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Evaluation of the Job Skills Education Program: Curriculum Review

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American Institutes for Research

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This report evaluates materials that are part of the Army's Job Skills Education Program-- a job-relevant, computer-based program designed to provide soldiers with skills prerequisite to learning job tasks. The researcher selected a representative sample of lessons for evaluating and reviewed the diagnostic pretest, soldier management system, and instructor's manual. Recommendations are as follows: re-write lessons to reduce the focus on steps or rules and emphasize underlying concepts or ideas; encourage students to practice applying skills learned in related novel contexts; provide more opportunity for students to practice higher order skills; re-write lessons to provide explanatory context for all lesson material; allow students more freedom to repeat lessons or sections of lessons; allow students to see errors on tests; and revise manuals to make them more helpful and user-friendly. (Authors)

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FOREWORD

The Technologies for Skill Acquisition and Retention Technical Area of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) performs research and development in education as part of its program. A major focus of this research is the development of information on which the Department of the Army can base decisions about its basic skills education programs. The work described in this report was conducted under Project A794, Education and Training, as part of Task 311, Improving Job Skills Education for Soldiers.

This report describes work carried out at the request of the Chief, Soldier Education Division, Total Army Personnel Agency, who requested that ARI evaluate the Job Skills Education Program (JSEP), a computer-based, job-relevant curriculum designed to teach soldiers competencies prerequisite to learning job skills. The researcher sampled JSEP lessons for evaluation and reviewed the program's diagnostic pretest, soldier management plan, and instructor's manual. Recommendations for revising or improving these materials are offered.

This effort was supported by the Soldier Education Division, Total Army Personnel Agency, Office of the Deputy Chief of Staff for Personnel. Division staff members were provided with copies of the report in August 1988.

EVALUATION OF THE JOB SKILLS EDUCATION PROGRAM: CURRICULUM
REVIEW

EXECUTIVE SUMMARY

Requirement:

This review of the Job Skills Education Program (JSEP) curriculum was carried out as part of the overall evaluation of JSEP to assess the quality of instructional design and to provide information useful for further lesson revision and development.

Procedure:

About 22 percent of the total number of JSEP lessons were reviewed. JSEP consists of both lessons presented on the computer (on-line lessons) and lessons in the form of paper materials (paper-based lessons). Both types were analyzed. In addition, JSEP supporting materials, including the JSEP diagnostic test, the Instructor's Manual, the Soldier Management System: Features and Functions Guide, and a selected Learning Strategies lesson were reviewed. It should be noted that at the time of the review some lessons, as well as the manuals, were not yet in final form. Therefore, some of the problems noted may already be resolved.

For each selected prerequisite competency, the review process involved going through the short lesson, the lesson test, and in some cases the long lesson. (Long lessons were not reviewed as systematically as short lessons because soldiers went through them far less often.) Notes taken on the lessons were later coded to reflect 18 different problem categories that appeared during the course of the review.

Lessons were reviewed independently of diagnostic statistics such as student test scores. However, the review comments are intended in some cases to help explain results among soldiers using JSEP.

Findings:

The major finding was that in about half of all JSEP lessons reviewed, deficiencies in teaching strategy lead students to learn skills that were only superficially or peripherally related to the performance of the major targeted skill of the lesson. About half of the lessons did not teach underlying concepts essential to an understanding of the skill but presented instead sets of steps or rules that could lead students to solve problems without an understanding of the processes involved. Definitions of basic terms and concepts essential to understanding lesson skill objectives were often not given or were put into a form that could mislead the student. Difficulties with language, organization, and practice and test items (such as ambiguities or cases where items did not test appropriate content) were also noted.

JSEP lessons were originally designed to distinguish between review (in the diagnostic review or "short" lesson) and instruction (in the skill development or "long" lesson), assuming that a student either once knew a skill and had forgotten it or had never learned it in the first place. [B. P. Roberts and R. K. Branson, "U.S. Army Job Skills Education Program (JSEP) Technology Transfer Plan," January 15, 1987, p. 13.] However, it was found that the "instruction" in some long lessons did not differ from the "review" in the short diagnostic review lesson, thus raising doubts as to the instructional value of long lessons. Paper-based lessons contained errors and significant organizational problems; in some cases they were also very lengthy.

In sum, the major learning benefits of the curriculum are likely to result from systematic exposure to and review of targeted skills and from the high interactiveness of nearly all of the lessons, rather than from instructional design or teaching strategy alone.

The JSEP supporting materials, prepared when the management of JSEP was still in the hands of Florida State University, need careful rewriting to make them helpful to users. This is especially important in the case of the Instructor's Manual, because budget constraints may mean that JSEP instructors cannot count on training or access to consulting.

Utilization of Findings:

It is recommended that these findings be used to revise the JSEP curriculum as follows:

- Revise lessons to focus instruction on the targeted skill of the lesson, rather than on supporting skills. In some cases, this may mean putting more emphasis on explanation of processes or procedures that underlie lists of steps or rules.

- Revise language, test items, and practice items to eliminate errors and ambiguities.

- Revise both short and long lessons to include useful and accurate explanations of underlying concepts. Long lessons should be revised so that they do not repeat material from short lessons.

- Revise supporting materials so that they are more comprehensible and helpful to users.

In addition, students should be permitted more flexibility in their use of JSEP. They should be able to re-take lessons or portions of lessons, if desired, and they should be allowed to see what their errors were on tests. These changes, if made, would permit JSEP to make better use of the advantages inherent in computer-based instruction.

EVALUATION OF THE JOB SKILLS EDUCATION PROGRAM: CURRICULUM REVIEW

CONTENTS

LIST OF TABLES

EVALUATION OF THE JOB SKILLS EDUCATION PROGRAM: CURRICULUM REVIEW

Chapter 1. Introduction

Purpose

The purpose of this review is to provide commentary on the JSEP curriculum from a perspective emphasizing instructional excellence. This information may be used (1) for revision of the lessons discussed, (2) as a guideline for lesson analysis and revision in other lessons that have not been reviewed, or (3) as a source of possible explanation for soldier outcomes as recorded in lesson statistics. Review comments can also be used to account for student reactions to particular lessons or parts of lessons as reflected in survey responses, interviews, personal notes, and classroom observations. Ultimately, the value of JSEP as an instructional medium will be measured by improvements in student test scores and job performance. However, at this point it is also useful to evaluate the curriculum solely from an instructional design point of view, taking into account basic principles of curriculum design and delivery that may affect student interaction with the materials and determine, in the long run, whether students in fact learn sufficiently well from the program. The focus in this review will therefore be upon the instructional value of the lessons themselves as evaluated independently of lesson statistics and student test performance.

Data Sources

The primary sources of data for this review are notes and lesson hard copy taken during on-line analysis of JSEP lessons. Other data sources include copies of JSEP paper-based lessons, soldier personal notes (p-notes), lesson diagnostics, soldier survey comments, and field notes taken during interviews with JSEP students and during observations of JSEP classrooms. It should be noted that this review was conducted on the PLATO version of the JSEP curriculum, rather than on the MICROTICCIT version.

Also, use of a MacIntosh MacPlus terminal may have contributed to minor distortion in some of the the lesson graphics.

JSEP: Brief Overview

As of this writing, JSEP consists of 186 lessons intended to teach the prerequisite competencies soldiers need to learn and perform their jobs. These lessons are of three types: lessons that are entirely on-line, lessons that are entirely paper-based, and lessons that combine both formats. Each prerequisite competency is covered by a diagnostic review lesson (or short lesson), and a lesson test. The short lesson is intended primarily as a review of a skill that is presumed to have been learned at some point, but may have been forgotten. For all but 34 prerequisite competencies, there is also a skill development lesson (or long lesson) that students take if they fail the lesson test after taking the short lesson. This long lesson is intended to provide the student with instruction in the targeted prerequisite competency, assuming that the student never learned it in the first place.

The Review Process

A total of 35 on-line lessons and five paper-based lessons were reviewed. This reflects approximately 22 percent of the total number of JSEP lessons. The review process involved taking the lesson as a soldier would, going through the short lesson, the test, and in some cases the long lesson. The time required to get through a lesson was far longer than that required by the average soldier because of the need to take notes, to compare portions of short lessons with long lessons, to compare test or practice items with lesson content, to compare different sections of the same lesson, or to examine feedback for wrong answers to practice questions. All the short lessons were reviewed, but only certain long lessons or particular sections of long lessons were reviewed, especially when the lessons had many sections, or if they appeared to repeat material

2

presented in the short lesson.[1] The review focused more upon the diagnostic lessons than upon the long lessons simply because more soldiers are likely to take the diagnostic than the long lesson, and because the underlying rationale for JSEP is primarily remediation rather than instruction.[2]

Lessons were selected for review based on a number of criteria. First, an attempt was made to review at least one lesson from each different lesson series included in the common task prescription, since the common task lessons are those that all soldiers must take while in JSEP. Most often, the particular lesson to be reviewed in a series was chosen randomly; in some cases, more than one lesson in a series was reviewed. Second, some lessons were chosen because comments from the field had indicated that such lessons were "difficult" or posed problems for soldiers, and review might be able to identify the source of such difficulty for later revision. However, it should be noted that no systematic attempt to select lessons based on diagnostic reports was made, so that the sample of lessons reviewed would not biased in favor of either "poor" or "good" lessons.

The lessons reviewed represent only a sample of the total number of JSEP lessons. Primarily because of the time consuming nature of the on-line review process, it would have been impossible to review every lesson. However, a sufficient number of lessons have been reviewed to enable general patterns across lessons to emerge in analysis.

Over the six-month period during which the on-line lesson review was conducted, Florida State University continued to review and revise JSEP lessons. Thus, at the time a lesson was reviewed it may not have been in its present implemented form. This may be significant as far as some of the specifics of lesson content and presentation are concerned (e.g., errors in practice or test items; language and typographical errors). However, the revisions performed by Florida State University generally did not include large scale rewriting of lessons involving changes in design, organization, content, or

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[1] The following lessons were reviewed: 1b, 1c*, 1d*, 1g*, 2a, 3a*, 3c*, 4a*, 5e, 6b, 7a, 8d, 9a, 9d, 11a (p), 12e*, 12h*, 13c, 14d, 14f*, 15d*, 16c*, 16f, 16h*, 25d (p), 26a, 26e, 27c*, 27e*, 28b (p), 29b*, 29c, 30a, 31a, 32e*, 33a (p), 34d, 35d (p), 36c, 41b. The asterisk indicates that the long lesson was also reviewed. (P) indicates the lesson is paper-based.

[2] B. P. Roberts and R. K. Branson, "U.S. Army Job Skills Education Program (JSEP) Technology Transfer Plan," January 15, 1987, P. 13.

approach. Thus the majority of concerns in this review which relate to the broader aspects of lesson design may be taken as still valid.

Lesson Evaluation Criteria

The evaluation criteria upon which this review is based were derived from a combination of principles of instructional design and basic skills applied to field-based lesson analysis. Such a process identified the following categories and characteristics of lessons that could be considered important areas for evaluation:

1. Aim or purpose.

   - Does the lesson have a stated purpose which is actually carried out in the lesson? Does the lesson content match the stated purpose?

2. Organization.

   - Do the sections in the lesson have a recognizable, sensible order? Are subsections clearly and logically ordered?

3. Concept presentation.

   - Does the lesson state or teach the underlying concept behind the skills the soldier is asked to learn? Is this concept adequately stated and explained?
   - Does the lesson explain why given skills or tasks must be performed, or explain the rationale for certain procedures so that the soldier can understand why he/she is asked to do something?

4. Tasks/Skills presentation.

   - What types or levels of skills are taught? Are these the most appropriate for performing given tasks or solving given problems?
   - How are skills taught? If "steps" are used, is this the best method? Are all necessary steps included and all unnecessary steps avoided?

- Are examples well-chosen? Do they adequately illustrate how steps or methods are used in solving realistic problems?
- What use is made of prior or assumed background knowledge? Are such assumptions appropriate?

5. Short Lesson-Long Lesson Relationship.

- How are these lessons related? Are they similar to or different from each other in content, approach, practice?
- How well are the stated review and instructional purposes of each lesson met? Which lesson is more effective?

6. Language.

- Are all statements, explanations, problems, etc., worded in the clearest, simplest way? Are there ambiguities?
- Is the terminology used in lessons consistent both within and across lessons?

7. Practice Items.

- Are these placed at the appropriate moments in a lesson? Do they illustrate the intended skills or concepts taught in the particular lesson/lesson section?
- Are they well designed to enable students to practice relevant skills?
- Are items balanced to reflect emphasis given in a lesson on different skills or content areas?
- Do they provide appropriate and helpful feedback -- i.e., feedback that is error-free as well as explanatory or illustrative?
- Is sufficient indication given of the format required for answers? Are answers that require much accurate typing avoided?
- How are practice items related to test items? Is there sufficient match?
- Do practice items give students the chance to advance to use of skills in higher level contexts? Is there adequate provision for advancement to higher levels or for application of skills in different, related situations?

8. Test.

- Are questions clearly worded so that the student knows what is being asked?
- Is enough indication given to the student as to the required answer format (in both English usage as well as in mathematical specifications)?
- Do the test items reflect the balance of material covered in the lesson?
- Are accompanying graphics easy enough to read?
- Do test items in fact test the skills students have been taught in the lesson? What do they test?

9. General Issues.

- Presentation: What is the quality of the screen display, graphics, diagrams, paper materials?
- User choice: What options do students have in going through lessons? How "flexible" is the program in responding to student needs or choices?
- Subjective appeal: What are some of the appealing features of the curriculum design?

In addition to evaluating the on-line curriculum in prerequisite competencies, this review also considers JSEP supporting materials. These include a JSEP Learning Strategies lesson, the JSEP Instructor's Manual, the Soldier Management System: Features and Functions Guide, and the JSEP Test. The review first describes and illustrates specific problems found in JSEP lessons, and then moves to consideration of general curricular issues, supporting materials, and recommendations.

Chapter 2. Specific Lesson Problems

Problems in JSEP lessons fall into three general categories: conceptual level problems, problems with presentation or delivery, and problems in short/long lesson compatibility (including tests). For each problem area, examples illustrating the problem are drawn from the lessons reviewed. Although in many cases the examples given here illustrate more than one problem area, for the sake of clarity, the discussion focuses on only one type of problem. Table 2.1 illustrates the lessons reviewed and the categories of problems found in each. The percent of lessons manifesting each type of problem is also indicated.

Conceptual Problems

Problem area 1. The lesson does not teach what it intends to teach; but rather teaches skills focused on the surface features of a given problem. Although the intention of the lesson is to teach a particular concept-based skill, the skills actually taught are peripheral to the underlying skill. In some cases the skill(s) actually taught "mimic" performance of the intended skill -- i.e., they bring the student to the same result, yet the underlying conceptual basis for performance and understanding is lacking. Thus students can be taught how to solve problems without necessarily achieving any understanding of the basic concepts involved in the process. If it is true that lower ability students often lack a conceptual model to facilitate learning, one of the major objectives of JSEP lessons ought to be to provide the necessary conceptual model or information to allow the student to learn a skill, not merely just to perform it in a mechanical fashion so that the result is correct. Examples of this problem follow.

