions to drain away any remaining life's blood or excitement; then he embalms the remains in molasses of polysyllable, wraps the corpse in an impenetrable veil of vogue words, and buries the stiff old mummy with much pomp and circumstance in the most distinguished journal that will take it. Considered either as a piece of scholarly work or as a vehicle of communication, the product is appalling.*

"ALL WRITING IS REVISION"

The need is thus established to revise frequently both the ideas and the prose. We sought a second guide, preferably utilitarian and entertaining, the latter to motivate engineers to read about prose revision! During the week required for faculty review of the draft proposition, we read and discussed Lanham's *Revising Business Prose*[5], and wrote and compared, in class, several revision exercises. The short (140-page) book takes a tough but humorous approach to revision, first through attacks on individual sentences, then on paragraphs, and finally on style.

The author's premise appears in his first paragraph:

> *What should business writing be like? It ought to be fast, concrete, and responsible. It should show someone acting, doing something. . . Business prose ought, therefore, to be verb-dominated prose, lining up actor, action, and object in a causal chain and lining them up fast.*

Intriguing? After twenty-five years of experience in paper and proposal reviewing, this description is my dream of a good *technical* proposition!

To shorten, clarify, and enliven the rhetoric, Lanham proposes actions summarized in his amusing eight-step "Paramedic Method" of "resuscitating dead prose." For individual sentences, take the draft writing at hand and quickly identify the extraneous phrasing and weak action by administering a

four-step antidote:

1. Circle the prepositions (there are usually too many).
2. Circle the "is" forms (too weak).
3. Ask "Where's the action?" "Who's kicking whom?"
4. Put this "kicking" action in a simple (not compound) active verb.

Lest the reader protest that business and technical writing are different, unrelated activities, consider the following only-too-familiar construction:

Original Sentence

> The substantial growth (of) the rate (of) the chemical reaction (was) mainly a result (of) the increase (in) the temperature (of) the reactor *(23 words)*

Lanham's directives locate the trouble spots, indicated here by parentheses. Among many revision possibilities, an example follows that contains no prepositions or form of the weak verb "is."

Revised Sentence

> The higher reactor temperature increased the chemical reaction rate substantially. *(10 words)*

The revision is shorter, clearer, and more forceful.

Lanham's *coup de grace* performance indicator for each editorial effort is the calculation of a "Lard Factor," or the percent of word reduction, in engineering parlance. For the reaction rate example above

$$\text{Lard Factor} = 100 \times (23 - 10)/23 = 56\%$$

Graduate students appear to have no difficulty recalling horrible prose examples encountered in their literature readings. Armed with Lanham's pointed directives, the students next administer a "paramedic" attack on their own proposition draft, identifying opportunities for tightening and strengthening their prose.

Lanahan's next recommendation is to be direct:

5. Start fast—no slow windups.

The student may object, recalling that Webster defined research as "careful, patient, systematic, diligent . . ." We reply that research writing can possess all of these qualities and still "start fast," as illustrated in Table 4 by several chapter titles and corresponding leadoff sentences from *An Introduction to Scientific Research,* the careful, patient, systematic, diligent text by Wilson.[6]

In his final chapter, titled "Why Bother?" Lanham reminds us of two powerful motivations for revision: First, *efficiency:* revision sharpens thinking, shortens the text, and thus delivers the message to the reader more accurately and more quickly. The grateful reader will doubtless hold the author in higher regard. Second, *ego*: "Writing is a way to clarify, strengthen, and energize the self, to render individuality rich, full, and social."

Lanham also appreciates author individuality in composition, but insists on substantial commonality in revision:

> *People often argue that writing cannot be taught, and if they mean that inspiration cannot be commanded nor laziness banished, then of course they are right. But stylistic analysis—REVISION—is something else, a method, not a mystical rite. How we compose—pray for the muse, marshal our thought, find willpower to glue backside to chair—these may be idiosyncratic, but revision belongs to the public domain. Anyone can learn it.*

The "Final Version" is copied and distributed to the faculty committee two weeks prior to the oral presentations.

