Informal Writing-to-Learn Exercises

Write and Pass:
Students record their response to a certain question. The response is then passed to the next person in the row or circle, who revises, critiques, or responds in some specified way to what the first student wrote. The response sheet is then passed to a third student, who responds. Eventually the first student gets her paper back with all the responses or revisions. The teacher may or may not collect the sheets. This exercise is ungraded.

Example: Students are asked to write down the definition of a concept the class is considering. This definition is passed to the next person, who then revises/improves/expands on the original. The definition may be passed three or four times before it is returned to the original writer. This exercise promotes critical thinking and sharpens students’ ability to evaluate their own understanding and the understanding of their classmates.

Journals:
Students may be asked to respond to assigned readings, class discussions, or clinical experiences in a journal format. The teacher identifies the goals of the journal assignment, the appropriate way of approaching the entries (how often, how long, what format), and the criteria for evaluation. Journals entries are often minimally graded during the term (check, check plus, check minus), and then at the end of the term the student writes a cover letter assessing the journal according to the specified criteria. Students may be asked to suggest a grade for their own journals and identify their best entries. This self-assessment not only encourages students to take stock of their own learning but also assists the teacher in assigning a final evaluation grade for the journal. (See WIC handout on journals and logs.)

Microthemes:
A microtheme is an essay so short it can be typed on a 5x8 note card. Microtheme developers John C. Bean, Dean Drenk, and F.D. Lee note the advantages of the assignment: “Capable of being graded rapidly and thus adaptable to large classes, microthemes can be designed to promote growth in specified thinking skills.” Microthemes may be graded (quickly!) for individual credit or used as a step in the process toward a larger project. The teacher might give feedback by photocopying several of the best and distributing them to the class. (Assignment adapted from “Microtheme Strategies for Developing Cognitive Skills” by John C. Bean, Dean Drenk, and F.D. Lee in Teaching Writing in All Disciplines, ed. C. Williams Griffin. Jossey-Bass, 1982.)

Types of microthemes include: Summary Microtheme; Thesis-Support Microtheme; Data-Provided Microtheme; and Quandary-Posing Microtheme.

Summary Microtheme: Students are asked to write a good 100-200 word summary of an article, which is a cognitively difficult task. The student must identify the structure of the article, identify the hierarchical relationships of ideas and details, and condense the whole, eliminating details and retaining main ideas.
**Thesis-Support Microtheme:** Students are asked to take a position on a topic, making an assertions about the topic and supporting the assertions concisely with appropriate details, empirical evidence, reasoning, appeals to authority. This exercise not only promotes critical thinking but also reminds students of what is and is not known in the discipline.

**Data-Provided Microtheme:** Students are provided with a data set and are asked to discover a general thesis or observation based on the data set. This exercise improves inductive reasoning and may prepare them to write the discussion section of a scientific paper.

**Quandary-Posing Microtheme:** Students are asked to use scientific principles as they offer an explanation of a problematic situation or occurrence, writing in language that an ordinary person could understand. This exercise gives them practice in communicating with lay audiences while putting abstract or complex concepts into everyday language.

**Cubing:**
Cubing is a form of directed freewriting in which students consider a topic from six different aspects or perspectives, each representing one face of a cube. Students write for a minute or so on each perspective:

- Describe X.
- Analyze X. What are its parts? Where did it come from? What is its purpose?
- Compare X to something else. What is similar to or different from?
- Associate X with other things. What does it make you think of?
- Apply X. What are its uses?
- Argue for or against X.

**Looping:**
Looping is a form of directed freewriting designed to improve focus on a topic. Students are told: Write for 2 minutes on your topic (or a question selected by the teacher). Stop. Review what you wrote and underline the most interesting or surprising word or thought: or sentence you wrote. Copy what you underlined and start your next 2-minute freewrite with the selected word, thought, or sentence and write from there. This can be repeated four or five times.

Write a test question.

Write a Rogerian argument that seeks common ground and accurately describes the opposing view.

During a lecture: Write down three things you understand so far and one question you have. (Teacher can use responses to start a discussion and check for understanding.)