Lesson 34d, "Labeling the Parts of an Outline." The purpose of this lesson is clearly stated at the outset: ". . . to identify each part of an outline as major topic, subordinate topic, or detail and to show how these are organized to form the whole topic." [Note:

Table 2.1

PROBLEM AREAS IN BSEP LESSONS

Lessons Reviewed

Problem Areas	1b	1c	1d	1g	2a	3a	3c	4a	5a	6b	7a	8d	9a	9d	o 11a	12a	12b	13c	14d	14f	15d	16c	16f	18h	o 25d	26a	26e	27c	27e	o 28b	29b	29c	30a	31a	32a	o 33e	34d	o 35d	36c	41b	% of lessons showing problem
I. CONCEPTUAL PROBLEMS																																									
1. Misfocus on surface features; lesson doesn't teach what is intended		l	s	s		l	s/l	s							✓		l		✓		l	l	✓	s/l	✓			s/l	s	✓					s/l	✓	✓	✓			53
2. Inappropriate Rule or Step-based approach		s/l		s	✓			s							✓	s	s		✓	s/l	l		✓	s/l		✓	✓		s	✓	s/l						✓				45
3. Incomplete or absent explanation for process or procedure				s									✓						✓	s/l	s/l		✓														✓	✓			20
4. Incomplete, absent, or misleading explanation for main concept		s/l	s	s		s/l	s/l	l	✓						✓		s/l	✓			l	s	✓	s	✓			s/l	s/l	✓	s/l					✓	✓	✓	✓	✓	48
5. Lack of introduction, context or rationale for task							s/2								✓	s				s/l		s		s						✓				✓			✓				23
6. Organization problems						s									✓	s				s/l										✓						✓		✓			10
7. Inappropriate comparisons or skill confusion		s/l				s/l	l																	s/l						✓	s/l			✓	T/l	✓		T			23
8. Logical problems or internal contradictions															✓										✓					✓										✓	10
II. PRESENTATION AND DELIVERY PROBLEMS																																									
9. Redundant format problems with practice and test items	✓	s/l	s/l							T			✓						✓		✓																✓				20
10. Language problems: inconsistencies, ambiguities, confusion	✓	s/l		l		s/l			✓	T			✓	s/T	✓		s		✓	l			T	s/2	✓					✓	s				s	✓					48
11. Inappropriate practices or examples			s	s/l		s									✓		s	✓							✓			s/l		✓	s/l							✓		✓	30
12. Inappropriate feedback						s		s									s		✓						✓					✓		✓			l						20
13. Confusing diagrams or illustrations						s									✓					l								l		✓											15
14. Inappropriate instructional methods		l		l				l								s/l							✓												l					✓	10
III. PROBLEMS IN SHORT/LONG LESSON COMPATIBILITY AND TESTS																																									
15. Short and long lessons use similar or identical approach		✓	✓	✓		✓	✓									✓					✓	✓		✓				✓	✓												20
16. Short and long lessons have content mismatch								✓	✓									✓			✓	✓							✓		✓									✓	20
17. Test items do not match lesson material									✓					✓			✓	✓			✓							✓	✓									✓	✓		23
18. Test items are confusing or ambiguous									✓	✓				✓			✓				✓					✓	✓	✓	✓												23.

Key:

✓ = only short reviewed, or short/long distinction not applicable.
l = long lesson
s = short lesson
T = test

the phrase ". . . to form the whole topic" is somewhat vague.] Thus, the major "skill" intended by the lesson is one of <u>understanding the relationship between major topics, subordinate topics, and details</u>. In order to label an outline correctly the student must understand what <u>levels of abstraction, generality, and specificity</u> are, and how these are reflected in the outline. The lesson in fact does not teach these skills. Rather, it teaches the recognition and manipulation of the outline code without teaching soldiers how to determine, for example, if a topic is major or subordinate, or how to see the relationship between the two. This is clearly reflected in the steps which soldiers are told to perform in order to label an outline:

Step 1. Alternate and indent numbers and letters to make a code.

Step 2. Identify major topics, subtopics, and details.

Step 3. Use the code to label the major topics, subtopics, and details.

The fact that this lesson does not teach what it intends to teach is evident in the highly unnatural and indeed impossible task of performing step one independently of, and prior to, step two. How can one even begin to know what the "code" looks like without first knowing how the elements to be contained in the outline are related? In reality the outlining process entails simultaneous coding and identifying relations between topics. Here, the process of making a code is separated from the process of identification of types of topics. This is a case not only of an inappropriate focus on the surface features of a skill, but also of problem area 2, overspecification or reduction of skills (to be discussed in the following section.)

The lesson adequately teaches students the elements of the code itself; indeed, it provides extensive practice in recognizing the code pattern. The practice items take the soldier from filling in some missing elements of a code to generating a code for a pre-organized list, an effective way of familiarizing the student with the code elements. But there is no instruction in <u>how to determine relationships among topics</u>. This is the real conceptual problem beneath the coding process, and it is never addressed in the lesson.

Lesson 1c, "Ordering Numbers—Intervals." The objective of this lesson is to teach soldiers how to sequence numbers, including decimal numbers and negative numbers. However, the lesson does not in fact teach students to <u>sequence</u> numbers -- that is, to <u>recognize relative value</u> (the underlying "intended" concept). Rather, it teaches students

9

peripheral identification or recognition skills that ultimately have little to do with this essential skill. For example, in the long lesson section "Sequencing Positive Numbers with Decimals" the focus is placed upon the skill of labelling place values, primarily by noticing where the decimal point is positioned:

> (p. 13) Positive decimal numbers may be a little more complicated because you must pay close attention to where the decimal point is placed. For example, look at this series:
>
> 3.021   3.120   3.012   3.2

The largest number in the set is 3.2.

> In order to determine the correct answer, you will need to know the numbers and the place value of the numbers.

As a matter of fact, the decimal point is "placed" in exactly the same position in all four cases -- after the whole digit. Thus, paying close attention to where the decimal point is placed has nothing to do with determining the relative value of these numbers.

The practice items in this section focus merely on labeling place values -- pages 14, 15, 16, 17 all give practice in labelling and identifying the tenths place, the hundredths place, etc. The rule given on p. 17, for example, states:

> Two place decimals are written with the decimal point (.) followed by two digits. Ninety nine hundredths is 99 parts of 100 parts.

True enough, but how is this information going to be helpful to the student who wants to compare numbers? Although this is a component skill in the process of recognizing relative value, it is not the same thing as being able to compare place values. In fact, the lesson provides little, if any, explicit relative place value comparison practice. (For example, students could be taught to compare the tenths place first -- with an explanation of how tenths are "larger" portions than hundredths, etc.)

Lesson 15d, "How to Use a Protractor." Another example of this process of "missing the main point" behind a skill is found in this long lesson. On page 11 the lesson asks the soldier for the largest number on the degrees scale of the protractor. The largest possible number of degrees is 360; however, the largest <u>printed</u> number is 355, which is

the answer accepted by the program. The point of the question should be -- or in fact is -- to teach the student that the largest measure on the protractor corresponds to that of a circle, 360 degrees, not that 355 degrees is the largest printed value. Then on page 12, after the soldier has been told that 355 is the largest number on the degrees scale, he/she is told: "Notice that the degree scale measures from 0 to 360. Note: the 360 and 0 marks are the same." A misfocus on the "surface" features of the protractor has replaced the underlying concept which is intended to be taught. Fortunately, in this case the situation is remedied at a later point in the lesson.

Problem area 2. The lesson teaches a skill as a series of steps or rules that substitute for necessary instruction in the underlying concept behind the skill. Often, these steps or rules overspecify the task, breaking it down into component skills that could be taught and performed more naturally as a unit.

The step or rule-based approach to instruction is found in nearly all JSEP lessons. In some cases, presenting a list of steps helps to clarify the tasks that need to be done to perform a skill; in other cases, however, the rules contribute to confusion and make the task more difficult than it really is. When rules or steps multiply, the student has more chances to make an error in carrying out a procedure. This is especially true, as in the following example, when the rules or steps are linked to the surface features of a task rather than underlying ideas.

Lesson 1g, "Rounding Numbers." In this lesson the skill of rounding is taught as sets of rules that specify what must be done for each separate case of rounding to a specific number, rather than through the application of a generalized, concept-based rule that can be used for any case where rounding is required. Students are given multiple sets of rules to follow for different cases of rounding to the nearest 5, nearest 25, nearest 50, etc.:

> (p. 12) Rounding Numbers to the nearest 5.
> Sometimes you must round to the nearest 5. For example, one of your tasks might be to round off the fuze setting to the nearest 5.
>
> If the fuze setting is 26, you would round it to 25.
> If the fuze setting is 23, you would also round it to 25.
> But if the fuze setting is 21, you would round it to 20.

On page 13, the lesson lists five rules for rounding to the nearest 5. These rules require the student to "learn" what to do with specific cases, instead of learning a general concept that would allow him/her to deal with any case.

Rule 1. Numbers ending in 0 or 5 are OK the way they are.
Rule 2. Numbers ending in 1 or 2 round down to the nearest number that ends in 0.
Rule 3. Numbers ending in 3 or 4 round up to the nearest number that ends in 5.
Rule 4. Numbers ending in 6 or 7 round down to the nearest number that ends in 5.
Rule 5. Numbers ending in 8 or 9 round up to the nearest number that ends in 0.

Similar sets of rules -- all of which focus student attention on the surface aspects (in this case, digits) of the given problem rather than on the underlying concept behind rounding -- are given for each case of rounding to 5, to 25, to 50, to 100. That translates into an enormous number of rules for the soldier to remember and work with. This is a highly impractical way to teach the skill of rounding; indeed, lists of rules appear to substitute for an adequate explanation of the concept of rounding. Such an explanation ought to at least contain the idea that the basic notion behind rounding involves how to decide to which multiple a given number is closer. The only time this point is made comes in the feedback to the practice question on page 22, when the lesson asks, "Is 67 closer to 50 or 75?" Had students been given a general concept-based method for determining which of two multiples is closer (such as comparing differences, looking for the halfway point, etc.), this multiplication of rules could have been avoided. Moreover, in the long lesson (where one would expect more "instruction") the same rules are repeated over again, still without an adequate conceptual framework. [This lesson is an example of problem area 15, identical approach in long/short lessons.]

Lesson 15d, "How to Use a Protractor." In this lesson, the steps to be followed in using a protractor are overspecified. In the long lesson, section B, Step 3 lists as two separate steps what would more naturally and easily be performed as one: (p. 26)

3. Two steps to line up protractor with the angle:

   1. line up reference line with line 1.
   2. line up the vertex.

Ten pages later (p. 36) the soldier is finally told, "When you line up the reference line with line 1, you can make sure the index mark is lined up at the same time." Over-specification such as this, unless remedied by pointing out how separate steps can be collapsed, contributes to holding students back at a "basic" competency level rather than encouraging them to advance to a higher level of skill performance.

Lesson 16h, "Solve Word Problems Involving Any Mathematical Process." This lesson relies on a set of rules that reduce solving a problem to a mechanical process of pattern matching. These rules substitute for a concept-based approach to teaching the target skill. In lesson 16h the primary "step" in the process is identified as "Select the right formula." However, this process is reduced to a mechanistic matching up of letters of the quantity words in the problem with letters in formulas. This does not allow a student to move toward a more "advanced" level of formula selection based on the perceived relation-ships between variables and knowledge of which formulas use such relationships. For example, the long lesson Section C (devoted to formula selection) asks the student:

What formula should be used to solve this one?

Calculate the (P)erimeter of a square given that its (S)ides each measure 10 inches. Touch the box with the correct answer.

$$P = 4S \qquad P = \pi D$$
$$A = S^2 \qquad A = R^2$$

An incorrect answer elicits the warning, "Watch the initial letters of the quantities in the problem."

The section concludes:

It's easy to select the appropriate formula to solve a word problem. Just choose the one which matches the initial letters of the quantities or units of the problem.

(R)ate of Speed = 50 mph. (D)istance = ? (T)ime = 2 hrs.

$$D = RT$$

In all the practice questions, formulas appear ready-made and available for the student to "match letters up with." What about cases in which no formulas are readily available? Is this not a more realistic situation? This sort of instruction does not really

teach the student to solve word problems; it merely teaches him or her to notice letters in formulas. The steps given do not prepare the student for realistic situations in which knowledge of basic mathematical relationships is involved in solving problems.

Problem area 3. Concept explanations for procedures or processes are incomplete or lacking. In most cases this translates into telling students to perform a step in a process without explaining why the step is necessary or useful, or without explaining how particular problem-solving procedures or elements work. Examples follow.

Lesson 16f, "Solve Conversion Problems." This lesson begins with a statement of the rule to be followed.

> (p.2) To convert from one unit of measurement to another, multiply by the appropriate conversion factor. The conversion factor converts one unit to another, for example, square feet to square inches.
>
> [Example] What is the square inches equivalent of 20 square feet? The conversion factor is 144.

[144 what? What does this 144 tell the student about the relationship between the units in this problem? Where does this 144 come from? What are "conversion factors" in the first place? No explanation is given.]

$$20 \text{ sq ft } \times \; 144 \; = \; 2880 \text{ sq in}$$
$$\text{old unit} \quad \text{conversion} \quad \text{new unit}$$
$$\text{factor}$$

There are two problems with this rule: (1) there is no real explanation of where conversion factors come from or how they are derived, and (2) it is not true that one always multiplies to get the answer, for later examples require the student to divide, given the form in which the problem is stated.

Telling students that conversion factors "convert from one unit to another" contributes little to a student's understanding of the conversion process. There is no explanation of how these conversion factors work. Furthermore, students are usually given the appropriate conversion factor for each problem, so there is no need to think through what is actually happening during the conversion process. These ready-made

14

conversion factors do not in fact teach the student anything; they merely enable him or her to solve problems mechanically without understanding the process. There is only one indication of the source of conversion factors in the lesson. On page 3, when students must determine the yard equivalent of 100 inches, the lesson says, "One inch = .028 yards so the conversion factor is .028." This is the only "explanation" for the source of conversion factors; even this does not explicitly get at the numerical and conceptual relationship between yards and inches.

A related problem concerns discrepancies in the ways conversion factors are presented. In some cases units are given, in others they are not. For example:

What is the meter equivalent of 50 yards?
(conversion factor = .914)

What is the gallon equivalent of 132 quarts?
(1 gallon = 4 quarts)

How many kilometers equal 100 mi?
(use conversion factor 1.6)

In the first example, there is no indication of the relationship between meters and yards. In the second, the conversion factor is presented in an entirely different form requiring the student either to "convert" the conversion factor to the appropriate form, or to divide to get the answer, contrary to the multiplication rule given at the beginning of the lesson. In the third example, units are again missing. Unless students are provided with some explanation of how conversion factors are derived and how they work, problem solving is reduced to a mechanical process that does not require students to really understand what is going on. A student's comment (p-note) about this lesson, "I can solve the problems without understanding the process" is thus exactly on target.

Lesson 15d, "How to Use a Protractor." This lesson also lacks an explanation for a procedure. On page 18 the examples show the protractor alined vertically, but students are not told if this is necessary, nor, if it is, why. This explanation would make good sense, given that this particular alinement occurs repeatedly. On page 20, the lesson states "You can use a protractor to plan an azimuth: just aline the protractor on a parallel to a North-South line with the index mark where you are located." But there is no explanation of whether this is necessary, or why.

15

Lesson 14f, "Multiplying and Dividing Fractions." In this lesson some explanations are incomplete or misleading. On page 7, students are told how to multiply a whole number by a fraction:

> "To multiply, convert the whole number to an improper fraction. (an improper fraction has a larger number in the numerator than the denominator.) "

Indeed, but the point is that for whole numbers the denominator will always be 1, not that the numerator is larger than the denominator. This is not specified.

Moreover, both the diagnostic and the long lesson omit an explanation of how to convert a mixed number to an improper fraction, a skill essential to the objective of the lesson. The explanations of basic terms which come at the beginning of the long lesson are complete for some terms (for example, for "reducing a fraction" a detailed step-by-step explanation of the process is given) but incomplete for others. (For example, the explanation for "improper fraction" merely states that it can be reduced to a mixed number, and illustrates: $3/2 = 1 1/2$ or $8/2 = 4$. And for "mixed number," the lesson simply states, "A whole number and a fraction written side by side.")

Problem area 4. Explanations of major underlying concepts behind targeted skills of the lesson are lacking, incomplete, or misleading. Thus, the lesson lacks an adequate focus on the conceptual level of explanation underlying skill performance. This was the most common problem identified in the lessons.

Lesson 25d, "Finding Main Ideas" (paper-based). The objective of this lesson is to teach soldiers to locate main ideas. However, the definition of main idea around which the whole lesson revolves is seriously deficient, and leads to confusion later on in the lesson. The definition for main idea given in the lesson is:

> "The main idea is a summary of important facts or actions."