ON THE MAKEUP OF FACULTY COMMITTEES

The formal regulations for the course instructor indicate that each four-member committee be composed of two faculty knowledgeable in the general area and two other selected at random. To insure uniformity of procedure, the instructor serves on all proposition committees and chairs each presentation.

Justice further demands that the instructor create each committee so as to contain a balance between known or perceived faculty "hardballs" and "softies." These widely presumed qualities were largely illusive: for the most recent class of eighteen students, the faculty average evaluation grade differed by only ±0.1 from the four-member average grade for that committee. Using the evaluation data from each of the 3-4 committees on which nearly every faculty member served, I calculated first the grading "bias" of the individual faculty and then the expected "bias" of each committee from summing these individual values.

TABLE 4

Titles and Lead Sentences Illustrating the "Fast Start"[6]

- **Choice and Statement of a Research Problem**
  Many scientists owe their greatness not to their skill in solving problems but to their wisdom in choosing them.
- **Searching the Literature**
  Six hours in the library may save six months in the laboratory.
- **The Design of Apparatus**
  An experiment involves the examination of some part of the universe under specially contrived conditions.
- **Errors of Measurement**
  A measurement whose accuracy is completely unknown has no use whatever.
- **The Analysis of Experimental Data**
  Observations are useless until they have been interpreted.
- **Reporting the Results of Research**
  Research is not completed until it has been reported and, if possible, published.

The average committee bias was only ±0.03, and no "Committee from Hell" was in evidence! Thus, the calculated "bias" of each committee was insufficient to affect any proposition outcome.

PRESENTATIONS MATERIALS AND PRACTICE

As a guide for good transparencies and good technical-presentation speaking habits, I distribute a brief two-page exhortation written by my colleague Richard Felder. Preparing transparencies (or slides) is a most underrated task, as any conference audience will attest. In an individual review session with each student, transparency drafts are treated critically: Does each have an informative title? Are figure legends, axes, and labels rewritten and redrawn to be brief and readable even to the aging eyes of elderly committee members? (Consider your audience!) Is all extraneous material removed? Is the whole proposition story outlined evenly and smoothly in 12-16 transparencies? Has a theme and clear vocabulary been chosen to transmit the argument forcefully?

During each twenty-minute oral practice presentation, the class acts as the "faculty committee." The students quickly see the utility of posing questions, even tough and unfriendly ones, since these identify weaknesses and alert the presenter to opportunities for improvement. Questions also indicate audience interest, for which every speaker is always grateful!

TABLE 5
Evaluation Form for Research Proposition

(Each segment is graded up to 100% of its relative weight; a "pass" mark is a total mark of 75% or higher.)

Written Document

1. Knowledge of "state-of-the-engineering-science"; perspective; critical analysis of existing body of literature **(10%)**
2. Suitability of selected research problem; originality; feasibility of success **(10%)**
3. Effectiveness of proposed research plan; understanding of relevant physical and chemical phenomena; chance of success, methodology current and viable **(10%)**
4. Quality and effectiveness of writing; conciseness; logic; clarity **(20%)**
5. Creativity; degree of innovation in proposed research **(15%)**

Oral Presentation

6. Quality and effectiveness of presentation; conciseness; logic; clarity; impact; thoroughness **(20%)**
7. Knowledge of field of research topic **(5%)**
8. Master of chemical engineering principles **(5%)**
9. Creativity in responding to questions (ability to think on one's feet) **(5%)**

FORMAL PRESENTATION AND DEFENSE

Audience attendance by some class members is encouraged at each formal presentation to the faculty committee. The student's PhD advisor is never present as either audience or committee member. In the one-hour exam, the student gives a twenty-minute uninterrupted presentation, responds to about twenty minutes of faculty questions, and is then excused.

Using an evaluation form (see Table 5) that provides weighting of various performance dimensions, committee members evaluate the written proposition in advance. Immediately after the presentation, faculty evaluate both the oral presentation and the responses to questions. Following a ten-minute committee discussion, the final faculty evaluations are averaged and a pass/no pass determination is made. Regardless of the outcome, the itemized evaluation averages are returned to the student for future reference.

A LEVEL PLAYING FIELD

Fairness to all aspiring PhD students during the semester dictates the establishment of a policy regarding allowable conversations with other graduate students, faculty, research professionals, etc., about the individual propositions. I have taken the simplest path—no such conversations are allowed.