Prewrite to prepare for a major writing assignment:
- List, cluster, mind-map, or loop on your topic
- Freewrite on the purpose of the paper
- Freewrite to analyze the audience of the paper
- Brainstorm research questions and key words.
WRITING-TO-LEARN STRATEGIES

Summarize/Remember/Reflect

1. **Write a Summary** of a lecture, class discussion, seminar or chapter.

2. **Condense your Notes**: Read over your notes from a class; write down what you think were truly the main ideas, the organizing ideas in that lecture or discussion.

3. **Create a Test**: Read over your notes and design a difficult test for yourself. Several hours or days later, take the test. Include an essay question.

4. **End of Class Observations**: Immediately after class, jot down your impressions of what went on and why the instructor organized the class that way. If you have any confusion, try to explain why or to pinpoint in writing the moment at which your confusion began.

5. **Lab Reflections**: Immediately after lab session, sit down and write about what you did and what the point of it was.

Zeroing In—Looking Closely at Important Passages/Details or Key Concepts

6. **Key Word**: Choose a word that seems important to your reading (one that you do not understand or is repeated or otherwise emphasized), and write about all of its associations with anything else in the text or from your experience. Look it up in a dictionary and puzzle over the possible implications of its different meanings.

7. **Mapping**: Write a key word from the text or lecture in the middle of the page. Then build upon it by association, jotting down related words and indicating relations with arrows. Continue until you reach terra incognita. Also try treeing: put a topic at the top or bottom of the page and branch into subtopics.

8. **Extraction of Significance**: Take a statement from your reading or a lecture and exhaust its possible meanings.

9. **Write Out the Definition**: Pick a key concept or term in your course, and try to define it fully, giving illustrations.

10. **Show off a Topic**: Pick any topic, and write down everything you know about it, no matter how obscure and irrelevant. This is a good way to get started on assigned papers or to study for a test.
11. **Double-entry:** Draw a vertical line down the center of a blank page. In the left column, write interesting quotes from the text or lecture. In the column, respond positively or negatively to the quote to write a related idea, something you wish to add, a question raised by the quote or paraphrase.

12. **Character Study:** Begin your analysis of a fictional or historical character by reviewing two or three key passage in the text; then write every detail you can think of about that character, puzzling over which details are the most important or revealing. Pay attention to the way the character is described, what the character says and does, and what other characters say about the character.

13. **Literary Term:** Choose a literary term (like “point of view” or “foreshadowing”) that seems to offer a way into the text. Write a brief definition of the term to see what it can reveal to you about the material you have read.

**Making Connections—Pushing your Thinking Further**

14. **Particle, Wave and Field:** Look at your subject from three different perspectives. First, consider it as an entity on itself (particle). Describe its essential characteristics. Next, consider it as a part of a process that takes place in time (wave). For example, you might describe its causes or effects; you might also explain what is required to keep it going. Finally, consider the subject as part of a whole system that affects things around it (field). What are the other components of the system? How are they related?

15. **Check your knowledge:** What is a term or concept you don’t feel confident of? Write as much as you can—what do you know? What don’t you know? Push for clarity.

16. **Pre-guessing Chapters:** Before you read a chapter in a text, write about what you imagine the chapter might be about, guessing from its title or from material covered in the preceding chapter (you might also pre-guess a lecture, discussion or lab).

17. **Narrow down your topic:** Write about an idea for two minutes. Stop. Pick a topic sentence from that paragraph and write for another two minutes about that. Again, pick another topic sentence from the second paragraph and write for two more minutes. The longer you do this, the more specific you become about the topic.

18. **Growing a Problem:** Raise all the questions you have pertaining to a particular concept or assignment, jot down all the thoughts on it, no matter how disordered and fragmented.

19. **Making Connections:** Write on every possible way in which new information can be connected to ideas, beliefs, and information you already have.
20. **Build Contradictions:** State all the oppositions and contradictions in the material you are reading or studying. Argue the pros and cons. Have a debate with yourself.

21. **Doubting and Believing Games:** Take an idea that is very hard to accept or believe and pretend to be someone who believes it. What would it be like to believe it? What would you notice. Now take an idea that is comfortable for you, that you really believe, and pretend to be someone who doubts it. Writing out as many doubts and arguments against it as you can.