However, main ideas are not "summaries;" they are more like one- or two-sentence statements of the guiding concepts or notions present in a chunk of text. Even if they

16

were "summaries," the inadequacy of this definition becomes evident when students are told that they can locate "main ideas" in the table of contents of a manual:

> "Manuals are divided into chapters and/or sections. The main idea of each is listed in the table of contents."

If main ideas are summaries, the inadequacy of this definition becomes obvious, for "summaries" are not found in the table of contents. Main ideas, moreover, are not "listed in the table of contents;" "topics" or "subjects" would be a more appropriate label to use.

In this lesson an obvious attempt to simplify the concept of main idea results in conceptual confusion. The notion of "main idea" actually becomes more difficult for students to use and understand, because now what are in fact conceptually distinct notions of summary, topic, main idea, (and, later on, heading) have been confounded. This is further emphasized by the way in which the main idea is initially presented as something one gets through reading a text, and then as something identifiable through other features such as a table of contents or an index. The lesson tells students that even "illustrations and tables . . . will help you discover the main idea." (Main idea of what?) This list of features includes "topic sentences of paragraphs" in the same breath as tables of contents, further confounding the text-based notion of main idea with the artificial notion of main idea as summary or topic. The main idea concept and the notion of locating information topically or categorically have been confused.

This confusion gets worse as the student moves through the lesson. On page 12 the lesson describes "page format" as a source of main ideas; the lesson states that to determine what the main idea is one should look for format cues such as centering and dark type. But the feedback for the answer to the practice question is not based on format cues, but upon a conceptual understanding of main idea: "This is the first page of a description of a procedure, so the purpose of this procedure . . . is the main heading." [Nothing is said at all here about format in making this decision.]

Moreover, in this example, main idea is confused with main heading. This confusion continues on page 14, where a question asks: "What are the headings on this page?" [Suddenly we have lost the main heading idea and are looking for regular headings.] The explanation then tells the student that there are three main headings. [But if these are

17

main headings, where are the regular headings?] Then, the lesson brings in the notion of section, stating "Each section has its own main idea."

A question is then posed: "What are the paragraph headings?" But the answer given on the following page gives section headings, not paragraph headings. Sections have now been confused with paragraphs; this confusion gets worse on page 17, where students are told that main ideas are located in the topic sentences of paragraphs. [They have just been told that main ideas are located in headings.]

The misleading explanations and concept confusion present so far in this lesson lead inevitably to the explanation on page 19:

> The main idea for subparagraph "a" by itself is found in the first sentence of the subparagraph. The sentence [sic] in (1) and (2) support the main idea in subparagraph "a." The main idea for "b" is found in its only sentence.

Later, main ideas are identified with captions.

Overall, the lesson lacks an adequate and clear presentation of the concept of main idea, leading to inconsistent and confusing explanations.

Lesson 1g, "Rounding Numbers." The lesson gives the following definition of rounding (page 2):

> "What is rounding? Rounding means not being exact when using numbers."

First of all, this is not a definition of rounding; it does not describe the process; rather it describes an outcome of the process. Furthermore, this statement is misleading because it implies that rounding is an imprecise process when in fact the rules governing it that are presented in the lesson are very precise.

The lesson then moves to a definition and illustration of whole numbers and place value, but without any mention at all of what it means to "round to the nearest x." The heart of the rounding process involves recognition and understanding of what ". . . to the nearest x" involves, but this concept is not discussed. However, it could be illustrated in a way that compares the results when one number is rounded to the nearest 5, 10, 25,

etc. The lack of an adequate treatment of basic concepts involved in rounding is what leads to the necessity of presenting the multiple sets of specific rules for rounding to the nearest 5, 25, etc., that are found in the rest of the lesson.

Lesson 11a, "Identify Shape and Position Terms" (paper). In this lesson misleading definitions of basic concepts lead to confusion and logical contradictions. The problem starts with the definition and description of circles on page 4:

> A circle is a single curved line in which every point is an equal distance from a center point.

[According to this definition, could also be called a circle.]

> Circles drawn on paper are two-dimensional.

[Are there in fact any "three-dimensional" circles? No, but the text is not getting at the main point, which is distinguishing two-dimensional from three-dimensional representations.]

> [1.] Circles are round, but not all round things are circles. [2.] Apples and oranges are not circles. Also, circular objects are often solid, or three-dimensional, such as a ball.
>
> (page 5)
> [3.] Things that are round are circular, or are shaped like spheres, circles, globes, or balls. [4.] An object does not need to be a perfect sphere to be called round.

[Numbers in brackets have been added for ease of reference.]

In addition to being redundant and confusing, these passages are also contradictory. According to the above logic, an orange could be called round. [4.] Then, given [3], an orange could be called circular. This leads to a contradiction with [2.], "Apples and oranges are not circles." Furthermore, [3] ("... not all round things are circles") contradicts [1] ("Things that are round are circular.")

The basic problem with this lesson is a conceptual one: an accurate and useful definition of circle has not been provided. This leads to a failure to illustrate in any coherent and effective way the differences between two-dimensional and three-dimensional terms, as well as to confusion of terms such as "circle," "sphere," "circular," and "round."

Problem area 5. The lesson lacks an adequate explanation of context, purpose, or rationale underlying the skill objective. Although the skill objective of each lesson is stated in a box that appears on the title page, some lessons lack an introduction stating why a skill is being taught, how it relates to other skills, what uses it may have for the soldier, or what basic concepts or definitions are involved in learning the skill. In some cases, lessons plunge right into a list of steps or rules to be followed.

Lesson 14f, "Multiplying and Dividing Fractions." This lesson exemplifies this lack of explanatory context. The lesson begins with a rule:

> "To multiply a fraction by a fraction, (1) multiply the numerators (upper numbers) across; (2) multiply the denominators (lower numbers) across."

There should be at least some explanation of what happens to fractions when you multiply or divide them (as opposed to whole numbers, for example), what occasions or situations might require this skill, and some explanation of why this rule works or where it comes from. This is lacking not only in the short lesson (where its absence can only partially be justified on the basis of a focus on remediation), but also in the long lesson, where it cannot.

In the long lesson (page 12, for example) students are given a list of steps to follow for reducing a fraction: "Here are the steps for reducing a fraction." This does not provide enough instructional context: an idea of what one wants and why is important to an understanding of the process. As it stands, soldiers are told to follow steps blindly without a clear understanding why they are there in the first place.

Lesson 28b, "Finding Information." The objective of this lesson is to teach students to read charts and tables to locate information. However, the lesson does not begin with a description or an illustration of a chart or table, but simply with instruction about "How to read a row." Unless students are first shown how rows are essential parts of a chart

20

or table and how they are used to represent information, teaching them how to read a row does not make sense. It would be much better to begin the lesson with an illustration, perhaps with parts such as rows or columns labelled, so that students could see the whole picture and associate the instruction with past experience and with some conceptual model of how parts fit together, and why they are important.

Problem area 6. The lesson has organizational problems: for example, sections are misplaced, presentation is circular, or practice items do not refer to the section in which they are placed. This particular problem is easier to detect in paper-based lessons than in on-line lessons, primarily because the whole paper-based lesson is available to the reader at once, facilitating comparison of different sections. The examples that follow have accordingly been drawn from a paper-based lesson.

Lesson 33a, "Record Essential Information," begins with a very good introduction to notetaking which clearly states why knowing how to take notes is useful. However, in the following sections basic ideas become muddled by very confusing topic organization.

The first half of the lesson is devoted to "informal" notetaking. According to the information given here, informal notetaking has two forms -- written and mental. The first key point is the category of notes described as "mental notes." "Lists," (page 10) is the second category; however, lists as they are described here are *stimuli for mental* notes. The third key point is entitled "Kinds of notetaking" -- which does not seem to fit in here, given that the lesson has already been describing kinds of mental notetaking. This category is subtitled, "Written notes." The next category is "Time and reason." This does not at all describe a kind of notetaking; it merely explains that the time available and the reason for taking notes influence the type of notes one takes. Then the lesson moves back to describe a kind of written notetaking, "notes for yourself." [Key point 3, page 11.] However, page 12 brings up another key point labelled "notes for yourself," this time combined with the subtitle "personal shorthand." The topic organization in this section is very confusing: key points, categories and sub-categories have no coherent relationship. The reader does not have a clear idea of the main idea nor of categories of notes when reading this section.

The next key point "Notes for others" seems out of place, since it is the entire second section of the lesson that is devoted to notes for others (which are presumably

21

"formal notes.") Moreover, in the middle of this misplaced "notes for others" section, the practice item (1.7) asks students to take down personal notes ("notes for yourself"); it is obviously out of place. The rest of the material on "notes for others" belongs in section II, not section I.

The confusion becomes more apparent when we find the section on "taking notes from print" of the first half of the lesson on informal notes (p. 14) repeated in section 2 (p. 18) on "formal notes." How is the student to tell whether taking notes from print is classified as formal or informal; or, indeed, what the conceptual difference in fact is between formal and informal notes? This is quite confusing, especially since in the formal notes section the lesson talks about taking notes from manuals that are only for personal use, such as the "informal" personal notes described earlier. In the end, the lesson never explains what difference it makes whether the notes are classified as formal or informal.

Indeed, the main point of the lesson -- developing skill in notetaking, which is predicated on an ability to distinguish essential from non-essential information -- is not taught at all (problem area 1). At each point, soldiers are merely told to "decide which information is important" -- but no guidelines are given for how to make such a decision, with the possible exception of the "SALUTE" mnemonic (S = subjects, A = activity, L = location, etc.). Conventions and categories for notetaking replace a focus on developing skill in abstracting and evaluating information.

Problem area 7. The lesson makes abrupt conceptual jumps or relies upon spurious comparisons or inappropriate juxtapositions that confuse one skill with another. In some cases, skill confusion occurs when practice or test questions intended to test performance of one skill -- for example, notetaking -- in fact require a student to use another skill, such as reading. In other cases, one concept (and related skill) is used to teach students another concept (and related skill), yet the two are not comparable.

Lesson 1c, "Ordering Numbers—Intervals." This lesson uses one concept in order to teach another, but these concepts are fundamentally different, leading to failure of students to master the intended skill. The lesson begins with an illustration of a thermometer whose temperature is going down. This is a good way to illustrate intervals; however, the linkage between the "increasing" negative numbers on the temperature scale and the idea

that the temperature is decreasing is not made explicit. This is crucial, as it seems to be the main point of the illustration.

The entire first section of this lesson is devoted to the temperature scale; on page seven, however, the lesson suddenly jumps to practice questions that have nothing to do with temperature or scale, but ask the student to sequence numbers and decimal _quantities_ entirely independently of a scale. The comparison between temperature scales and decimal quantities is inappropriate; unless some of the similar notions inherent in interval and distance on a number scale and the notion of negative numbers are made explicit. Thus the comparison is of little value to the student in learning how to sequence negative decimals.

Moreover, the lesson began by presenting the concept of negative decimals as temperature marks on a thermometer. The focus was upon identifying (reading) negative temperatures. This task does not require a student to arrange numbers in a sequence; it only requires him or her to read a thermometer. This represents a spurious equivalence of tasks. Expecting students to make the conceptual jump from reading off numbers on an interval scale to sequencing and to notions of quantity phrased in terms of least and greatest is problematic.

The notion of "negative quantity" upon which some sections of the lesson and test questions are based is also difficult to visualize. The lesson requires students to determine which of a series of negative decimals is "larger" or "smaller." These terms carry over the concept of "large" and "small" from positive numbers which, when applied to negative numbers, leads to errors, since students automatically consider the "size" of the number in positive terms. Moreover, the lesson never makes explicit the fact that the "larger" the negative number appears, the "smaller" it in fact is. Instead, the lesson gives students this rule:

> "To determine whether a number comes before, after, or in between a group of numbers, put the numbers in sequence from least to greatest, then compare your new number to each of the sequenced old numbers, one at a time."

"Determining whether a number comes before, after, or in between" is exactly what sequencing involves, so essentially this rule reduces to the tautology, "To sequence a number, put it in sequence." The lesson inappropriately uses one skill (reading tempera-

23

tures on a scale) to "explain" another (negative decimal "quantity"), failing to make explicit the relationship between distance on an interval number scale and negative quantities.

Lesson 3a, "Identify Degrees and Mils." The stated purpose of the lesson is cloudy: "How to identify angular measurements by using degrees and mils." Does this mean that the lesson will teach students to identify which measurements are degrees and which are mils -- that is, to distinguish between measurements in degrees and mils? Or will students learn how to measure or compare angles in both systems? This purpose becomes even more fuzzy when juxtaposed with the "second" purpose of the lesson: "You will also review how to recognize temperature in both degrees fahrenheit and degrees centigrade." Juxtaposing angular measurements and temperature measurements as if they were somehow "equivalent" is a false comparison: angular degrees have little to do with temperature degrees, except for the fact that they are both called "degrees." They are measured in entirely different ways and they are applied to entirely different entities; they are thus conceptually quite distinct and their juxtaposition here does not clarify what is already a rather muddy lesson purpose.

This confusion over what skill the lesson is in fact teaching is carried over to the test. Item 4 asks for the angle of the soldier's arm (in salute posture). This is not an identification question involving mils or degrees; it tests previous knowledge of proper salute posture. Item 3 shows an angle with a 45-degree measure. The question asks whether 45 degrees refers to temperature or angular measurement. This does not test any ability to "distinguish" different types of degree measures from one another, but simple reading ability. One must concur with the soldier who said that sometimes the questions are so obvious that ". . . they begin to play with your mind."

Problem area 8. The lesson contains internal logical problems: parts of the same lesson contradict each other, or the lesson teaches one thing but practice questions require another.

Lesson 41b, "Identify and Use Hand and Arm Signals." The short lesson 41b draws a basic categorical distinction between mounted and dismounted arm signals: it illustrates both types, and teaches that these are two separate categories without overlap. However, the long lesson abandons the mounted/dismounted distinction, and tells the student: (p.6) "The

24

signals in this part of the lesson may be given from the ground or a vehicle,"
contradicting the information presented in the short lesson. [This is also a case of
short/long lesson content mismatch, problem area 16.]

In lesson 28b, section 2, page 12, there is a description and illustration of columns:
"On a printed page, a column is made up of two or more vertical sections of lines of the
page." [The language here is awkward and confusing: what are "vertical sections of
lines?] Practice questions 2.1 and 2.4 look like perfectly legitimate columns, but the
answer key says 2.1 is not a column because the numbers ". . . do not go up and down in
a straight line." Then, logically, 2.4 is not a column either, because those numbers "do
not go up and down in a straight line" either -- in both cases one digit "sticks out." Yet
the answer key says 2.4 is a column because ". . . the numbers that form this column run
up and down." So do the numbers in 2.1! Logical inconsistencies result from the
confusing and misleading verbal descriptions in this lesson.

Presentation or Delivery Problems

The previous section dealt with various types of conceptual problems present in JSEP
lessons. This section will consider problems affecting presentation of lesson material,
including answer formats, language, practice items, illustrations, and instructional methods.

Problem area 9. The lesson has mechanical or format problems with test or practice
questions that interfere with answering the question in the correct manner. In some
cases the question focuses more on the format than upon the skill or concept behind the
question, thus confusing students:

> The 01 series on JSEP has many test questions that are confusing to the students. I
> feel that if those questions were worded differently, more of my students would pass
> the diagnostic test and save a lot of time. A student may know the skill itself, but
> miss the question because he didn't know what was being asked. [Instructor's p-
> note, 2/5/88]

In one sense this particular problem could be seen as related to a failure of some
lessons to teach the concepts underlying skills in ways that focus students' attention on
the concepts themselves rather than upon aspects of format or mechanics. Questions

25

worded so that the main skill objective is not clear may be those in which other aspects of the problem -- such as format -- take precedence. On the JSEP attitude survey, students said: "Sometimes the computer doesn't explain how to answer some of its questions." "At times the explanations were unclear as for their answers." "Sometimes I would get so frustrated I would put wrong answers because of abbreviations." Format problems thus can not only obscure the skill being tested, but also lead to frustration that can affect student performance.