INSTRUCTOR ROLES

The course structure demands various roles for the instructor. He or she must be a lecturer/discussion leader for the two texts by van Wegenen and Lanham, an advisor in individual sessions to discuss literature reviews, outlines, and draft transparencies, a proposal reviewer of the draft and final versions, and a critic at the practice oral presentation. Providing occasional comic relief is also an asset, to relieve the tension arising from the obvious fact that the course outcome is substantial for each student. Class sizes have ranged from 10 to 18, and the total instructor time commitment is comparable to that for any 3-unit course.

OUTCOMES

> *The Proposition should demonstrate the student's ability to define a research problem and design a program to determine a potential solution using the fundamental principles of our discipline."*[2]

The pass rate for the approximately fifty students who have taken the course is about 85%. Those who pass enter PhD candidacy and are expected to prepare and defend their written PhD preliminary proposition by the end of their second year in residence. Students judged not yet ready are invited to pursue a Master's thesis, and upon completion this second work may, at the student's and advisor's request, be presented to a committee of four faculty (not including the research advisor) to allow reconsideration for PhD program admission.

It may be only slight exaggeration to say that the research proposition course welds each class of students together, much as does joint passage through any other crisis or substantial challenge in life.

The proposition evaluation (Table 5) invites measurement of qualities presumed indicative of research potential and technical maturity. The four years of experience with this class indicate that the research proposition committee grades correlate only weakly with graduate grade-point average, and not at all with GRE verbal or quantitative scores. That PhD achievement does not correlate well with GPA or GRE is not new; early on, I tell students the anecdote about the one NSF fellowship application variable that correlated most strongly with eventual achievement of the PhD—early completion and submission of the application!

FEEDBACK FROM CURRENT AND FORMER GRADUATE STUDENTS

Previous graduate student suggestions led to including both a rough draft, with feedback on technical content, and a sample oral presentation by a previous-year student.

Next year we will augment the presentation by the senior PhD student by including a faculty committee question period, inserting more illustrations of good technical writing (van Wegenen's text offers only social science examples), and providing a fall discussion to initiate earlier idea development.

Student consultation with faculty or other students in the department remains an issue. I have allowed none, but will try one feedback conversation with the second faculty reader of the draft proposition.

EVALUATIONS

A survey conducted this spring of our proposition course participants, currently in years 1-4 of their graduate study, provided the responses summarized below.

Among learning to formulate research problems, to improve writing, or to improve public speaking, problem formulation was the dominant outcome selected by all four classes: 79% (1st year), 85% (2nd year), 67% (3rd and 4th years).

Higher-rated individual aspects of the course were

- extremely valuable:
  writing the rough draft; comments received on the rough draft; giving a practice talk
- generally helpful:
  doing a literature review; writing the proposal outline (with references); preparing the technical presentation; class questions after the practice talk

(Other available responses were "somewhat helpful," "not particularly helpful," and "not helpful at all.")

The distribution of course evaluations from 41 of 52 students follows:

My attitude toward the class is:

• liked it and benefited from it	68%
• hated it, but benefited from it	20%
• neutral	5%
• hated it and didn't benefit	5%
• liked it, but no benefit	2%

Hours per week spent on the class were:

• less than 10	10%
• 11-20	44%
• 21-30	29%
• more than 30	17%

The effect of this course on my desire to do research is:

• very positive	27%
• somewhat positive	44%
• neutral	24%
• somewhat negative	0%
• very negative	5%

As a result of this course, my writing ability is now

• much higher	5%
• higher	49%
• about the same	44%
• lower	2%

As a result of this course, my initiative to start my research is now

• much higher	15%
• higher	44%
• about the same	39%
• lower	2%

Men and women responded similarly to many of the forty-four questions. The following exceptions to this generality are also informative:

- Initiative to start my own research is now rated "higher" or "much higher": *men (65%), women (38%)*
- Starting my own research after taking this course has been "somewhat difficult" to "very difficult": *men (15%), women (63%)*
- Giving a practice talk was "helpful" to "extremely valuable": *men (71%), women (92%)*
- Attitude toward class? "liked it and benefited": *men (61%), women (85%)*
- Rate effort in class above or very much above average? men *(56%), women (85%)*

but

- Workload of course rated as reasonable?: *men (75%), women (100%)*
- Subject more interesting than expected? *men (37%), women (54%)*
- Most frequent hrs/week on course effort? *men (11-20),*

women (21-30),

- Anxious about taking the course? *men (60%), women (76%)*

Women were more positive than men about all activities involving communication, including writing and receiving comments on the rough draft and giving the practice talk and responding to class questions. Eleven of thirteen women liked the course (regardless of benefit), but eight of twenty-eight men hated it!