22. **Metaphor:** Compare something else, and then elaborate on the similarities and differences between the two things, e.g., “This hunting story is told with such artful language, it’s like a BMW lurching down a bumpy country road.” Unpacking such wild comparisons can yield surprising insights.

**Teaching a Difficult Concept to Someone Else**

23. **Letter Writing:** Choose a real person to write a letter to about your subject, experiment with audiences of varying backgrounds and level of expertise in your subject area (try writing to a precocious five-year-old who would need an especially clear and simple, yet not condescending, explanation).

24. **Create an Audience:** Pick a fictional or historical character or imagine a person to whom you might want to explain a difficult concept, someone who might be anything from your worst possible to your best possible audience. Begin by describing that person in detail. Include that person’s background, values, and habitual way of thinking. Briefly explain why it would be useful or helpful for that person to understand the concept. Then, with this portrait of your audience in mind, explain the concept.

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Adapted from Sam Watson; Western Oregon U. handout, and other sources.
A sequence of short writing assignments can help students in any discipline to develop both their thinking and writing skills without adding a heavy paper-grading load on the instructor.

Microtheme Strategies for Developing Cognitive Skills

John C. Bean
Dean Drenk
F. D. Lee

Generating faculty enthusiasm for a writing-across-the-curriculum effort is not an easy task. As long as content area instructors think of writing instruction as doctoring up the grammar of term papers, there can be little hope of progress. A successful writing-across-the-curriculum program therefore demands some conceptual blockbusting.

One of the best blockbusters we have discovered is the microtheme—an essay so short that it can be typed on a single five-by-eight-inch note card (Work, 1979). Capable of being graded rapidly and thus adaptable to large classes, microthemes can be designed to promote growth in specified thinking skills. Once content area instructors discover that a new kind of writing assignment can help their students become better learners and thinkers without adding a heavy paper-grading burden to their own work load, they become enthusiastic about writing-across-the-curriculum programs.

The microtheme method can be employed successfully in both large and small classes. Instructors who use the method generally give all students the same assignment, along with a description of the criteria by which the

theme will be evaluated. Since writing is seen as a mode of learning, students are urged to work together outside of class as a way of expanding their active thinking time. The assignments are designed according to a principle that we call leverage in which a small amount of writing is preceded by a great deal of thinking. Not all microthemes need to be graded; some instructors, considering them practice for later graded exercises, simply record that they have been completed. When microthemes are graded, they can be scored rapidly according to a variety of strategies. Using simple rating scales (several examples are displayed later in this chapter) instructors report that they can grade between thirty and fifty microthemes per hour. In large lecture classes, graduate assistants or even top undergraduates can be trained to grade microthemes. Rather than writing comments on individual microthemes, the instructor can provide feedback to students by duplicating and distributing several of the best microthemes, as well as a few of the less successful ones that exhibit representative writing or thinking problems. Class discussion of these microthemes provides adequate feedback; indeed, some students report that it provides better feedback than traditional comments on papers.

We have had success with four kinds of microtheme assignments. Each is designed to focus on a different cognitive problem.

The Summary-Writing Microtheme:
The Problem of Cognitive Egocentrism

As anyone who has tried it knows, writing a good one- or two-hundred-word summary of an article is a cognitively difficult task. The writer must first determine the structure of the original article by locating the transitions and other cues that signal hierarchical relationships among specific details and various levels of abstraction. Then the writer must condense the whole, retaining main and subordinate ideas while eliminating supporting details. Such a task builds students' reading comprehension skills and also gives students practice in writing concise, flexible prose. (Figure 1 shows a sample rating scale for summaries.)

The summary-writing microtheme can have another benefit for students—as a way of helping them combat what cognitive psychologists call egocentrism. According to Piaget, an egocentric thinker "sees the world from a single point of view only—his own—but without knowledge of the existence of [other] viewpoints or perspectives and... without awareness that he is the prisoner of his own" (Flavell, 1963, p. 60). As maturing thinkers develop toward formal operations—that is, toward the ability to think in abstractions by attending to the form of logical arguments, without dependence upon concrete or specific examples—they gradually acquire the ability to imagine the
Figure 1. Evaluation Criteria for Summaries

A summary should be directed toward imagined readers who have not read the article being summarized. The purpose of the summary is to give these persons a clear overview of the article's main points. The criteria for a summary are (1) accuracy of content, (2) comprehensiveness and balance, and (3) clear sentence structure with good transitions.