In Lesson 1b, "Writing Sequential Numbers," it appears that mechanical errors can be a major source of wrong answers, even when the student knows the answer. Often, it is not clear what form an answer should be in: For example, in test item 3, the question does not specify if spaces (space bar) should be used, or if so, how many spaces should be inserted between numbers. Nor does it state if and where commas or periods should be used. Moreover, all the items on the practice section have been sequenced low to high, but test item 6 asks for a high to low sequence. This sudden change can be misleading. These mechanical difficulties led one student to complain, "Either the scoring [on this lesson] is screwed up, or the instructions are so confusing I don't know what they want." [Personal note]

Lesson 34d, "Outlining," poses major mechanical difficulties for students, since answers to practice and test questions depend on repeatedly pressing the space bar the right number of times in order to get the code elements in the correct places. According to JSEP staff at one site, the lesson teaches students more about the mechanics of manipulating the computer than it does about outlining.

Similar problems plague **Lesson 6b, "Alining Parts and Equipment."** Test items require the student to use arrows to manipulate objects on the screen, but in some cases it is very difficult to tell if one has moved the given object far enough or if one has gone too far. In test item 13, for example, it is exceedingly difficult to tell exactly where the 45 degree position is. Thus, even though the student may understand the concept and know what he or she must do, the mechanics of answering the questions can defeat their purpose.

Problem area 10. The lesson has language problems such as inconsistent terminology, ambiguities, awkward or confusing phrasing, grammatical errors, or typographical errors.

26

(This section will be devoted to problems in the lessons themselves; for language problems affecting test items, please see problem area 18.)

Language problems were common in the JSEP lessons reviewed. Ranging from minor typographical errors to ambiguous and confusing explanations, they became particularly troublesome when they affected presentation of basic concepts. Examples follow.

Lesson 9a: "Identifying Angles." (p.2) "Two lines segments emerging from a common endpoint make an angle." It is not clear whether the writer meant "lines" or "line segments." The verb phrase "emerging from a common endpoint" is awkward; things normally emerge from beginnings, not endpoints.

> (p. 18) The angle of site forms with the gun or battery as the vertex. One line segment is the gun to the target line. The other segment is the gun to the ground line, also called the base line.

This is confusingly worded, and could be written much more clearly (if I have understood it) as:

> The vertex of the angle of site is the gun or the battery. One line segment extends from the gun to the target. The other line segment runs from the gun along the ground.

Lesson 5c: "Read and Interpret a Gage." Inconsistent terminology in different parts of this lesson can cause students difficulties. The short lesson tells students they need to perform two steps in order to read multimeters. The first is to "select the correct band." The short lesson uses the term "band" consistently and offers practice in identifying bands. However, the long lesson states the rules a little differently: students need to "select the correct scale." In the long lesson, the focus is upon "scale." "Scale" and "band" are not the same: this distinction needs clarification and illustration.

Lesson 12h: "Estimating a Sum or Difference." In this lesson on estimating sums or differences, a prepositional error changes the meaning of a basic rule: (page 4)

> "Determine which two tens the number you are rounding to is between." (639 is between 630 and 640)

27

"To" is an error; the sentence should read, "Determine which two tens the number you are rounding is between." The number being rounded and the number being rounded <u>to</u> are quite different.

Lesson 29b: "Use a Key, Legend, or Parts List." This lesson instructs students in reading keys, legends, and parts lists. The short lesson (pages 16-17) gives rules for using parts lists as follows:

> "A parts list gives the names and numbers for the parts shown in the illustration ....
>
> To find a part on an illustration:
>
> - Find the name on the parts list
> - Look for the part number
> - Look for the part number on the illustration

In this case the term "part number" is ambiguous, for there are two kinds of "part numbers" -- one relating to the sequence of parts found in the illustration, and one that serves as the part identification number. These are not distinguished from each other.

Lesson 28b: "Finding Information." There are numerous examples of awkward and ambiguous wording in the paper-based long lesson.

> p. 12. "On a printed page, a column is made up of two or more vertical sections of lines on the page."
> p. 24. "You will find the row heading from the intersection of the row and column."
> p. 25. "Sometimes several rows of information about one item will be listed below its first listing, and the information that identifies it will not be repeated."

Lesson 11a: "Identify Shape and Position Terms." There are similar problems in this lesson.

> p. 4. You will often need to draw a circle when instructed to "draw a circle..."
> p. 2. Some endings to words change their meanings a little bit, like -ly and -ed.
> p. 5. Things that are **round** are circular, or are shaped like spheres, circles, globes, or balls. In everyday usage, the word circle refers to a general shape. An object does not need to be a perfect sphere to be called round.

28

[Paragraph is confused, changes topic from "round" to "circle" in second sentence, then goes back to "round"; also, redundant: "circular things are shaped like circles."]

Problem area 11. Practices or examples are poorly chosen, inappropriate or confusing, given the aim of the lesson. In some cases, practice items do not give the soldier practice in the skills objective of the lesson, but in peripheral skill areas. Thus, they misrepresent the skill objective of the lesson.

Lesson 27c: "Finding Information in a Book." The skill objective of this lesson is to teach students how to locate specific types of information using features such as an index, appendix, table of contents, or glossary. The focus should be on giving students practice in how to determine what kind of information is found in each, and how to make judgments as to where a particular kind of information would be found. However, the practice items fail to target this essential skill; instead, they repeatedly ask the student to locate page numbers for specific given topics. Most of the items are of the format:

> "On what page would you find the appendix concerned with the vocational training institute?"

This type of item does not give the student practice in deciding where different kinds of information might be found. It does not illustrate how an index, for example, might be more appropriate to use than a table of contents, depending on the type and degree of specificity of the required information. Asking students to read off page numbers in samples of appendices, tables of contents, and so forth, only gives practice in peripheral table or list reading skills, not in the intended skill objective of the lesson.

Lesson 11a: "Identify Shape and Position Terms." Section 1, page 2, contains a very confusing example. The intention is to illustrate how "suffixes" alter the meaning of words -- in this case, the suffixes -ly and -ed.

aline	do now
alined	already done
horizontal	a position
horizontally	a descriptive direction

As it stands this example does not illustrate the meanings of -ed or -ly; it merely confuses the reader by seeming to provide definitions for the terms: e.g., "Aline means 'do now.'" Contrasting "a position" and "a descriptive direction" does not illustrate the meaning of -ly very effectively.

Lesson 1g: "Rounding Numbers." The first practice question in rounding on page 10 asks the soldier to round a number ending in 5. The task involved here (rounding to the nearest 100) has not been explained yet; the next section of the lesson deals with rounding to the nearest 5, and the "rules" for rounding to the nearest 100 do not come until later in the lesson.

On page 20, we find an example of a practice question that requires the student to "round" a number for which rounding is in fact not necessary. The feedback to this question even states that it is "tricky" -- if so, then it should not appear as a practice item.

Lesson 1d: "Ordering Numbers - Greatest and Least." The objective of this lesson is to teach the skill of ordering numbers, or recognizing relative values. The walk-through example illustrates how to compare numbers by lining them up in place value columns. All the numbers to be compared have the same number of digits (or places.) However, the practice question on page 7 suddenly asks students to compare numbers in which the number of places is not the same; moreover, the same number (22871) occurs twice in the list. No instruction has been given as to what to do when the numbers do not have the same number of digits. This practice is thus inappropriate.

In the section on fractions (page 17) the practice item on page 24 asks students to compare fractions where both the numerator and denominator are different <u>before</u> they get to the section of the lesson that in fact explains how to do this. This practice item is out of place.

<u>Problem area 12. Feedback to practice question answers is inappropriate</u>. In some cases, the feedback incorrectly "presumes" the user made a particular kind of error in answering the question. In other cases, the feedback is contradictory or irrelevant to the intent of the question.

Lesson 32c: "Locating Information on a Form." (Long lesson, section B, page 17) The question presents a section of a form, and asks the soldier to locate information from a block on the form.

> (Question) How was the failure first detected? Type in the correct answer.
> (Answer) > normal op
> (Feedback) No, the failure was detected during <u>normal op</u> (eration).

This is the sort of error that prompted a soldier to comment at one point in a lesson, "Hey, your answer and my answer are the same. How can I be wrong?" [Personal note]

Lesson 4a: "24-Hour Time." (page 9) The answer to a practice question requires the student to use 12 hour time notation. A typing error in "PM" elicits this response:

> No, the rule you should use involves subtraction. Did you subtract correctly?

Yes, I did, but that was not the problem. Although feedback is designed to be as helpful as possible to the student, incorrect presumptions such as this can be misleading -- especially if the student is not aware that he has made a mechanical error in the answer. Such feedback does not provide adequate information about the required answer format.

Lesson 29c: "Use A Cross-Section." Page four illustrates two flame devices, one cross-section with its parts labelled and one non-cross section without labels. The question asks the soldier to "touch the rim on the flame device." If the student touches the rim that is labelled, [a logical and defensible response, given that the aim of the lesson is to give students practice with cross-sectional illustrations] the response is:

> No. This **is** the cross-section. Touch the rim on the other bottle.

This feedback is not helpful to the student, for it does not specify why this response is wrong. Moreover, the peculiar boldfaced "is" does not make sense. It implies that the question asked was something like, "Is this or is this not the cross-section?"

Furthermore, the point of this question is not clear. If it is to get the soldier to distinguish between cross-section and illustration, then the question should specify this. "Flame Device" alone is ambiguous.

31

Problem area 13. Lesson graphics, illustrations, or captions are confusing, mis-labelled, or misdrawn. (This section considers only graphics or illustrations in the lessons themselves, not in the tests.)
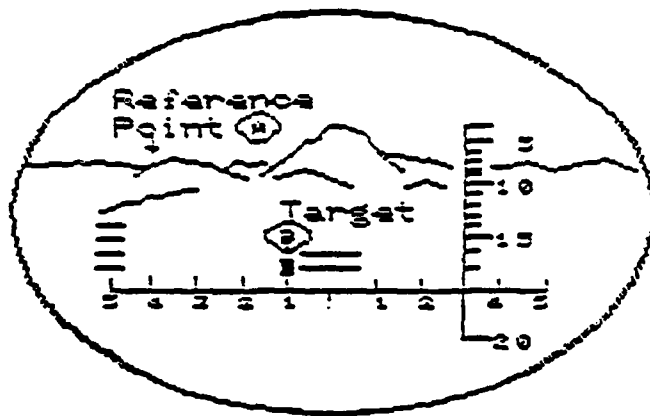
Lesson 3a: "Identify Degrees and Mils."

Now you try it.

Measure the deviation from the known point to the target.

Type in the blank.

Target ⓑ is ⟩ ____ ʍ to the right of point ⓐ.

[BACK to review]

This diagram on page 20 (short lesson) is misleading. Reference point A appears to be almost directly above target B; only a small arrow points to a different point farther out. I originally saw only the A, which led to a wrong answer.

On page 32 there is a rather confusing illustration. The diagram can be interpreted as showing two separate thermometers (with the Fahrenheit on the left and the centigrade on the right) or as showing one thermometer with two separate scales (the latter probably being the intended interpretation).
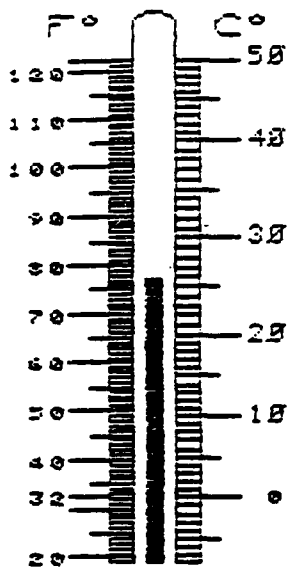

```
F°              C°
            ──50
120                    All right, what is the
                       temperature in degrees
110         ──40       Centigrade in the
                       thermometer at the left?
100

90
            ──30
80

70
            ──20       Type in the correct
60                     number.  26  °C
50          ──10
                       You're right, 26°C.
40

32          ── 0

20
```

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┌──────────────────┐   ┌─────────────────────┐
│ BACK to review   │   │ NEXT to continue    │
└──────────────────┘   └─────────────────────┘
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The question asked is:

What is the temperature in degrees centigrade in the thermometer at the left? This question adds to the ambiguity, implying either (1) that the student should simply read the one thermometer (whose position is left of the text on the screen) or (2) that

33

the student should read the "thermometer" on the left (whose scale is in degrees Faren-
heit) and then "convert" the reading to centrigrade by reading across to the other scale.
A clearer illustration would be helpful here. (I made the mistake of seeing the diagram as
two separate thermometers.)

Lesson 27c: "Finding Information in a Book." (Long lesson, Section D) In the illustra-
tion requiring the student to touch the term "center point," there is more than one
"center point" term printed on the screen. I spent five minutes touching one of the
"center point" terms on the screen, without realizing that there were others. The
computer would not respond. Finally I realized there was another "center point" term on
a different part of the screen, which was the one that had to be touched in order to get
the computer to respond. This was not specified in the instructions.

Lesson 14f: "Multiplying and Dividing Fractions." (Long lesson, page 5)

Sometimes you multiply more than two fractions. The
same rules apply.

$$\frac{3}{4} \times \frac{5}{6} \times \frac{8}{3} \times \frac{1}{7} = ?$$

Multiply across. $\frac{15}{24} \times \frac{8}{21} = \frac{120}{504} = \frac{5}{21}$
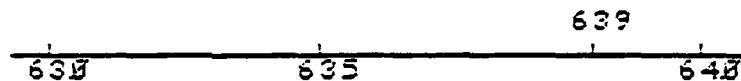
BACK to review   NEXT to continue

The indicator lines in this illustration of fractions are confusing. They seem to show that somehow the denominators 4 and 6, when multiplied together, become the numerator of the fraction beneath. [The same thing holds for 3 x 7 and 8.]

Lesson 12h: "Estimating a Sum or Difference." Pages 3 and 4 show number lines in order to illustrate the concept of rounding. However, the "midpoint" on the number line connecting two numbers is not placed in the middle (where it should be) but slightly to the side.

It works the same when rounding to other place values.

- Round 639 to the nearest ten.

- Determine which two tens the number you're rounding to is between.
  (639 is between 630 and 640)

- Ask yourself which number 639 is closer to.

- It's closer to 640. So...
  639 rounded to the nearest ten is 640.

BACK to review   NEXT to continue

Especially since the point is to estimate how far a number is from another, these distances should be represented as accurately as possible.

Problem area 14. The lesson uses an inappropriate instructional method: for example, "telling" rather than teaching, or using a practice item prematurely that "traps" students into a wrong answer.

Lesson 4a: "24-Hour Time." The long lesson section on adding military time begins by offering students a very useful option: if they would like to see more "information" on the topic they may choose "I," or, if they feel they already know the material, they may choose "P" and go directly to more "practice." The lesson says:

> If you're sure you know this information, touch the "P" box below to go directly to the practice. If you aren't sure you know this information, touch the "I" box below.

Touching the "P" box does indeed bring up practice questions. However, touching the "I" box also brings up a practice question, not information:

> (p. 34) The time is now 1548. The enemy attack began 3 hours and 15 minutes ago. At what time did the enemy attack begin? Type in the correct answer."

This is almost as if the intent of the program were to prove to the student that he or she in fact did not know the answer. This is inappropriate as an instructional method given that the student has specifically requested more information, not practice, because he or she does not know the material. This practice question appears designed to "trap" the student into a wrong answer, or to "rub in" the fact that he or she does not know the material.

Lesson 12c: "Add or Subtract Military Time." A similar problem occurs here. The lesson lacks any sort of introduction or statement of context. It immediately presents students with a test question:

> (p. 1) Your unit was participating in NBC training. After the alarm sounded, you were told to wear your mask and hood for exactly one hour and forty minutes. The alarm sounded at 1052 hours. What time was it when you took off your mask and hood? Type your answer.

