The Development of a Knowledge Test for Armor Trainees

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Jerry H.

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The Development of a Knowledge Test for Armor Trainees

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Western Kentucky University
Bowling Green, KY
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Master of Arts

by
Jerry H. Seibert
June 1987
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THE DEVELOPMENT OF A KNOWLEDGE TEST FOR ARMOR TRAINEES

Recommended 7/12/87
(Date)

Ray M. Mandel
Director of Thesis

Approved July 31, 1987
(Date)

E. S. Effmann
Dean of the Graduate College
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1. Table 1 Percentage of Items on Pilot Test and TKT for Each Topic.
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5. Figure 1 Proportional Representation of Topic Areas on Pilot Test and TKT.
A study was conducted to develop a written tank knowledge test for United States Army armor trainees. Such a test may be employed as a tool for training program evaluation and as a criterion measure for assessing trainees. The Tank Knowledge Test (TKT) was developed from items written by subject matter experts familiar with the armor training program. After pilot testing, a revised version of the TKT had an internal consistency reliability of .79. Item difficulty levels ranged from .16 to .92 with a mean of .57. A factor analysis performed to examine the possibility of deriving subscales from four clusters of topically related items revealed no support for a four factor solution.
Chapter I

Introduction

The M1 Abrams is the United States Army's main battle tank. It is a technologically advanced weapon system with an on board computer, laser rangefinder, thermal imaging sight and other state of the art equipment. The M1 is operated by a four man crew consisting of a driver, loader, gunner and tank commander (TC). Newly trained soldiers are usually assigned as loaders or drivers. Gunner and TC are promotional assignments, the latter requiring five to six years of service to achieve. Technological complexity notwithstanding, new recruits proceed from receiving station through advanced armor training to field placement in just fourteen weeks. The Army has a continuing need for high ability soldiers capable of quickly and thoroughly assimilating the maximum level of knowledge and skill possible in this short training period.

The armor training is referred to as One Station Unit Training (OSUT). The emphasis is on maintenance, loader, and driver tasks with some gunnery training. The extent of OSUT is constrained primarily by cost and equipment limits which cannot be exceeded. OSUT therefore has become a program in which the maximum number of trainees must achieve at least the minimum level of competency for a tank crewmember.
The need to maximize trainee skills implies a need to thoroughly evaluate training effectiveness. Without such training evaluation, the adequacy of the program remains unknown. However, the Army currently focuses its efforts on the testing of hands-on skills. In order to adequately assess the effectiveness of the training program, the level of knowledge retained by trainees must also be measured.

Criterion measures developed for program evaluation may serve an additional purpose. While the proportion of trainees achieving a minimum score on a knowledge test might function as an assessment of program effectiveness, the performance of individual trainees could be employed to validly evaluate trainee competence. A knowledge test would be a useful adjunct to current criteria in determining a trainee's readiness for field placement.

In this study, the development of a written test designed to assess the degree to which trainees have retained the material presented to them in OSUT is presented. First, the measures currently used to assess training performance are described, including some measures currently under development. Second, the development, pretesting, and administration of a written knowledge test is delineated. The psychometric evaluation of the instrument, called the Tank Knowledge Test (TKT), is then presented, followed by a discussion of the results. Recommendations for the further refinement of the instrument are also provided.
Currently, OSUT participants are assessed on a limited set of criteria consisting primarily of hands-on skill tests. However, training is often a complex endeavor; and multiple criteria are frequently needed to assess a program's effectiveness. Kirkpatrick (1967; 1976) described four types or levels of criteria appropriate for training evaluation: reaction, learning, behavior and results. Other classifications are possible, e.g. process versus outcome or criterion versus norm referenced (Goldstein, 1986).

Reaction criteria are simply measures of participants' impressions and feelings about the program, usually assessed by simple questionnaires. Learning criteria are more rigorous than trainee reactions as measures of training outcomes (Cascio, 1982). Learning criteria assess the knowledge, skills and attitudes assimilated by trainees during and at the conclusion of the program. Behavioral criteria are measures of performance on the job intended to detect training transfer. Results criteria relate training programs to organizational objectives, attempting to demonstrate a program's utility through measures such as accident rates or productivity (Kirkpatrick, 1967; 1976). Goldstein (1986) classifies criteria such as learning...
and performance as outcome criteria, because they represent various levels of achievement. Process criteria, on the other hand, examine what happens during training. Goldstein also differentiates between criterion referenced measures, which compare individuals to absolute standards, and norm referenced measures, which compare individuals to each other.