6 A "six" summary meets all the criteria for accuracy, comprehensiveness and balance, and clear sentence structure. The writer should understand the article thoroughly. The main points in the article should appear correctly in the summary with all main points proportionately developed (that is, the writer should not spend excessive time on one main point while neglecting other main points). The summary should be as comprehensive as possible and should read smoothly from beginning to end with appropriate transitions between ideas. The sentence structure should be clear and varied, without vagueness or ambiguity and without grammatical errors.

5 A "five" summary should still be excellent, but it can be weaker than a "six" summary in one area. It may have excellent accuracy, comprehensiveness, and balance but show occasional problems in sentence structure. Or it may be clearly written but somewhat unbalanced or less comprehensive than a "six" summary or it may show a minor misunderstanding of the article.

4 A "four" summary is one that is good but not excellent. It will reveal a generally accurate reading of the article with a clear sense of the main points, but it will be noticeably weaker than a "six" summary in one of the areas of criteria or somewhat weaker in two areas.

3 A "three" summary must have strength in at least one area of competence, and it should still be good enough to give a reader a fairly clear and accurate overview of the article being summarized. A "three" summary is generally either seriously unbalanced or fuzzily written and lacks the clarity and precision of a top-rated summary. The sentence structure of a "three" summary frequently prevents inclusion of enough ideas for good comprehensiveness.

2 A "two" summary is weak in all areas of competence, either because it is so poorly written that the reader cannot understand the content or because the content is inaccurate or seriously disorganized.

1 A "one" summary fails to meet any of the areas of competence.

points of view of other thinkers and thus to initiate the kind of dialectic interplay between opposing views that leads to intellectual growth.

Lunsford (1979) has used Piaget's concept of egocentrism to explain why basic writers, when asked to compose paragraphs analyzing objective data, frequently write instead about personal opinions provided by the data, apparently unaware that they have veered from the assigned topic. We have noted the same kind of egocentrism in students' first attempts at summary writing. For example, students frequently distort the ideas of authors whose views are unfamiliar or distasteful. These students either introduce their own
opinions and observations into the summaries, or they turn disturbing ideas into comfortable ones. With repeated practice, however, students can learn to "listen" to the authors whom they are summarizing and consciously guard against the tendency to block out dissonant points of view.

The summary-writing microtheme, therefore, is particularly beneficial in courses where conflicting world views clash—sociology, ethics, political science, and so forth. Having students summarize articles that express opposing points of view urges them away from superficial one-right-answer thinking. One especially valuable procedure in such classes is to have students summarize opposing articles while keeping a journal that allows them to explore their own subjective reactions to the material. In fact, it is only a short step from summarizing articles with varying viewpoints to accomplishing the kind of synthesis required for library research papers. A recent anthology on writing across the curriculum takes just this approach (Behrens and Rosen, 1982).

The Thesis-Support Microtheme: The Problem of Focused Argumentation

An essential concept for writers is the thesis statement, that is, the basic proposition or controlling idea of a piece of writing. Whereas a topic is a noun phrase by itself (for example, "the student revolutionary movement in the late sixties"), a thesis statement has a predicate that makes an assertion about some issue within the topic ("The student revolutionary movement in the late sixties resulted from the childhood permissiveness popularized by Benjamin Spock"). Because thesis statements generally take a stand on an issue, mature writers learn to imagine a doubting audience that needs to be argued out of a countering position ("The student revolutionary movement in the late sixties was not causally related to the permissiveness of Benjamin Spock"). Many student writers, however, have difficulty discovering issues within a topic or formulating thesis statements that take focused positions on issues. Either they write a diffuse thesis statement ("The student revolutionary movement in the late sixties had good points and bad points"), or they write a paper that has no thesis statement at all (for example, a research paper on the student revolutionary movement replete with historical facts but devoid of clear purpose or point—what one of our colleagues calls data dumping). Illogical or poorly focused papers; therefore, frequently stem from inadequate thesis statements, which stem in turn from an inadequate sense of the issue at hand.