36

This seems designed only to trap students into making a mistake, to show them they do not know how to solve the problem. The instructional value is negative. Page two jumps immediately to statement of the "rule" used to solve the problem.

In the long lesson, the problem seen in lesson 4a reappears. Students are given a choice to select the I (information) option or the P (practice) option. Selecting information again brings up a test-type question that imitates the format found at the beginning of the short lesson. Students who select information do so presumably because they do not want to confront a practice question. This is an inappropriate instructional technique.

Lesson 1d: "Ordering Numbers – Greatest and Least." This lesson contains an example of teaching students to use a method to solve a problem that results in a wrong answer. In the long lesson, page 56, students are taught a way to find a common denominator by multiplying denominators of fractions. The example given produces an answer of 40. However, the next page of the lesson tells students: "40 is not the lowest common denominator," and that they must find the smallest one possible. However, no further instruction is given, nor is the correct answer to the problem given. This is highly inappropriate. If the method taught gives 40 as the answer, and 40 is not correct, then why teach this method? Either additional instruction in how to use this technique is needed, or it should not be taught at all.

Lesson 41b: "Identify and Use Hand and Arm Signals." The long lesson asks students if they remember the meaning of a particular signal:

(p. 7) Do you know what this signal means? [Yes or No]

If the student answers **Yes** the program responds,

Good. Then the first signal will be easy.

The lesson proceeds to explain the meaning of that same signal.

If the student already knows what it means, why teach it? This wastes student time and is needlessly repetitive. There should be some way to opt out of unnecessary instruction,

37

especially in this case in which the student is led to expect such a choice by the very fact that the program asks if he or she already knows the material.

The problem recurs on page 19 in the practice section. The lesson illustrates signals and asks,

Do you already know any of these? Touch Yes or No.

Touching Yes elicits the response,

Fine! You're well on you way to mastering all 7 signals. Your first signal is next....

The lesson then proceeds to teach all seven signals, some or all of which the student already knows. Asking the question leads the student to expect an option that is then denied, resulting in needless repetition.

Problems In Short/Long Lesson Compatibility and Tests

Problem area 15. The short and the long lessons use a similar or identical approach to the lesson material. The basic problem here from the point of view of instructional excellence is: If students have trouble with the way material is presented in the short lesson, will more of the same approach in the long lesson be any better? Despite the intention of JSEP lesson design to provide review in the short lesson and instruction in the long lesson, this contrast is in reality often obscured by repeating short lesson material in the long lesson, or by failing to take an approach that is sufficiently different in the long lesson to qualify as "instruction" (as opposed to review.) In fact, the review/instruction distinction is an artificial one for many lessons.

In such lessons, whole segments of the short lesson sometimes reappear in the long lesson. In other cases the long lesson presents material in essentially the same manner as the short lesson, though with some additional remarks or explanations. Yet overall these additional explanations and practice items do not significantly differ from the short lesson explanations and practice in their focus or approach. Examples follow.

38

Lesson 1g: "**Rounding Numbers.**" The short lesson presented the rules governing each case of rounding, based on the particular place one is rounding to. Section A, page 1 of the long lesson introduces the topic of rounding using exactly the same illustration as in the short lesson, but there is an error in the caption. On page 2, "instruction" consists of telling the soldier that "27 rounded to the nearest 10 would be 30. (27 is closer to 30 than to 20.)" Simply telling the student what the answer is without any walk-though or explanation is not instruction. Page 4 introduces a section on whole numbers which is taken directly from the diagnostic lesson. Page 10 presents an "overview of rules" that appears to be a little more general than the diagnostic lesson, since a section is labeled "rounding to a specific place value." But the lesson then immediately goes back to repeating lists of specific rules for each case of rounding to a different place value, just as was done in the diagnostic lesson. The long lesson in fact does not provide any new instruction in rounding; it is based entirely on the approach taken in the short lesson.

Lesson 3a: "**Identify Degrees and Mils.**" The long lesson also repeats material from the short lesson, but adds some new contextual information such as why knowing about mils and degrees is important. The discussion beginning on page 4, however, introduces material that does not really serve the instructional purpose of the lesson. It goes back to a very basic level, describing in detail what line segments, rays, and angles are. This is not the focus of the lesson; it is "instruction" in peripheral areas. Section B repeats the same material from the short lesson, but appends a game ("tank shoot") which is wise, helping to relieve what may be monotonous repetition. Section C also repeats much of the same material found in the short lesson. Though the long lesson does contain some new material, the approach is essentially the same as that of the short lesson with the exception of the game. (The game, however, qualifies as practice, not instruction.)

   <u>Problem area 16. The long lesson and short lesson do not match each other in content; one lesson teaches something the other doesn't</u>. In contrast to the above described problem where both lessons take the same approach to the lesson material, in some cases the lessons differ from each other in content. In fact, from an instructional point of view it should be the other way around: Lessons should differ in approach but match in content.

39

Lesson 27c: "Scanning for Facts." The long lesson contains a section devoted to "skimming" while the short lesson is concerned entirely with scanning. In fact, the long lesson points out the difference between scanning and skimming, and then confuses them later in the practice questions:

(p. 42) Directions. **Skim** the paragraph for the main idea.

(paragraph here)

What was the paragraph you just scanned about?

This is a case where content mismatch should not have much impact on student performance since the extra content is not tested. It merely becomes a source of confusion within the lesson practice questions.

Lesson 15d: "How to Use a Protractor." The short and long lessons for this prerequisite competency are essentially very different in the skills that they teach. The short lesson begins with a statement as to how the soldier can use a protractor to measure angles and plot azimuths, but the next screen announces that this lesson will not actually allow him or her to use a protractor. [Why not, if that is the purpose of the lesson?] The main point here is that the long lesson, in contrast, does require the soldier to actually use a protractor. Thus, the short lesson teaches about the protractor; the long lesson teaches how to use the protractor. The skills of knowing about and knowing how to are essentially quite different.

Lesson 5c: "Multiscale Gages." In this case, a content mismatch between long and short lessons leads to problems when students take the diagnostic test. (See also problem area 18.) The diagnostic lesson does not present any material at all on selecting the appropriate range or setting the selector switch to do so. Selecting range is however covered in the long lesson. In fact, the "two steps" of the short lesson become "three steps" in the long lesson:

Steps to reading multimeters:

(Compare:) (short) • Select the correct band.
                      • Determine the value of the tick mark at which the needle points.

            (long)   • Select the correct scale.
                      • Select the correct range.
                      • Determine the value of the tick mark at which the needle points.

Once students are given the long lesson information on how to select the range, they are able to answer all test items; however, with the short lesson material only, test questions on range pose major difficulties.

Problem area 17. Test items do not match material in lessons; information or material required to answer test items is not present in lesson.

Lesson 36c: "Capitalization." The lesson presents eight simple rules for capitalization. These work very well given all test questions except items seven and eight. These two items require application of lesson rule 2. As stated, this rule reads:

Capitalize the first word of a direct quote.

This is an ambiguous and incomplete formulation, since it does not cover the situations actually presented to the student in test items seven and eight. This rule only specifies that the first word of a direct quote need be capitalized; however, item seven contains a quote that has more than one sentence. In item eight, the quoted sentence is divided into two separate parts with the normal subject/verb/quotation order changed to quotation/subject/verb/quotation order (i.e. "that's how I did it," he said, "by climbing a tree.") Rule 2 does not tell the soldier what to do when the quoted sentence is divided into two parts. Should only the first word of the first half be capitalized? What about the first word of the second half? Soldiers may not even realize that we are dealing with a complete though divided sentence here. Practice has not illustrated what to do in

41

a situation. Moreover, the rule does not specify what to do when the quote precedes the subject phrase, as it does here.

Lesson 27c: "Scanning for Facts." In this lesson, rules and practice items are insufficient for answering some test items, although the mismatch is more subtle than in the previous example. In the lesson, rules and numerous practice items ask the student to identify mostly one or two word clue words that correspond exactly with the piece of information the student is required to locate. However, on "difficult" test items the required answer is usually a phrase rather than one or two words; moreover, in these items the "clue words" are more complex and are not found in the same sentence as the information the student is required to locate. Examples follow.

> Item 1. Asks students to "touch the word that describes what perpendicular obstacles do to the movement of attackers."

> • The answer is not "one word" -- as stated in the question -- but a phrase.

> • The "clue word" here, as the notion has been used in the lesson, would be "perpendicular obstacles." However, in this case "perpendicular obstacles" is insufficient; it must be combined with the notion of "attackers" as well as a notion of effect or outcome in order to located the desired information. This "clue" is much more complex than those given in the lesson.

> • The required information is not found in the sentence containing the words "perpendicular obstacles" but in the following sentence. This is a condition not taught in the lesson, where clue words almost always act as flags for information located in the same sentence.

In item 8, the student uses the clue "dead mail" to scan, but the sentence containing "dead mail" does not answer the question, nor does the following sentence. The student must continue to read until the next sentence. Practice in this sort of complex scanning was, in fact, not given in the lesson.

Lesson 12h: "Estimating a Sum or Difference." The short lesson does not review material essential for answering some test questions concerned with the place value to which a sum

or difference should be estimated. Instruction in the long lesson is not much better: section E, "Choosing a Level of Estimation" (which appears to be students' main weakness) gives these guidelines:

> Usually if you are working with smaller numbers, you make the estimate closer to the actual numbers; e.g., 33 plus 36 is about 70. If you're working with larger numbers, the estimate would not be as close.

> If you're in a hurry, you'd use the 1st or 2nd two digits to estimate.

But these rules do not explain what to do when the numbers one is adding or subtracting have different place values, as on the test. Test item 22, for example, reads as follows:

> To what place would you make a rough estimate of these numbers?
> 17342 - 1618

[This is poorly worded: the question intends to ask for an estimate of the difference of these numbers, not the numbers themselves.]

> The answer given is 1,000.

The lesson does not specify how to determine this. It has only taught students to first round the two numbers separately and then subtract in order to get an estimated answer. Moreover, the lesson contains a similar practice item whose answer seems to contradict the answer given for this test item:

> (page 24, short lesson) To what place value would you estimate the following?

> 3252 + 79850

> Answer: 10,000.

In both these cases, one number is in the thousands (and presumably is rounded to the thousands) and the other is in the ten thousands (and is presumably rounded to the ten thousands.) In both cases the estimated sum or difference will be in the ten thousands.

43

How therefore can the answer be 1,000 in the first case and 10,000 in the second? This is inconsistent -- either the test answer is wrong or the lesson examples are wrong.

Problem area 18. Test items are confusing, ambiguous, or misleading.[3] The source of such difficulties may be in the language of the question itself, in the instructions for answering the question, or in the accompanying diagrams or illustrations.

Lesson 6b: "Alining Parts and Equipment." The test contains some very ambiguously drawn items, as well as awkward and ambiguous language. The lesson introduction itself warns of problems to come:

> In this lesson pictures of objects will appear on the screen. Your task will be to aline objects as directed. You will use arrows to move the objects, instead of actually moving them around. [As if objects pictured on a screen could actually be moved around....]

In test items 9, 11, and 12 confusing diagrams and instructions make it very difficult to answer correctly. In item 11, for example, there are two ways to make a 45 degree angle. In item 12, the language as well as the diagram is confusing. This item requires the student to "move the right edge of the logs down . . . ." (Do logs have "left" or "right" edges? What are the logs in the illustration?) This item also seems to require previous knowledge of terminology such as "culverts" and "clogs."

Lesson 27c: "Scanning for Facts." Aside from aforementioned problems with lesson/test content mismatch, some test items are simply misleading. Item 9, for example, asks the student to scan for the answer to the question, "When should a native scout lead a patrol?" Based on the way the question is phrased, one expects to find some mention of conditions or time in which native scouts should lead. However, the answer to the question is "never." During rapid scanning it is very difficult to identify "never" as the required "when." I had trouble answering this one.

Lesson 26a: "Recognizing Word Meanings." One test item has two possible answers.

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[3]For purposes of test security, the items shown here resemble, but are not the same as, actual JSEP items.

Lesson 27c: "Finding Information in a Book." Test item 31 is ambiguous:

SGT Smith needs to locate the page numbers of a specific subject in his TM manual. Which part of the book should he use?

- The appendix
- The glossary
- the index
- the table of contents

This question does not define "specific subject" adequately enough to allow a choice to be made among these options.

Item 32 appears to have a wrong answer. The question asks the student to select the term that describes the section of a book that contains any related material that is not part of the text. The answer accepted by the program is "glossary." However, a glossary is better described as a set of definitions for specialized terms; the correct answer should be "appendix."

Lesson 15d: "Use a Protractor." Test items in this lesson have typographical errors and omissions that lead to confusing language. Item 31 asks students to identify the steps in in ". . . measring [sic] an angle with a protractor."

Two answer choices read:

- Line up the reference line of the protractor with 1 of the angles. ["line" apparently omitted here before "1"; only one angle is pictured.]

- Read the protractor scale where the vertex crosses it. [awkward phrasing; a "vertex" does not "cross" the scale.]

Item 32 is basically the same but asks for the second step in "measring" [sic] an angle.

Chapter 3. The JSEP Curriculum--General Considerations

"Successful" vs. "Unsuccessful" Lessons: What Makes a Lesson "Good"?

Since the purpose of the preceding review was to identify problem areas in JSEP lessons in such a way as to provide a basis for revision and correction, the comments made reflect a deliberate hunt for flaws rather than a balanced judgment of JSEP lessons. Though many of the lessons reviewed had at least one problem, some lessons did not have any and could therefore be considered "good" lessons. In particular, of those lessons reviewed, 7a -- Identify Points, Lines, Segments, and Rays, and 30a -- Identify Flow Chart Symbols, could be considered very good examples of instructional design.

The primary characteristic of these lessons as opposed to others was that (1) their lesson design was not step- or rule-based and (2) the lesson design put the capabilities of the computer as delivery system to best use. The objective of both lessons was to teach students to identify or recognize shapes. In lesson 7a, the major terms point, line, ray, etc., were illustrated and accompanied by an on-screen verbal definition. Similarly, lesson 30a illustrated each flow chart symbol along with a statement of its significance. In both lessons, the objective was to teach a one-to-one correspondence between an object and its meaning. An on-screen format was ideal for this purpose, because of the simple correspondence between the graphic image and its verbal identifier. Practice questions in lesson 30a, for example, used a basic stimulus -- recall -- reinforcement model, in which students were asked to recall the meanings of forms pictured on-screen. After every three symbols, a review section tested students' recall of all of the preceding symbols, thus reinforcing previous learning.

The objectives of these two lessons were limited to low-level identification skills and did not require more complicated mathematical or verbal processing. Thus they could avoid the pitfalls of the step approach, inappropriate surface features-focus, and lack of concept explanations common in other lessons. These "good" lessons taught what they

intended to teach, since the skill to be taught (identification) was already at the most basic level. There was thus no occasion for skill confusion such as that seen in other JSEP lessons where the "intended" higher-level skill was broken down and taught only peripherally in terms of "basic" skill components.[4]

JSEP Assumptions About Learners: User Choice and Program Flexibility

A major issue that arose in the course of the curriculum evaluation concerns the status of user choice and responsibility for learning. The JSEP curriculum as it currently stands offers little opportunity for students to make real choices in their interaction with the program. All major responsibilities for lesson selection and progress through lessons rest with the soldier management system rather than with the individual soldier. Even though students can decide the order of the lessons they take or the order of the lesson sub-sections in long lessons, there are few opportunities for students to exercise truly responsible choice -- that is, to make decisions about whether they need to take a particular lesson or section of a lesson, or which parts they need to take over again, or which lessons they want to take despite having passed the pretest.[5] The only occasion on which there is some freedom to make such decisions is in long lessons that offer the student the choice between more tutorial instruction or more practice. There are numerous points in the program at which soldiers could be given more responsibility for their own learning. Overall, the JSEP curriculum design makes an assumption about learners that seems to reflect a limited view of students' abilities to make judgments about their own academic progress or performance.