FACULTY RESPONSE

All faculty participate in and are strongly supportive of the course in its current state, although possible improvements always beckon.

ACKNOWLEDGMENTS

I am pleased to thank George Roberts who, as department head, encouraged the formation of the founding committee for the Research Proposition course and who provided teaching recognition for it. Peter Fedkiw originally noted the very strong correlations between graduate GPA and written PhD qualifier scores, and thus the disutility of the latter. Peter, Ruben Carbonell, and Peter Kilpatrick devised the original PhD proposition requirements and evaluation criteria. Diane Beaudoin, PhD candidate, created (with Rich Felder's assistance), administered, and summarized the course evaluation questionnaire.

REFERENCES

1. Graduate Policy Statement, North Carolina State University, Chemical Engineering (1995)
2. *Webster's New Universal Unabridged Dictionary,* New World/Simon and Schuster (1983)
3. van Wegenen, R. Keith, *Writing a Thesis: Substance and Style*, Prentice-Hall, Englewood Cliffs, NJ (1991)
4. Woodford, F.P., "Sounder Thinking Through Clearer Writing," *Science* **156**, 743 (1967)
5. Lanham, Richard A., *Revising Business Prose,* 3rd ed., Macmillan Publishing Co., New York, NY
6. Wilson, Jr., E. Bright, *An Introduction to Scientific Research,* Dover Publications, Inc., New York, NY (1990) ❐

ChE ***book review***

STUDYING ENGINEERING: A Road Map to a Rewarding Career

by Raymond B. Landis

Published by Discovery Press, Burbank CA: Distributed by Legal Books Distributing, 4247 Whiteside St., Los Angeles, CA 90063; 236 pages, $22.95 (1995)

Reviewed by
Phillip C. Wankat
Purdue University

There is considerable current interest in courses for first-year students in engineering. Two major approaches have been used. One approach is a design course, preferably with hands-on experience (*e.g.,* see Beaudoin and Ollis, *J. Engr. Ed.,* **84**, 279, July, 1995). The second approach is an orientation course which helps students learn how to survive and then to thrive in engineering. Ray Landis, the Dean of Engineering at California State University-Los Angeles, has written a textbook for this second approach. This book is written for a course with students who will be going into all disciplines, but it easily could be used for a course for chemical engineering students.

The introductory chapter on "Keys to Success in Engineering Study" is an important part of the book that students should not just skim over. This chapter firmly makes the point that it is up to the student to succeed—determination and effort are often more important than "smarts." Based on my experience with freshman engineers, I feel this is absolutely true. But how do we get students to believe it? Dean Landis has a very convincing argument and discussion of this point. He notes that a combination of determination, effort, and proper approach is all important.

Chapter 2, "The Engineering Profession," is supposed to explain what engineers do. Unfortunately, the descriptions of different engineering disciplines and different engineering job functions are just too short. For example, there is only one-half a page on chemical engineering, six lines on materials science engineering, and three lines on petroleum engineering. A better approach would have been to present scenarios on a typical day at work for different engineers. The general information on what is important in selecting a career will be very useful to the students. At universities where students select chemical engineering before their first year, the shortcomings of this chapter will not be critical since the professor can easily supplement the section on chemical engineering. At universities where students start in a general engineering program or a university college, however, a major function of the orientation course is to help the students select a major. Chapter 2 is inadequate for this purpose.

Chapter 3, "Academic Success Strategies," is a strong and useful chapter. Section 3.2 on structuring one's life situation is particularly critical and shows that the author has worked with many students. The guide for course loads and hours of

Continued on page 274.