Thesis-support microthemes are designed specifically to enable students to discover issues and create propositions within a content discipline. An assignment sequence designed by Dean Drnek for an upper division finance course in investments illustrates this strategy. Drnek assigns students ten issues from a list of more than sixty. Each issue is stated in terms of contra-
dictory propositions or theses. Students must choose one of the alternative propositions for each issue and write a microtheme that defends the position. (Drenk allows students to write as many as two typed pages—slightly more than the other microthemes described in this chapter.) These propositions differ from most essay examination questions in that they take positions that are controversial and unproven in the field. Here are five representative issues:

1. The price-earnings ratio of a stock (does/does not) reflect the rate or return that an investor in that stock will achieve.
2. Professional management (is/is not) an effective means of achieving higher than average stock returns.
3. Random diversification (is/is not) more reliable than selective diversification.
4. The geometric mean of a return distribution (is/is not) an indicator of the risk of that investment.
5. Mutual fund performance (is/is not) superior to the average investor’s performance.

In writing this kind of microtheme, students must stop being passive memorizers and become active thinkers. They must support their assigned propositions concisely, using empirical evidence, syllogistic reasoning, appeal to appropriate authority, and so forth—all the tools of argumentation used by professionals in the field. (Criteria for grading such microthemes are shown in Figure 2.) Because many of these propositions can be best supported through library research, students learn to seek out information for themselves, information that they must weigh, synthesize, and reshape in order to build a logical, cohesive argument. Moreover, the proposition not chosen—the alternative counter-proposition—continually reminds students that their task is not simply to utter facts but to defend a position. Finally, because the thesis-support microtheme demands mastery of the principles covered in courses that rely on the textbook and lecture, students are actively learning central course material as they prepare their microthemes.

Drenk posits two immediate advantages to thesis-support assignments: Students become noticeably more skilled at focused argumentation as the course progresses, and students learn to see their disciplines as a field of controversies, not as a body of facts to be memorized. Thus, students learn to understand the complexity of what is known and what is not known within their disciplines.

The Data-Provided Microtheme: The Problem of Inductive Reasoning

The task of the data-provided microtheme is the obverse of the task of the thesis-support microtheme. Here, students are provided with data and
Figure 2. Grading Criteria for Thesis-Support Microthemes

There are various types of support of theses, including the following: empirical evidence, theoretical argument, authority, and intuition. These types of support are listed in order of their strength. That is, empirical evidence outweighs theoretical arguments, which in turn outweighs authority, and so on. When using different types of support, students should take into account such factors as:

For empirical evidence:
- The past versus the future
- Precise pertinence of the data to the thesis
- The unbiased or biased nature of the data

For authority:
- The past record of the authority
- Qualifications of the authority
- The extent of concurrence with other authorities

Thesis-support microthems should be written so that they are clear to those who are not members of the class or even in the same discipline. They should not be written so that they can be understood only if the reader already knows the thesis and its support.

Grading Criteria

<table>
<thead>
<tr>
<th>Support of Theses</th>
<th>Other Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Clarity of support</td>
<td>Grammatical errors are numerous</td>
</tr>
<tr>
<td></td>
<td>enough to interfere with understanding your response.</td>
</tr>
<tr>
<td>B. Logic (Relationship of</td>
<td>The organization of your response is not clear.</td>
</tr>
<tr>
<td>support to thesis)</td>
<td></td>
</tr>
<tr>
<td>C. Sources of Support.</td>
<td>The logic of your support is confusing or does not</td>
</tr>
<tr>
<td>1. Quantity</td>
<td>make sense,</td>
</tr>
<tr>
<td>2. Quality</td>
<td>Your conclusions are not warranted by your support.</td>
</tr>
<tr>
<td>Total Microtheme Grade</td>
<td>Your support is too imprecise or too general to</td>
</tr>
<tr>
<td></td>
<td>convince.</td>
</tr>
</tbody>
</table>

asked to discover a thesis or general statement that gives meaning to the data. The data can be provided as a list of sentences (Figure 3) or as a graph or statistical table (Figure 4). Students must arrange the data in a logical order (in more complex assignments, students must select only the significant data and omit irrelevant data), connect the parts with appropriate transitions, and write general statements showing the meaning that they have induced. In a sense, data-provided microthems are to writing as scales are to piano-playing or school figures to ice-skating. They de-emphasize individuality and creativity, forcing students to concentrate on technique—in this case, on the development of inductive reasoning powers and on the shaping of meaningful paragraphs by means of the transitions and generalizations that students must pro-
vide. Ideally, this kind of exercise helps students to learn the difference between a mere list of facts (the data as they are provided) and an assertion of meaning: (the data reshaped into a logical microtheme).