Student comments on this topic reveal that they are both able and willing to exercise such choices. In the attitude survey, students said:

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[4]This does not mean that a computer-based instructional system such as JSEP is only good for teaching the most "basic" or low-level skills. Indeed, higher-order skills can be taught, but this requires preserving the essential concept behind the skill, not replacing it with lower-order peripheral skills. In the JSEP lessons I reviewed, however, higher-level skills are too often reduced or broken down into steps involving lower-level skills which, taken as a whole, do not lead to an adequate conceptual understanding of underlying notions or processes behind skills.

[5]The lesson pretests were instituted as part of the JSEP evaluation plan, in order to provide a baseline against which to measure students' subsequent learning of lesson material.

"After you take the first posttest before a lesson, you should be able to say 'yes' or 'no' to taking the test over before getting into the lesson. Sometimes you missed it by one and you know the one you missed."

"I would make it so that if an individual wanted to get more practice he could go back to a specific lesson and work on weaknesses."

In personal notes, students said:

"If we are about to choose a lesson we should have more control of the system than we do. For example, I have just finished a lesson and I have only 20 minutes left. I do not wish to start a paper-based lesson, it being Friday, because I will not have enough time to finish the lesson today, and I will have to jump right into it on Monday and I would rather have a lesson that I could completely finish today. But the way the system is set up that is not possible for me to do that I am aware of, once I select a lesson that is it I have to finish it to get out of it. That does not give us much room for time management. Please if there is a way to allow this it would really make it easier for me to manage my lessons better."

"I could solve the problems but don't understand the process. The only way that I could take the lesson is by failing the tests."

[This student obviously would like a choice to go through the lesson or not, despite having passed the test.]

"I did the best I could on this task and I passed. I had to guess some of the questions and got lucky. I need to get into the task."

[Similarly, this student recognizes a need for more instruction and would like to be able to take the lesson.]

"I should be able to get into the lesson if I feel unsure." [Same thing here.]

"Let it be my choice to go into a lesson or not."

48

"The student should be allowed to go back over the lesson even if he passed it."

It is obvious from these comments that students realize when they are unsure of lesson material, and when they would benefit from more instruction or from a chance to review. As it stands now, the JSEP program is not flexible enough to address these desires, and ignores students' ability to assess their own instructional needs.

Allowing students more flexibility in their progress through the program would also enhance the "diagnostic" character of JSEP. Perhaps most importantly, the more an instructional program encourages students to take responsibility for their own learning by being flexible enough to meet their needs and desires, the better its subjective psychological impact and, in the long run, its instructional effectiveness.

JSEP Assumptions About Learners: The Test Feedback Issue

Another area in which JSEP lesson design is based on a crucial unexamined assumption is in the area of test feedback. According to designers, students should not be allowed to know the answers to tests because this would compromise test security. Repeated observations, interviews, and student comments in surveys and personal notes indicate that this is an unfounded fear. Students who take JSEP are not interested in beating the system; they are simply interested in learning as much as possible from the program. To assume that telling students which questions they missed will lead them to pass along answers to their colleagues reflects a lack of faith in students' desire to improve themselves, as well as a somewhat "grade-schoolish" attitude toward learning that is simply incompatible with a computer-based instructional system in the first place.

For a test-based program such as JSEP, it is unfair as well as unwise to forbid students the chance to see where they made their mistakes. Students' major request is: "Please let us see which questions we missed so we can improve ourselves." In nearly every other test situation in which the purpose is educational improvement (and not merely assessing performance or rank relative to others) they receive such feedback. There is no reason why JSEP should not allow students a similar opportunity. It simply is not true that a student can tell which test questions were missed by looking at performance on practice questions. Students have commented: "I can pass every practice

49

question perfectly and still flunk the test." Given the already described problems with test items, this is not surprising. As long as JSEP remains a test-oriented instructional program -- especially one in which there are various ways students can make mistakes on test items, aside from simply not knowing the skill -- it is unreasonable not to offer students a chance to see their errors.

JSEP and Underlying Targeted Competencies

The JSEP curriculum is supposed to provide remedial instruction in targeted competencies for selected MOSs. Though there are 186 different JSEP lessons dealing with these specific competencies, there appears to be a small number of unstated competencies that are actually taught by the lessons. This review has identified at least three basic competencies (aside from reading) that underlie the skills supposedly taught by JSEP lessons. These are identification (or recognition), element manipulation, and pattern recognition. Often enough, as described earlier in problem areas 1 and 2, the lessons teach these skills rather than the stated objective of the lesson. For example, even in lessons whose focus is on teaching a skill such as rounding, a large proportion of the lesson is spent on identifying and naming problem elements such as place values. The focus on element manipulation is seen in lessons that require the student to solve problems entirely by the application of given rules of mechanical relation between problem elements. Students are not required to "understand" the task, but merely to apply the rule correctly in order to generate a correct answer. Many of the quantitative lessons in the JSEP series involve such element manipulations.

Tasks requiring the skill of pattern recognition ask the student to match up numbers, compare series of numbers, compare printed information, or copy information verbatim. This skill is taught in JSEP lessons such as outlining, which depends more on recognition and use of a patterned code than upon higher order skills such as deciding the relative level of abstraction of textual elements.

There undoubtedly are other examples of underlying competencies taught in the lessons, but the purpose here has been to give examples of cases where lower-order skills substitute for a focus on higher order skills that are in fact necessary to perform the targeted skill of a lesson. The fundamental instructional problem with such lessons is

50

that, while aiming for simplicity and ease of instruction, the lessons have also avoided teaching the notions that are most important (and ultimately most helpful) to students in performance of the targeted skill. In general, the skills that get overlooked in JSEP lessons are the higher order skills such as inference, abstraction, synthesis, association, or evaluation. These are essential to performance of many targeted competencies, and yet these are the skills that most "lower ability" students lack. They are therefore the ones that should be taught in the lessons.

This is shown, for instance, in the lesson on finding information in a book. The lesson teaches, and gives lots of helpful practice in, locating page numbers for specific points of information. But this is not the main skill in fact needed in order to find information in a book. Rather, a student needs to learn how to find a given piece of information based on the characteristics of that information -- topic, specificity -- and to compare these with what he or she knows about the different characteristics of information presented in a table of contents, a glossary, index, etc. In order to do this, however, higher-order skills involving assessment of levels of abstraction and association are needed. There is no instruction in fact on the "differences" in the information presented in each of these text sections. Thus the student does not learn the essential skills based on a conceptual understanding that are essential to performance of the targeted skill, locating information in a book. When this occurs, lessons do not in fact teach what they intend to teach, but teach only supporting or peripheral skills.

Higher-order skills may not be intrinsically more difficult to learn, contrary to the assumption made by most basic-skills oriented curricula. They can be taught in a simplified manner; but it is essential to avoid confusing "simplified manner" with simplification of the skill itself, or reduction into component skills that when added together mimic performance of the higher order skill. This seems to have been a major problem in some JSEP lessons, where attempted use of simplified language or approach seems to have led to an avoidance of concept explanations, perhaps for fear that these would complicate the lesson. Yet, avoidance of concept explanations tends to increase the multiplication of rules and steps based on simpler tasks such as pattern recognition or identification, ultimately leading not to simplicity, but to more opportunity for confusion and errors. In order to do an adequate job of teaching skills that can be applied to jobs or that can contribute to job-related learning, it is essential that JSEP lessons provide a conceptual basis for what is being taught.

51

JSEP and Field Dependent Thinking

A related problem concerns what educators term "field dependency." This notion describes the tendency of some (mostly lower-ability) students to remain "grounded" in their thinking. Students who are field dependent have difficulty associating what they have learned in one context with another related context. They are unable to make the necessary cognitive jumps from information or situations as given, to the application of the same information to new situations. Most JSEP lessons reviewed encourage students to remain at this basic field dependent level in their approach to tasks. The lessons repeatedly remind students to perform all the steps in a task exactly as given, without encouraging combinations or abbreviations of steps or other ways to save time. The practice questions do not require students to apply their learning to new situations or contexts; rather, they present the same problem formats over and over again. By failing to offer students practice in moving away from very grounded, situation- and step-based thinking in approaching tasks, JSEP primarily offers practice in thinking in simplest terms. It is questionable whether this should in fact be the endpoint of any instructional program. Lower-ability students do not need more encouragement to remain grounded in their thinking; they need, on the contrary, encouragement to get beyond this basic level. The real strength of any instructional program is the extent to which it can develop the learner's ability to go beyond the information presented to more sophisticated levels of concept application and analysis. As it stands, JSEP encourages the soldier to consider only the information given in the most straightforward. literal way. It does not suggest that there may be alternative interpretations or approaches to problems or evidence.

A simple example of this is found in the Time Management lesson. The lesson approaches the concept of "time on task" in a very literal manner, obscuring the necessary interpretive skills involved in making a judgment about time on task. Two soldiers are shown talking while sitting at (presumably JSEP) computer terminals. The student must touch the box indicating whether this illustration represents "on-task" or "off-task" behavior. The required answer is "off-task." However, this answer does not allow the alternative interpretation that the soldiers were actually talking about JSEP lessons. rather than about non-related subjects -- in which case their talk would have been entirely "on-task." The concept of "on-task" has been reduced to its most literal, appearance-based

52

level, ignoring the fact that alternative judgments could be made. The supplementary feedback, "You will not need to talk to someone to complete JSEP lessons" is also simplistic; students may very well need to talk to someone -- indeed, they often do -- while they complete JSEP lessons. Moreover, the implicit message, "Don't talk to others while you are on JSEP" defeats what the computer-assisted instruction literature considers one of the major advantages of computers as an instructional medium -- the way they encourage peer interaction in solving problems. Computers encourage users to help each other and to learn from each other -- yet this advantage is explicitly denied in the way soldiers have been encouraged to think about "time on task."

Subjective Appeal and Paper-Based Lessons

One of the major positive points about the JSEP curriculum is in the area of on-screen delivery. Aside from touch-screen problems, graphics that take too long to complete (soldiers made repeated complaints about these two aspects), and occasionally confusing or distracting illustrations, on-screen presentation of lesson material was appealing. Use of screen space was effective, with screens neither overloaded nor too empty. Interactiveness was generally maintained, with students frequently required to respond in one way or another to screen material, without long stretches of "page turning." The subjective appeal of interacting with a computer was undoubtedly a major factor in students' preferences for JSEP over BSEP and in students' overall sense of satisfaction with the program.

However, according to student comments, the appeal of the paper-based JSEP lessons was significantly less than that of the on-line delivery system. These paper lessons were designed to cover prerequisite competencies involving complicated graphics or tasks (such as writing) that would have been unsuitable for on-line presentation. However, switching from on-line to paper delivery proved to be cumbersome for both teachers and students. Students said they "wasted time" signing on and off the computer; teachers disliked the grading and record-keeping involved. Significant errors and organizational problems were noted in the lessons reviewed; in addition, some of the lessons (for example, the learning strategies paper-based lesson for Problem Solving) were far too lengthy. Also, for some lessons it was not immediately apparent why the contents of the lesson were not suitable for on-line format. (For example, Lesson 11a, "Identify shape and position terms," and

the long lesson for 28b, "Finding information" contained material that appeared to be quite similar to that of other on-line lessons involving shape identification and reading charts and tables. With some changes (especially in the detail of the tables given in 28b), these lessons would appear suitable for on-line delivery.

JSEP can undoubtedly make a contribution both to Army education and to the development of individual soldier competencies. It can, however, make such a contribution much more efficiently and effectively if certain of the problems identified in this review are corrected. To some extent the problems identified are not specific to JSEP or to computer-based instruction alone; their source lies in the underlying assumptions and approaches currently in vogue in models of basic skills or remedial instruction. As educators and instructional designers are aware, instructional materials and programs themselves are not paradigm-free, and sometimes they represent more the opinions of the "experts" about what learning should be like, than the realities of what learning in fact is like for many students.

Yet the responsibility of instructional designers to bring their materials ever closer to meeting students' needs cannot be dismissed. Perhaps by taking steps toward col- laboration, by involving students more deeply in the design and revision process, and by in-depth examination of "hidden" as well as obvious instructional strategies and needs, commonly defined goals of excellence can be set and achieved.

Chapter 4. JSEP Supporting Materials Review

This chapter offers summary comments on four important supporting materials for the JSEP program: the JSEP Learning Strategies Lessons, the JSEP Instructor's Manual, the Soldier Management System (SMS)--Features and Functions Guide, and the JSEP Test.[6] These materials were designed to aid JSEP instructors in the performance of tasks required by their role as instructors and program managers, and to help students in learning JSEP lesson content. The primary focus of the review comments will therefore be upon how well these materials meet criteria for helpfulness. Specifically, this review considers the following questions:

For Manuals:

- Do the materials have a clearly stated purpose, and do the contents reflect this purpose?

- Are the materials organized so that users can easily follow points made and locate desired information? Is all essential information included?

- Is the language free of error, clear, and easy to understand?

- Is the information presented in a format that encourages users, answers their questions, and inspires further involvement with the JSEP program?

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[6]This section summarizes more detailed reviews. The reviews of draft versions of both manuals and the JSEP test were submitted to the Army Research Institute. Presumably these materials will be revised before their final release.

For the Learning Strategies Lessons:

- Are the strategies taught in such a way as to encourage transfer of learning to JSEP lessons?

- Is the lesson purpose clear and well-illustrated?

- Does the lesson in fact teach students material that facilitates learning how to learn?

For the JSEP Test:

- Are the items clearly written, free of errors or ambiguities?

- Do the items in fact test what they intend to test?

- Are accompanying graphics easy to read?

JSEP Learning Strategies

Purpose

This section reviews one of the five JSEP Learning Strategies lessons, the Problem Solving module. Since these lessons were designed to stand independently of the JSEP subject matter curriculum and since they were reviewed internally by Army Research Institute personnel, a systematic review of each was not performed. However, because many students actually took at least a portion of the Problem Solving module, review comments are included here in order to provide a more complete look at how the JSEP curriculum as a whole functions.

Rationale for Learning Strategies Lessons

The intention of the learning strategy lessons is to provide remedial help to soldiers who experience difficulty with the JSEP program by teaching them how to go about

approaching the learning tasks that are found in JSEP lessons. The basic assumption is that students can learn better if they first learn how to learn -- that is, if they have a set of strategies that they can apply to different problem situations to facilitate their interaction with the material. This principle has been translated in the JSEP learning strategies model into a set of lessons detached from the main curriculum. Soldiers are routed into these lessons if: (1) they have been prescribed by the JSEP instructor, or (2) the soldier management system detects repeated failures or other problems in student performance that indicate that one of the strategies is needed.

This model of "detached" instruction seems reasonable. However, as R. P. Kern notes in his analysis of the Reading Strategies module[7], the detached learning premise is flawed when applied to the Army situation, for there is little or no evidence for the transferability of learning from generalized non-Army relevant content to Army-relevant content. Kern also notes that printed self-study materials (such as those found in the Reading Strategies lesson and others) do not seem to lead to much effective learning among lower-ability students. He recommends that the Reading Strategies lesson be reformatted as "help" sheets whose practice content is taken directly from JSEP lesson material. These help sheets would appear as aids to students, available when needed, and not as a "front end block of instruction." [Kern, p. 3]

Problem Solving Lesson -- Purpose and Format

The apparent purpose of the Problem Solving module, according to the on-screen statement of lesson purpose, is to teach students to ". . . learn more effective ways of problem solving and show how to identify different types of word problems." This purpose is somewhat unclear, since the first part of the statement refers to problem solving in general, and the second part refers to math word problems.

According to information provided by staff at the Army Research Institute and Florida State University, the module has five lessons, with the first two lessons on-line, and the other three in paper format. The five lessons, as listed at the beginning of the paper-based lesson 5, are:

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[7]See R.P. Kern's review of the Reading Strategies Module for JSEP, May 1987.