In order to graduate from OSUT a trainee must pass four tests: the Military Stakes (MS) and Gate tests I, II and III. All four are hands-on performance measures designed to test minimum skill proficiency levels. They are a subset of one type of outcome measure: learning criteria. Gate tests I and II assess basic soldiering skills such as first aid and small arms maintenance. Gate III focuses on tank tasks (driving, loading and gunnery skills). For each test all tasks must be performed to the standards put forth in the training manual, and each is scored on a pass/fail basis. For a soldier to successfully complete a test, all individual tasks must be passed; a soldier may receive a maximum of two retests per task during the administration. For example, loading the tank's main gun is a task included in Gate III. The correct sequence of actions must be followed to safely load the gun within a maximum of five seconds. A step performed out of order, omitted, or exceeding the five second limit is cause for failing a soldier. If the soldier fails on two more attempts, he receives a final opportunity one week later.

The Military Stakes is similar to the Gate tests. The MS tests a diverse set of non-tank subjects ranging from measuring distance on a map to pistol assembly/disassembly to sending a radio message. The MS
however, is set up as ten testing stations along a five mile running
course. In addition to successfully performing the tasks included in
the test, soldiers must complete the entire course within a specified
time period in order to pass the test.

Recent work by researchers examining armor skill retention has
also focused on performance measures. For example, Morrison and
Bessemer (1981) studied a set of machinegun assembly/disassembly tasks
present on the Gate III. Noting that soldiers who were unsure of the
appropriate procedures hesitated frequently, Morrison and Bessemer
found that task execution times could reveal subtle performance
differences not reflected in pass/fail scores. Graham (1985) examined
the psychometric qualities of several performance measures provided by
a sophisticated electronic M1 simulator. The Unit Conduct of Fire
Trainer (UCOFT) generates realistic combat scenarios through which crew
members may practice and develop armor battle skills. Graham found
that several reliable measures of gunnery skill could be obtained from
the UCOFT.

However, the improvement of current performance measures and the
development of new ones does not obviate the need for an instrument
which assesses knowledge retention. The training program for M1
crewmen includes both classroom and hands-on training. Typically,
soldiers will first receive a class in which the use and operation of a
particular piece of equipment is described. An opportunity to actually
use the equipment follows soon after. Yet, because the M1 is so
complex and the training is brief, soldiers do not apply some aspects
of their training until they have completed OSUT and are stationed in
the field. The knowledge is important, however, and must be retained. Knowledge retention cannot be inferred from the successful completion of performance tests, particularly in the case of OSUT, since soldiers are permitted (and encouraged) to refer to their training manuals during test administrations.

In summary, there is a component of OSUT that cannot be properly tested as performance skills and is therefore not being assessed. This component should be amenable to measurement by means of a knowledge test. Some factors that should be considered in the development of a written knowledge test are described in the following section.

Considerations in Criterion Development

Relevance is the primary requirement for any criterion (Cascio, 1982; Goldstein, 1986). Criterion relevence is that portion of the actual criterion space which overlaps with the theoretical ultimate criterion space, that is, the variance shared between the operational and ultimate criterion. Because relevancy is a relationship between an operational measure and a hypothetical construct it is often judged on a logical basis, not directly measured. In essence, criterion relevancy is the content validity of criteria. For example, in the present research, the overall or conceptual criterion is the level of knowledge and skill obtained by trainees. Criterion measures such as performance tests for specific tasks or a written test of tank knowledge may be judged relevant to the extent they possess a logical relationship to the conceptual criterion.

Criterion deficiency is that part of the ultimate criterion variance which is not accounted for by the actual criterion (Goldstein,
Since the ultimate criterion is theoretical, there will always be criterion deficiency. Deficiency can be minimized, though, by utilizing as complete a set of relevant criterion measures as possible.

Criterion contamination can be conceptualized as any portion of the operational criterion space that does not overlap with the ultimate criterion space. This unshared variance between actual and ultimate criteria can be divided into two parts, error and bias (Cascio, 1982). Error is random variation and will not correlate with anything, other than by chance. Bias, however, is systematic contamination and can lead to incorrect conclusions regarding the training program. For example, opportunity bias occurs when some trainees have better or more frequent opportunities to demonstrate new skills in the transfer setting. Such a situation might lead program evaluators to believe the training had been effective only for the portion of trainees who were exhibiting their new skills, when in reality the program may have been equally effective for all participants.

In addition to relevancy, deficiency, and contamination, criterion reliability is of great concern when evaluating criteria (Bernardin & Beatty, 1984; Goldstein, 1986). Although it cannot replace relevancy, reliability is a necessary condition for criteria. Test-retest and internal consistency are common indicants of criterion reliability for written tests.

Once relevancy and reliability have been established, there are several lesser, but still important, considerations (Goldstein, 1986). These include sensitivity (the ability of the measure to discriminate
among trainees), acceptability to the organization, the practicality of data collection, and the cost of using the criterion measure. For example, some measures might require an impractical amount of time and effort on behalf of trainees, interfering with actual training. Still other measures might simply be too time consuming and expensive to develop.