Data-provided microthemes can serve a variety of purposes. At the most basic level, they can teach students to arrange paragraphs hierarchically and to signal the relationships with transitions. In these cases, the instructor can provide a tree diagram for the intended paragraph (see the "diet" assignment in Maier and others, 1981, pp. 50–51). Lainsford (1979) uses data-provided assignments to help students to improve their skills in inductive reasoning. (For commentary on Lunsford’s methods, see Bean, 1981–1982). At a more advanced level, instructors can use data-provided assignments to teach students how to write the discussion section of a scientific paper. The instructor can duplicate a chart or table from the findings section of a sample paper and ask students to write an appropriate discussion paragraph that analyzes the meaning residing within the raw data. Exercises of this nature can sometimes have a dramatic effect on students’ understanding of how meaning is conveyed in written discourse.

Figure 3. Example of Data-Provided Assignment (Sentence Method)

Using all of the data supplied below, write a brief essay on the topic "Is the Energy Crisis Real?"

1. 90 percent of the world’s oil (2,100 billion barrels) is still in the ground.
2. The proportion of oil left in the U.S. is much less than 90 percent.
3. Experts estimate that the U.S. will ultimately produce a total of 204 billion barrels of oil.
4. The U.S. has produced and burned 110 billion barrels of oil so far.
5. 75 percent of America’s potentially available oil has already been discovered.
6. Half of all the oil produced in the past 110 years was pumped and burned in the last ten years.
7. The Alaskan oil discovery added 35 billion barrels of oil to America’s proven reserves.
8. The U.S. presently uses 30 billion barrels of oil per decade.
9. We have used 1.7 percent of the world’s coal supply.
10. Coal contains a lot of sulfur, which vaporizes when burned and gives off noxious gas.
11. Coal burning leaves much ash, which poses a significant disposal problem.
12. Coal smoke is a serious air pollutant.
13. Coal mining can damage the countryside.
14. Miners are killed in mine accidents every year.
15. Many coal miners suffer from black lung.
Figure 4. Data-Supplied Microtheme Assignment (Table Method)

Your assignment is to write a paragraph using specific detail data from the table provided. You will notice that the death rates for some diseases have declined sharply from 1910 to 1966, while the death rates from other diseases have increased.

To make your microtheme interesting, you might speculate as to why these changes have occurred. Your priority, however, is to explain clearly that the changes happened and highlight what you feel to be significant about the data.

You are to imagine a general audience who has never seen this table, and your task is to create an interesting and informative paragraph. This assignment will test your skill in creating a hierarchical structure that alternates between general statements and specific details in a clear, logical order.

The following is a chart depicting the death rates (per 100,000 population) and the causes of death from 1910 to 1966 in the United States. Fetal deaths are not included.