Lesson 1: Introduction (on line)
Lesson 2: Identifying Problem Types (on line)
Lesson 3: Goals and Diagrams (paper)
Lesson 4: Selecting Sub-Goals (paper)
Lesson 5: Answer Recognition (paper)

In addition, there is a "Math Prompt Notebook" to be used when the on-line prompt for problem solving appears while a student is working on a math lesson.

According to my review of the module, the material from lesson 2 has been combined with that of lesson 1 to form a single on-line unnumbered lesson. This change has not, as far as I have been able to tell, been noted anywhere in the lesson materials themselves. In fact, the instructions for lesson 3 remind the student that he or she must first complete "lesson 1" and "lesson 2." The on-line lesson does not describe the various parts of the module, so the soldier has no idea of the general topics to be covered. Neither is there any indication that there are paper lessons that must be completed after the on-line portion. In fact, at the end of the on-line lesson the soldier is told: "You have completed the material on problem solving. Thank you . . . ." It would appear that there is a serious discontinuity in the module design.

Education staff contacted at evaluation sites said only the on-line portion of the module was used. Staff members at two sites said they had the paper lessons, but did not use them. (One did use the math prompt notebook, however.) At another site, instructors said they did not have any paper lessons for the module.

General Module Review Comments

This module was difficult to evaluate, because it was not clear exactly what it consisted of. In principle, the soldier takes all five lessons; in reality, he or she probably takes only the on-line lesson, and perhaps uses the math prompt notebook. If the soldier takes only the on-line portion (which deals primarily with problem type identification) the module does not teach what it intends to teach -- for the soldier cannot learn strategies for solving problems, but only how to identify types of problems. These skills are definitely not the same.

Second, the relationship of the module to the JSEP curriculum as a whole is proble-
matic. The module is focused almost entirely on solving math word problems, yet there
are few lessons on math word problems in JSEP. (In fact, JSEP's lack of instruction in
word problems was cited as a weakness by some instructors and students.) The JSEP
lessons that do deal with word problems cover only simple ones. Yet, all of lesson 4 in
the Problem Solving module concerns complex word problems.

Third, the student is assigned to the Problem Solving module when he or she fails
five math lessons, whether or not these lessons involved solving math word problems.
Thus, much, if not all, of the material in the module may be irrelevant to students' needs.

Another consideration relates to the length of the module. Requiring the student to
go through 157 pages of paper-based material (in addition to the on-line module material)
is simply not realistic. Even students who start out highly motivated are likely to have a
hard time remaining so when confronted with such long lessons.

One of the main concerns in discussions of remedial skills education concerns the
issue of context, with much of the research pointing to lack of transferability of skills
from one context to another. This is seen (by Kern and others) as an argument for
"embedded" instruction -- instruction based on the actual materials the student is working
with -- rather than "detached" instruction, such as that represented by the JSEP learning
strategies lessons. Following this argument, the Problem Solving module should use
examples drawn from the lesson material students are actually working with, rather than
generalized content that is not related to JSEP. Skill learning would thereby be en-
hanced, since the student can more readily apply it to the job contexts in which the skills
must be used.

There is a difficulty with the transferability argument, however, that most discus-
sions of the problem ignore. Transferability only becomes significant when one considers
first what students are actually learning (and thereby attempting to transfer) through the
material. If, for example, they are learning to solve problems by focusing on discrete
surface-features of the problem (as in often the case in JSEP) "transferability" of problem
solving skills would naturally be unlikely. (For instance, in JSEP students are taught to
solve word problems by matching up letters of quantity words with formulas. If they are
then asked to solve problems in which the letters or quantities are not immediately

59

evident, this learning becomes impossible to transfer.) On the other hand, if materials enable students to learn something besides a surface-feature dependent approach to a problem -- for example, what the "quantities" in a problem are, or how to apply a formula to problems that may appear different on the surface -- then the possibility of transferability increases.[8]

Specific Comments: On-line Lesson

The lesson begins with an introduction stating the purpose of the lesson ("to learn more effective ways of problem solving and how to identify different types of word problems"). The focus in the second part of this stated purpose is on math word problems. The lesson introduces the "4 C's of Problem Solving: Clarify, Come up with, Carry out, and Check," and defines each one. The student is told that the 4 C's will help with understanding math word problems, but is not told how. Then, the lesson states that the 4 C's can be used to solve any type of problem, not just math word problems. It appears that the 4 C's in this module are the same as the 4 C's in the Reading Strategies lesson reviewed by Kern. This raises the interesting question, are math problem solving and reading really so similar that they can be accomplished using the same strategy? A second, more likely, implication is that the 4 C's "strategy" is so general as to be of limited use in meeting the requirements of specific tasks or skills.

In fact, the difficulty with the 4 C's approach is that it is not sufficiently "strategic." It is not really a problem solving strategy, but a general guideline for approaching problems. A strategy produces a solution to a specific kind (or kinds) of problem, but using the 4 C's alone does not produce a solution. The illustration problem -- how to move prisoners -- has nothing to do with math word problems. The 4 C's would be better illustrated in a context relevant to that of the lesson . . . math word problems.

The next part of the lesson deals with identifying different types of word problems, and has nothing to do with the 4 C's. This is an apparent discontinuity. This section of the lesson is accessed through a menu that lists different types of word problems -- conversion problems, percent problems, work problems, etc. Each section (with the

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[8]Perhaps the reason why much research has shown "non-transferability" is simply because learning materials are structured around context rather than around content.

exception of the first one on conversion problems) deals with a different type of problem. Sections can be taken in any order. Section B on conversion problems begins,

> This exercise will help you identify different types of math word problems.

[The word "exercise" is inappropriate; this is not an exercise, but a section of a lesson.]

In case the student doesn't understand "different types of problems," the lesson illustrates the notion of "type" with different types of restaurants. [The notion of "type" is hardly likely to be a problem for students.] The lesson then proceeds to list all the different types of word problems. This appears to be misplaced. The various types of problems should be listed and described in the introductory part of the lesson, not in this section on conversion problems. The section then moves into a discussion of conversion problems:

> A conversion problem is one which asks you to change one way of measuring something to another way of measuring. For example,
>
> How many inches are in 1 1/2 yards?
>
> Don't try to figure out the answer. Just notice that this is a conversion problem because it is asking you to change one measurement scale to another.

["Scale" is inappropriate in this context; the student is not changing "scales," but changing units.]

Examples of conversion problems are then given.

Subsequent sections on percent problems, work problems, etc., follow the same format. Practice items present different types of problems and require the student to identify the problem type.

The difficulty here is that identifying the "type" of problem is only the first step toward solving it. Other instruction is needed; yet, when students reach the end of the on-line lesson they are told that they have completed the material on problem-solving, and are not referred to the subsequent paper-based lessons.

The Paper-based Lessons

Due to their length (157 pages total) and because we were told that students do not use them, these lessons were not reviewed systematically. However, a few observations emerged from a cursory review:

- Lesson 3 on "Goals and Diagrams" begins by telling the soldier that he or she will learn how to label and diagram a math word problem. The soldier is told that labelling and diagramming will "help you work through each of the problem solving 4 C's." (page 3.) Yet no definition or description of labelling and diagramming is ever given. The lesson even takes the soldier through the first step of "labelling and diagramming" without ever describing what it is.

- The four steps to labelling and diagramming are impossible to perform in order: one cannot do step 1 (get rid of useless information) until step 2 (identify and label the problem goal) has been completed. In other words, how can one know what information is useless until one knows what one is looking for?

- Lesson 4 begins with illustrations whose aim is simply to "show how complex word problems can be." Despite reassurances that "you will be able to solve problems like these." it is probably not a good idea to begin a lesson by resurrecting student anxieties.

- The purpose of lesson 5 is to show the student how to do the fourth step in problem solving -- "checking your answer." This returns to the 4 C's, implying that the first three of them have been taught. But the stated purposes of lessons 3 and 4 have nothing to do with the 4 C's.

Summary Comments

There is an apparent confusion throughout the module between the 4 C's as a problem solving strategy, and the unnamed "strategy" introduced in lessons 3 through 5 that involves the steps of "labelling and diagramming" and "selecting sub-goals." These two approaches are not integrated: in fact, they make the module appear confused and disorganized.

It is doubtful that knowing the "4 C's" or how to identify types of problems provides much specific help to students in actually solving word problems. My impression is that the material in lesson 3, though of slightly greater specificity, risks bogging the student down -- particularly the section on diagramming -- rather than providing him or her with easy to use tools for problem solving. No clear, succinct picture of how the strategies discussed can be used to solve a problem from beginning to end is ever given; rather, each lesson deals with just one aspect of the problem solving, and it is very difficult to see how these parts fit together as a whole when solving an actual problem. No applications to problems presented in JSEP lessons are made. In sum, it is unlikely that the 4 C's (and the additional "strategies" taught in the paper lessons) are specific enough and conceptually rich enough to help students solve problems more efficiently.

Instructor's Manual

Purpose

The overall purpose of this manual is not clear. At no point is the purpose stated; long descriptive sections about the JSEP program are intermingled with sections that appear to be telling the reader how to accomplish a particular task, leading to a rather confusing presentation of textual material. Is the purpose of the manual to act as a training tool for new instructors? Or is it meant to be a "how to" manual for specific troubleshooting purposes? Or is it supposed to provide a descriptive overview of JSEP as a program? If all three functions are intended, these ought to be clearly marked and separated from one another.

An overall menu or chart describing the basic parts of JSEP and how they are set up is needed at the outset, in order to provide some contextual understanding for what JSEP is all about. Instead, the manual goes into detail about schedules, instructor responsibilities, benefits, etc., without at all describing the basic components of the JSEP program. Especially if the manual is intended to act as a training tool, it needs much clearer organization and structuring, with detailed step-by-step instructions at each stage of involvement with the JSEP program.

The way the manual is set up now makes it impossible to find information without going through a lot of page-turning and random searching. Instead of presenting a clear description of instructors' roles in the JSEP classroom, for example, the manual presents a "skill test" and "daily schedule." These, however, are inadequate substitutes; they do not give a clear picture of what roles instructors actually play in JSEP classes. Moreover, it does not make much sense to describe these until the bigger points about how JSEP is set up have been made. Locating information about instructors' roles as well as components and functions of JSEP could be much simpler if the manual were reorganized around clear objectives and descriptions that support them.

Also, comments that are intended to be descriptive need to be separated from those that are "prescriptive," or that indicate a course of action or a procedure to be followed. For example, the reader is told that there is "very minimal instructor involvement" during most of the JSEP classroom time. This certainly does not reflect the actual experience of most JSEP instructors; nor is it a very good recommended course of action. This confusion of levels of writing detracts from the authority of the manual.

Tone and Style

Another major area of concern about the manual, particularly in the beginning section, is tone and style. The initial section presents the typical instructor as an individual who is unfamiliar with computers, dislikes them, resists them, and feels a lack of confidence around them. This is an unfounded stereotype that many instructors may resent. The tone of this section does nothing to alleviate such attitudes even if they do exist; it reinforces them or may actually help to foster them. Condescending references to "instructor fears" and insecurities make a negative impact on the reader and establish a tone that is inappropriate for a manual whose purpose presumably is to encourage, guide, and instruct.

As an introduction to JSEP, this section should emphasize that the instructor is not merely an adjunct to the success of JSEP instruction, but a crucial component. This would address instructors' concerns in a much more direct manner. Our interviews and surveys found that JSEP instructors often feel that they have less contact with their students than before, and that they have a harder time keeping track of students' progress. The belief that their role may become entirely a peripheral one ought to be

64

countered here with a strong statement to the contrary, emphasizing how JSEP can allow instructors to work more closely with students in a more collegial fashion. Such an approach would be far preferable to the stereotypical "computer-phobic" image of instructors actually presented in the manual.

Organization

This is a major problem in the manual that occurs on many different levels, from overall organization of sections and subsections to specific phrasing within paragraphs and premature references to JSEP terms that have not been defined.

This problem becomes particularly evident in section II. Sections on "benefits to commanders" and "history" seem inappropriate here; discussion of "benefits" should either come in Chapter I or in a final concluding section. "History" likewise ought to occur in a section describing the overall orientation of the JSEP program, perhaps in a separate "descriptive" portion of the manual in a preliminary orientation chapter. Within the "history" section, a flow chart on the soldier management system (SMS) suddenly appears, and seems totally out of place. The SMS has not even been described yet; moreover, it makes no sense to introduce this in a section on JSEP history.

In section III on "policies, procedures, and report forms" the reader is led through all the "supporting" aspects of JSEP without first having been given any idea how JSEP actually operates or how to operate it. This material would fit much better after a section on how to operate JSEP on the MicroTICCIT and PLATO delivery systems. Also, the first chapter's material on scheduling and personnel policies ought to be combined with this policy material; separating the two only adds to confusion. Again, the tone in this section is rather "teachery" at times and inappropriate for a professional-level publication.

Section IV on the PLATO system is very confusing. Such procedures as loading the JSEP program, creating a sign-on, creating the soldier demographic record, and using instructor options are presented in a way that makes it very unclear for the reader when description of the function ends and actual "how to" information begins. The section lacks coherence and logical organization. It was impossible to tell the difference, for example, between what is shown on the terminal screen and what the user must do. In

the "Creating a sign-on" section, for example, the term sign-on is never defined. The section becomes confusing because of two apparent procedures of signing on -- one as instructor, and one as student. Moreover, in this section, the reader is suddenly given a description of the process for printing a file. This seems to have little to do with the sign-on process and simply does not make sense here. For other procedures, such as getting to the "PLATO facilities screen" and creating a soldier demographic record, the manual does not give enough "how to" information, nor does it give the reader a clear idea of the overall organization of steps or procedures that must be followed in using JSEP.

The section on TICCIT is much more detailed than that given for PLATO. There is a clearly labelled section on "logging on" for TICCIT, as well as sections on how to "view and edit soldier records" and "escape from a lesson" for TICCIT, but not for PLATO. There is more troubleshooting information for TICCIT than for PLATO. This imbalance contributes to the overall impression of poor organization in the manual.

General Comments: Usefulness

The manual does not present information in a readily accessible and understandable manner. Indeed, without rather extensive prior experience with PLATO most instructors would have a difficult time with JSEP if they had to rely upon the manual as their primary information source. If the manual is to be used by instructors, it needs to be written from an instructor's point of view -- perhaps following a question-answer format, or at least offering some kind of step-by-step directions for crucial procedures.

The language also needs to be made clearer. Grammatical errors, ambiguities, and condescending or teachery-sounding statements detract from the overall professionalism of the manual. Format needs revision; typographic conventions telling the reader when a piece of text is on--creen computer script, when it represents something the reader must do, or when it represents a key to be pressed would be helpful. The manual would also benefit from some clear graphic presentations that perhaps illustrate what users might see on the screen itself, as well as graphics illustrating the overall organization and specific procedures within the JSEP system.

66

Most importantly, perhaps, the manual should provide more positive encouragement for instructors in the JSEP program. Suggestions for instructor involvement, contributions, potential for individual uses of JSEP, and ideas on how to enhance student involvement with JSEP are sorely needed but lacking. What might instructors do to facilitate student learning, other than "provide supplementary materials?" As written, the manual is dry and lackluster, something to be kept on the shelf rather than something to be kept on the desk and made an integral part of an instructor's classroom activity.

The SMS — Features and Functions Guide

Problems similar to those found in the Instructor's Manual are also present in the SMS guide. The purpose of this document needs to be made explicit, as well as the relationship between the SMS guide and the Instructor's Manual. How are these to be used? It would be far more convenient if they could be combined, thus eliminating what is at present considerable redundancy. Is this guide supposed to be a source of "how-to" information? If so, it needs restructuring and a much clearer organization, along with a subject index so that users can find the information they need.

The guide presents no clear picture at any point of just what the SMS is. The flow chart describing how soldiers move through JSEP (which appears seven times in all) just doesn't do the job; it is not the SMS. A clear presentation of the various aspects of components of the SMS is needed at the outset. Options, functions, components, and procedures appear jumbled together; as it stands it is impossible to disentangle "how to's," "must do's," and "can do's" from one another. JSEP terms (such as "soldier record," "soldier primary menu," "soldier performance data," "soldier profile," "statistics option") are used without definition, adding to the confusion. In some cases it appears that two different terms in fact refer to the same thing -- e.g., "soldier performance data" and "soldier record." This terminology needs to be straightened out, and clear definitions for each JSEP term should be given before such terms are used in the text.

Section headings lack parallel structure, and seem to jump randomly from one topic to another. The first, "Instructor Options," does not describe instructor options; it seems merely to draw attention to the fact that there are things called instructor options in JSEP. What these are, however, is never stated. The next heading, "Registration," leads

the reader to expect that the registration process will be described; in fact, the section never provides this information. It simply tells the reader that a soldier needs to be registered and that demographic information needs to be entered at some point, but never how to go about doing this. It also contains information on the "bases for a soldier's prescription" which does not make sense here. Linkages between components such as prescription, demographic information, etc., need to be made explicit, as well as the processes for accomplishing such tasks as registration.

The next section heading, "Create Option," is ambiguous. (Is "create" a verb or a noun modifier here?) Does this section describe a procedure that should be performed or a feature of the SMS? Without answering these questions, the guide then returns to a section called "Soldier Demographic Information," which is just what the preceding section seemed to be all about; it thus appears out of place. The text then mentions a "statistics option" that is never explained.

Another major subheading appears, "Primary Menu Options," accompanied by the statement that this is another "statistics subsection." What is a statistics subsection? What is a "soldier menu line?" What are "primary menu options" in the first place?

The section on "prescription and sequencing" is quite convoluted. Drawing a distinction between prescribing and sequencing assumes the reader has a question about this in mind; in fact, since sequencing has never been mentioned, the reader does not even know what it is, let alone need to distinguish it from prescribing. The section could be written much more clearly and succinctly. Two paragraphs are used for what could be said in one or two sentences. Once again, the flow chart does not explain anything.

Overall, categories for the types of data collected by the SMS are confusingly presented, perhaps in part because of inconsistent terminology and terms that have not been adequately explained. The various components, features, functions, options, and procedures used in JSEP need disentangling, and clearer organization is essential. The guide seems to have been written by programmers for programmers, or for users who already have a rather complete idea of what the SMS entails and how to go about using it. Whatever the purpose of these materials may be, they simply will not get much use in the field if they are not substantially revised and rewritten from a user's point of view.

68

The JSEP Test

The JSEP Test was developed by Florida State University to serve as the primary diagnostic tool for JSEP. It was to be administered to soldiers as they enrolled in the JSEP program in order to identify which prerequisite competencies were already mastered, so the soldier would not have to waste time going through material he or she already knew. Although it is currently not being used, the test was reviewed (in paper format) as part of the overall evaluation of JSEP supporting materials. Detailed comments were submitted to the Army Research Institute, recommending substantial revisions if the test were to be used as the primary means of diagnosing student weaknesses. By way of illustration of some of the major difficulties with the test, a summary critique is presented here.

The 300-item test was divided into two sections, verbal and math. However, some items supposedly testing verbal ability depended more on math skills (and vice-versa) so that a clear distinction between verbal and math items was not always maintained.

The major problems with test items fell into the following categories: (1) problems with wording -- awkward phrasing, ambiguity, verbosity, poor word choice; (2) problems with item focus (i.e., the item tests a skill or knowledge other than the one intended -- for example, a math item tests knowledge of math vocabulary rather than sequencing skill, or a reading item that tests specific factual knowledge rather than reading ability; (3) problems with answer choices -- e.g., more than one possible answer; (4) lack of sufficient information to determine the item answer; and (5) unclear drawings or illustrations. Of a total of 180 items on the math section of the test, 43 were found to be defective for one of the five reasons just indicated. Eighteen items had language problems; seven lacked essential information upon which to base an answer; six were misfocused. Of the 120 items on the verbal portion of the test, 29 were defective, with nine poorly worded, five misfocused, and six lacking information required to answer the question.

For these reasons, it was recommended that the test be substantially revised (and shortened) before being used as the JSEP diagnostic instrument.

Chapter 5. Summary of Findings and Recommendations

This chapter summarizes the findings and recommendations made in previous chapters of this volume. The criticisms made throughout this review may be seen as specific recommendations for changes to the JSEP program. In this chapter, however, only more general findings and recommendations are discussed.

Specific Problem Areas in Lessons

This review identified 18 different problem areas in JSEP lessons which fell roughly into three categories: problems in conceptual development, problems in lesson presentation or delivery, and problems concerning the relationship between the short lesson and the long lesson. Summary comments and recommendations for each problem area follow.

Category I. Conceptual Problems

Problem area 1: The lesson primarily teaches skills that are only peripherally or superficially related to the targeted skill. This was one of the major weaknesses of the instructional approach taken in JSEP lessons. Fifty-three percent of the lessons reviewed showed evidence of this problem. In such lessons, students were taught skills that focused on manipulation or identification of surface features of a problem or situation, instead of being taught the underlying targeted skill of the lesson. It is recommended that such lessons be re-written to eliminate exclusive focus on peripheral skills, so that they in fact teach the skill they intend to.

Problem area 2: The lesson uses an inappropriate rule or step-based approach to instruction. This weakness was found in 45 percent of the lessons reviewed. Students were taught to solve problems by following lists of steps or rules, instead of by acquiring an adequate conceptual understanding of the process. Because of the lack of focus on

underlying concepts, steps or rules often had to be presented for each specific problem case, thus increasing the amount of memorization or rote work the student was required to do. Following the steps could lead students to successful performance of the targeted skill, though without an understanding of what they were doing as they solved a problem. In some cases, lists of steps or rules led to highly inefficient use of student energy and time; targeted skills could be performed much more easily if students were given fewer steps to follow. It is recommended that lists of steps or rules be used only when they represent the most efficient and easiest way to solve problems, and then only accompanied by adequate concept-based explanations.

Problem area 3: Explanations for processes or procedures are incomplete or lacking. This difficulty was found in 20 percent of the lessons reviewed. Although students were told to follow a procedure in order to solve a problem, reasons behind the process or explanations for it were lacking. It is recommended that such explanations be provided, for they ultimately lead to more effective learning of lesson material, and possibly to learning that is more transferable to other non-lesson related situations.

Problem area 4: Explanations related to the main targeted skill in the lesson are misleading, incomplete or lacking. This was the most common problem in the lessons reviewed, appearing in 60 percent of the cases. Misleading definitions of basic terms led to confusion in some lessons; in others, the targeted skill was inadequately defined, leading to weaknesses in subsequent instruction. These lessons could be improved by providing accurate and complete definitions and explanations for all basic terms and skill objectives.

Problem area 5: The lesson lacks an adequate introduction or context for skill instruction. Twenty-three percent of the lessons reviewed showed this weakness. Providing an introduction or context for instruction shows students why a skill is important, and gives students an idea where the lesson is heading. It allows them to see how parts (or sub-skills) are related to the whole (or major skill objective.) In most lessons, this deficiency could be remedied by providing clear overviews of skills to be taught before instruction is begun. This information ought to be accompanied by some statement about its usefulness to the soldier.

71

Problem area 6: The lesson has organizational problems. This difficulty was found in 18 percent of the lessons reviewed. It was easiest to analyze in paper-based lessons, since all materials were readily available to the reviewer at one time. Most often, organizational difficulties appeared when practice items were placed in sections to which they did not refer, or lesson headings and subsections were inconsistent, redundant, or simply confusing. In such lessons, re-organization and careful checking of section coherence and consistency is suggested.

Problem area 7: Lesson instruction relies upon inappropriate comparisons or confuses one skill with another. In 25 percent of the lessons reviewed difficulties were found related to the use of inappropriate comparisons or skill confusion. This difficulty is illustrated, for example, in using a temperature scale to illustrate number quantities, or equating the ability to notice decimal point position with being able to tell the place value of a number. Instruction in such cases could be improved by use of more accurate comparisons, and focus on skills that are in fact readily interchangeable.

Problem area 8: The lesson contains logical inconsistencies or contradictions. This difficulty was found in only ten percent of the lessons reviewed. These lessons had circular presentations of material or explanations that led to contradictions within sections or across parts of lessons. Careful re-writing with attention to logical consistency of arguments and materials is recommended.

Category II. Presentation and Delivery Problems

Problem area 9: Lesson practice and/or test items do not provide adequate information about the answer format required, or answers to questions depend too much on mechanical performance factors such as manipulating computer keys. In 20 percent of lessons reviewed, mechanical format problems interfered with answering practice or test questions. In some lessons answers had to be in a format that was not indicated. (This problem arose most often on the lesson prettest. Once students took the short lesson, however, they became aware of the required formats since practice items use the same format as test items. However, it is still important that test items state specifically the answer formats required, and not just rely on students' short lesson experience.) In other lessons, answers depended upon manipulating the on-screen cursor, or required the student to do too much detailed typing that could easily lead to errors. Such items need to have

answer formats specified, or else they need to be reprogrammed to accept a larger variety of formats. Those items that depend inordinately upon typing skill should be revised.

Problem area 10: The lesson has problems with language: ambiguities, redundancies, inconsistencies, or errors. Forty-eight percent of the lessons reviewed manifested some type of language problem, ranging from minor typographical errors to confusing definitions of basic terms. These problems were among those most obvious to the JSEP user, and among those that appeared to detract from users' sense of satisfaction with the program.

Problem area 11: Practices or examples are inappropriate for the given lesson skill objective. This problem was detected in 30 percent of the lessons reviewed. In some cases, practices did not match lesson material; in others, they gave students practice in skills only minimally related to the objective of the lesson. For example, a lesson on measuring angles might contain a long practice item sequence focused solely on naming parts of angles. Practice items should be re-written to maintain adequate focus on the target skill of the lesson.

Problem area 12: Feedback to practice items is inappropriate. Twenty percent of the lessons reviewed had practice items whose feedback was either misleading or inappropriate. In some cases the feedback assumed the student had made an error he or she may not have made. In other cases, the feedback did not appear to match the question. It is recommended that feedback to such questions be re-written so that it does not mislead the student into thinking he or she made a certain type of error that in fact was not made.

Problem area 13: The lesson contains confusing diagrams or illustrations. This difficulty was found in only 13 percent of the lessons. In some cases, it was difficult to read parts of illustrations because labels were misplaced or ambiguously positioned, or because the illustration was extremely detailed. Recommended changes include positioning all labels so that they can be clearly matched with indicated points on the illustration.

Problem area 14: The lesson uses inappropriate instructional methods. This problem was present in 18 percent of the lessons reviewed. For example, before giving any instruction in the target skill, some lessons posed a test question the student was sure to miss -- apparently to demonstrate to the student just how much he or she did not know.

73

In other cases, the lesson would ask the student if he or she knew certain material, and then proceed to explain that same material even if the student answered "yes." Such inappropriate instructional strategies should be eliminated from lessons.

Category III. Problems in Short and Long Lesson Compatibility and Tests

Problem area 15: For a given prerequisite competency, short and long lessons use a similar or identical approach to instruction. This problem was present in 28 percent of the lessons reviewed. Despite the intention of JSEP lesson design to focus on review in the short lesson and instruction in the long lesson, in reality these lessons did not significantly differ from each other in their instructional approach. Though long lessons did tend to provide more "walk-through" of basic skills underlying a given targeted competency, when it came to the targeted skill itself, sometimes whole sections of material from the short lesson were repeated verbatim in the long lesson. Such long lessons did not, in fact, provide any instruction significantly different from the remediation of short lessons. It is recommended that in order to make long lessons more effective, instructional approaches different from those taken in the short lessons be used.

Problem area 16: Short and long lessons do not match in content. In 20 percent of the lessons reviewed, short and long lessons taught different things. In at least one case, information presented in the long lesson contradicted information given in the short lesson; in other cases, students were simply taught related, though different, skills. It is recommended that short and long lessons be reviewed for instances of content mismatch.

Problem area 17: Test items do not match lesson material. This difficulty was present in 23 percent of the lessons reviewed. In some cases, information not taught in the lesson is necessary in order to answer test questions. In other cases, test items focused on skills that were not those of the lesson objective. All instances of test item mismatch should be corrected.

Problem area 18: Test items are confusing or ambiguous. Twenty-three percent of the lessons reviewed contained at least one such problem test item. In some cases, the confusion was due to language; in others, to misleading drawings or illustrations. It is recommended that all such items be re-written or eliminated.

74

General Curricular Concerns

Aside from the above noted specific lesson weaknesses in the JSEP curriculum, the review identified more general areas in which there is some room for improvement. Although interactiveness of the program was high, with users constantly required to answer questions and make choices while taking lessons, there appeared to be a certain inflexibility in the program. This derived from the fact that though students could decide the order of lessons they took, or in some cases the order of sections within a lesson, more responsible choices -- such as deciding to take a lesson over again, repeat a section in a lesson, skip a section they felt they did not need, or select a lesson to fit a limited time period -- were not possible. Yet students repeatedly stressed that they were willing and able to make these choices.

A second more general concern relates to the level of skills actually taught by the JSEP curriculum. Although each lesson was designed to review or teach a specific prerequisite competency, the competency (or skill objective) was frequently broken down into lower level component skills that, when added together, did not adequately represent the original targeted competency. JSEP lessons thus tended to teach lower-order skills such as identification, recognition, pattern matching, element manipulation -- rather than higher-order skills such as association, abstraction, synthesis, and evaluation. Yet these higher order skills were often essential to learning the stated competencies.

A third issue related to the focus on lower order cognitive skills concerns the tendency of JSEP lessons to encourage students to remain grounded in their thinking, and to approach problems or situations only in the most literal way. Students were not taught lesson material in such a way as to encourage transfer or application to other related contexts; instead, they were taught to follow lists of steps or rules for each separate case or particular type of problem. In general they were not given practice in applying learning to novel contexts, in abbreviating steps, or in approaching problems from other than a focus on surface features of the problem.

75

JSEP Supporting Materials Review

The JSEP Instructor's Manual, the Soldier Management System: Features and Functions Guide, the Learning Strategies lesson on problem solving, and the JSEP test were reviewed. The two manuals were difficult to understand and use because of organization problems, language, and generally unclear sense of purpose. Unless users had prior knowledge of the JSEP program, the manuals would be very difficult to use.

The Problem Solving Module, one of five Learning Strategies lessons, was found to have a discontinuity in its design, with the on-line portion of the lesson failing to establish any connection to the paper-based lessons that followed it. Information from sites indicated that only the on-line portion of the lesson was used. However, the on-line portion did not teach students how to solve problems more efficiently, but only how to identify different types of problems.

The JSEP test was found to have numerous items that were defective due to problems with language, item choices, focus, or lack of information necessary to answer the item correctly.

Recommendations for Curriculum Improvement

Suggestions for curriculum revision flow from the above identified problem areas. In addition to the obvious need to eliminate all errors, the following recommendations are made:

1. Re-write lessons to reduce a focus on steps or rules, or supplement lists of steps with clear explanations of underlying concepts or ideas.

2. Include problems in each lesson that allow and encourage students to practice applying skills learned in related, novel contexts.

3. Provide more opportunity for students to practice higher-order skills. Reduce

number of lessons and number of practice items in lessons that are concerned solely with rote, identification-level tasks.

4. Re-write lessons to provide explanatory contexts for all lesson material.

5. Revise and substantially reduce the length of paper-based lessons, or make these optional for use during computer down-time only.

6. Re-write long lessons so that they do not repeat material from short lessons, but take a different instructional approach. Also, reduce focus on component lower-order skills such as identification in long lessons, and substitute with more varied concept-level explanations.

7. Allow students more freedom to repeat lessons or sections of lessons, skip lesson sections that are not useful, and in general, to choose the lessons they take.

8. Allow students to see their errors on tests.

9. Revise manuals to make them more helpful and user-friendly.

If such changes are made, JSEP can undoubtedly make the contributions to education and job preparation that it was designed to make. It remains for students, JSEP instructors, program administrators, and designers to work ever more closely together to reach these goals.

77