<table>
<thead>
<tr>
<th>Year</th>
<th>All causes</th>
<th>Cardiovascular diseases</th>
<th>Infant pneumonia</th>
<th>Certain diseases of early infancy</th>
<th>Influenza and pneumonia</th>
<th>Diabetes</th>
<th>Bronchitis and pneumonia</th>
<th>Accidents</th>
<th>All Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>1,460</td>
<td>373</td>
<td>74.2</td>
<td>75.0</td>
<td>166.9</td>
<td>15.3</td>
<td>84.2</td>
<td>714</td>
<td>714</td>
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<tr>
<td>1920</td>
<td>1,433</td>
<td>363</td>
<td>72.4</td>
<td>69.2</td>
<td>167.3</td>
<td>16.0</td>
<td>79.8</td>
<td>659</td>
<td>659</td>
</tr>
<tr>
<td>1930</td>
<td>1,410</td>
<td>313</td>
<td>74.2</td>
<td>69.2</td>
<td>167.3</td>
<td>16.0</td>
<td>79.8</td>
<td>659</td>
<td>659</td>
</tr>
<tr>
<td>1940</td>
<td>1,316</td>
<td>407</td>
<td>72.7</td>
<td>67.9</td>
<td>167.3</td>
<td>16.0</td>
<td>79.8</td>
<td>659</td>
<td>659</td>
</tr>
<tr>
<td>1950</td>
<td>1,332</td>
<td>400</td>
<td>72.7</td>
<td>70.0</td>
<td>169.6</td>
<td>16.0</td>
<td>79.8</td>
<td>659</td>
<td>659</td>
</tr>
<tr>
<td>1960</td>
<td>1,368</td>
<td>444</td>
<td>22.7</td>
<td>67.9</td>
<td>166.9</td>
<td>16.0</td>
<td>79.8</td>
<td>659</td>
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<tr>
<td>1970</td>
<td>1,368</td>
<td>444</td>
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<td>67.9</td>
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<tr>
<td>1980</td>
<td>1,368</td>
<td>444</td>
<td>22.7</td>
<td>67.9</td>
<td>166.9</td>
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<td>659</td>
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<tr>
<td>1990</td>
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<td>444</td>
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<td>166.9</td>
<td>16.0</td>
<td>79.8</td>
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<td>659</td>
</tr>
</tbody>
</table>

The Quandary-Posing Microtheme: The Problem of Cognitive Puzzles

Evidence is accumulating in scientific journals that nearly two-thirds of today's college students are not fully capable of abstract reasoning (Arons and Karplus, 1976). Among physics students, this problem frequently manifests itself as an inability to understand the differences between such concepts as weight and mass, or velocity and acceleration (although students can, of course, recall textbook explanations and perform formula computations). It is students' confusion about such concepts; in fact, that has led to the interest in Piaget among science educators and to the multiplication of Piaget-based science curricula throughout the country.
Recently, Arons (1981) reported that students can be guided toward mastery of a concept if a Socratic dialogue technique is used to urge them to articulate the concept in their own words. Apparently, the process of thinking out loud, of working to transform vaguely formed private thoughts into public words, enhances comprehension. Arons’s report seems to bear out the professorial folk wisdom that one does not really understand a concept until one can articulate it clearly to someone else. In an effort to duplicate in a 400-student lecture course some of the benefits reported by Arons from face-to-face conferences with students, F. D. Lee designed a sequence of quandary-posing microthemes. These microtheme assignments asked students to solve puzzles involving velocity, acceleration, and other physics concepts and to teach their solutions in writing to an imagined learned, often in humorous case situations (Figures 5 and 6). The microthemes received a top grade only if, in the grader’s opinion, they had explained the physics concepts clearly to the specified audience. Such microthemes can be sequenced if the difficulty of the

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**Figure 5. Quandary-Posing Microtheme for Introductory Physics**

Suppose that you are Dr. Science, the question-and-answer person for a popular magazine called *Practical Science*. Readers of your magazine are invited to submit letters to Dr. Science, who answers them in “Dear Abby” style in a special section of the magazine. One day you receive the following letter:

Dear Dr. Science:

You’ve got to help me settle this argument I am having with my girlfriend. We were watching a baseball game several weeks ago when this guy hit a high pop-up straight over the catcher’s head. When it finally came down, the catcher caught it standing on home plate. Well, my girlfriend told me that when the ball stopped in mid-air just before it started back down, its velocity was zero, but acceleration was not zero. I said she was stupid. If something isn’t moving at all, how could it have any acceleration? Ever since then she has been making a big deal out of this and won’t let me kiss her. I love her, but I don’t think we can get back together until we settle this argument. We checked some physics books, but they weren’t very clear. We agreed that I would write to you and let you settle the argument. But, Dr. Science, don’t just tell us the answer. You’ve got to explain it so we both understand, because my girlfriend is really dogmatic. She said she wouldn’t even trust Einstein unless he could explain himself clearly.

Sincerely,

Baseball Blues

*Can This Relationship Be Saved?* Your task is to write an answer to Baseball Blues. Because space in your magazine is limited, restrict your answer to what can be put on a single 5 × 3 card. Don’t confuse Baseball and his girlfriend by using any special physics terms unless you explain clearly what they mean. If you think some diagrams would help, include them on a separate sheet.
Suppose you put a big block of ice in a bucket and then fill the bucket with water until the water level is exactly even with the edge of the bucket. (The ice, of course, is now floating in the water.)

Now we will wait for several hours for the ice to melt. Which of the following will happen? (Neglect evaporation.)

1. The water level in the bucket will remain exactly the same.
2. The water level in the bucket will drop.
3. Some water will overflow the sides of the bucket.

Your Task: After deciding upon your answer, explain it in writing. Imagine that you are writing to a classmate who doesn’t yet understand flotation and who is arguing for what you consider the wrong answer. Your task is to explain your reasoning so clearly that your microtheme serves as a little textbook, teaching your classmate the physics principles involved. Thus, your microtheme will be judged not simply on whether or not you figure out the correct answer, but also on whether or not you can write clearly enough to teach a fellow classmate.

cognitive puzzle presented is increased gradually, moving, for example, from simple mass and weight puzzles to complex puzzles—such as “Alaska, Land of the Midnight Sun,” designed by Drummeller and others (1978)—that require students to think from multiple perspectives and to make transfersences from analogous experiences.

Although we have not yet completed an empirical study of the effect of microtheme writing on students’ comprehension of physics concepts, we know that the quandary-posing microthemes have generated vigorous discussions among students. At the very least, they have altered students’ study habits and helped them to view writing as a learning tool. From the instructor’s point of view, the microthemes have also laid bare problems in students’ thinking patterns, revealing that what appears to be a writing problem in an unsuccessful microtheme is actually a problem in reasoning and understanding. Because many students have been unable to solve the puzzles presented (their micro-
themes revealed a baffling train of misconceptions and illogic), microthemes by themselves cannot ensure comprehension. Nevertheless, students do shift their emphasis from rote learning to an active struggle with concepts; moreover, many students report that the need to teach their ideas has helped them to understand the physics principles involved. We intend in the future to assign students to collaborative learning teams, whose members will write a microtheme together as a group project. In this way, students can perhaps teach each other, which better approximates the Socratic technique; teams may also help to temper the isolation that students sometimes feel in large lecture courses.

Conclusion and Summary

We would like to conclude by making some brief connections between microtheme assignments and the general problem of designing a curriculum that better enhances cognitive development. Lochhead (1978) has identified a number of obstacles that hinder the development of such a curriculum, the foremost being general resistance to change among academics. In this regard, microthemes are particularly useful, because they are politically innocuous. They can be added to any instructor's syllabus without necessitating major changes in teaching style or course design. If teachers who currently require no writing simply add two or three microthemes to their course assignments representing, we guess, a tolerable increase in an instructor's work load students' writing output during a four-year college career will increase enormously.

Microthemes are also pedagogically appropriate. That is, they meet all the requirements for curricular reform cited by Lochhead: They are designed to develop students' intellectual maturity; they reward qualitative, not factual knowledge; and they make students active learners. Moreover, since the level of difficulty of microthemes can be controlled, it is theoretically possible for a department to design a coherent sequence of assignments for a four-year curriculum. For example, instructors can design simple microtheme assignments for the freshman level, more complex assignments for the sophomore level, and longer analytical or research papers for students at the upper division level. Such a sequence could be designed to promote growth along Perry's (1970) intellectual maturity scale, which places students at points ranging from immature cognitive dualism (all questions have right or wrong answers) to relativism (all opinions are equally valid), to mature commitment within relativism (there may be no right answers, but a thinker must take a reasoned stand). Summary writing and thesis-support microthemes do much to promote such growth, because they encourage openness to alternative points of
view and foster the ability to see the world in terms of complex issues, not of right and wrong answers.

But, these are theoretical concerns that await further research and further experimentation in curriculum design. At this point, it is enough to say that across-the-curriculum microthemes are an attractive alternative to term papers and a decided improvement over no writing assignments at all.

References


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