To summarize the problematic issues in criterion development as they apply to the present research, two primary objectives can be put forth. One, a strong emphasis should be placed on ensuring the relevancy of the test. Typically, relevance is inferred and cannot be directly measured. In the case of measuring learning outcomes it is fairly straightforward to base criterion measures on curriculum content, and with a detailed curriculum summary in hand, to minimize criterion deficiency. Two, the reliability of the measure must be established. Unreliable criteria are useless, no matter how relevant they appear.

To meet these objectives, a number of subject matter experts (SMEs) were recruited to assist in test item development. The resulting instrument was piloted, revised, and administered to a sample of OSUT trainees. These procedures are fully described in the next chapter.
CHAPTER III

Method

Participants

Seven subject matter experts assisted in the test development. Two hundred eighteen soldiers in their final (fourteenth) week of training participated in testing: 52 took part in the pretesting of items and 166 participated in the actual test administration.

Item Generation

The areas most appropriate for a knowledge test administered at the end of OSUT are those topics unique to the training program, that is, tank related topics. Focusing on material pertaining to the M1 should help make the test highly relevant and maintain a reasonable test length. Tank specific topics are covered in the final six weeks of OSUT. The content of this portion of the OSUT curriculum was determined by examining training schedules, lesson plans, and training manuals. This survey identified 34 distinct topics, lessons and tasks taught during weeks eight through fourteen of OSUT. Independent reviews by three trainers confirmed the list of topics.

In order to determine the appropriate number of items to generate for a topic, a measure of training emphasis was required. To achieve this goal, the first of two SME workshops was convened. Seven SMEs met
for one hour to accomplish four tasks: rating training topics on importance, estimating the number of hours training a soldier receives on each topic, assigning topics for question writing, and a short lesson on how to write a multiple choice question.

One SME actively involved in the training of recruits was drawn from each of three companies. The majority of topics covered after week seven are vehicle specific, that is, they relate directly to the M1 tank and are taught by tank commanders (TCs). Therefore, the remaining four SMEs were TCs involved in training recruits. In this way SMEs familiar with both tank topics and non-tank topics participated in the test development.

The SMEs independently estimated the amount of training time a student received on each of the topics. The SMEs also provided a rating of the relative importance of the topics on a five point Likert scale, "Not Very Important" to "Extremely Important." Each point on the scale was presented with a clarifying definition. Inter-rater reliability was .83 for the importance ratings but only .64 for the time estimates. The lower reliability of the time estimates may have been due to some confusion among SMEs as to whether time spent included time spent "doing and observing" or just "doing" a task.

After the ratings were collected, instructions for the writing of multiple choice questions were discussed and a handout with examples and explanations of good and bad questions was provided to the SMEs. Later that day, SMEs met briefly to have topics assigned. Each SME was asked to write two or three questions on up to ten topics. It was felt that this would be easier and less time consuming than writing ten to
fifteen items on each of a few topics. A topic was given to one, two, or three SMEs depending on its mean importance rating. As a result of the confusion among SMEs on what time spent included, and the low inter-SME reliability of the measure, the time estimates were not utilized. SMEs were instructed to make the items difficult enough that half of the trainees would not be able to answer them correctly. Workshop materials are included in Appendix A.

Four days later, items generated by the SMEs were collected and sorted by topic. Some additional items were taken from a set of brief tests which are administered to experienced soldiers as they are retrained from other specialties for duty as M1 tank crews. The author of the prior tests, a member of the training battalion's headquarters staff, indicated which items pertained to the topics included in the current effort. A pool of 267 items was generated by these efforts: 210 written by SMEs and 57 culled from previous tests.

Item Review

The SMEs then met for a second time. At this meeting the objectives were to 1) edit and clarify items, 2) obtain a consensus on the correct answers, 3) get independent estimates of the percent of trainees who would pass each item, and 4) choose between duplicate items.

Each SME was provided a list of the entire pool of items, organized by topic. The lists did not indicate who had written which items. The meeting followed a simple format. A question was read out loud, including what the correct answer was supposed to be. Each SME had an opportunity to speak if he felt the item could be worded better
or if he disagreed with the answer. Lesson plans and a training manual were available as references. After each participant was given the opportunity to comment, a vote was taken on any proposed changes. SMEs penciled in changes on their individual lists. Each SME then independently estimated what percent of OSUT trainees would get the item correct on a test, i.e., the difficulty level of the item. The mean inter-rater reliability for these difficulty estimates was .75. When all the items for a topic had been reviewed, the group chose between any duplicates. Duplicates were read aloud, each person stated his preference and reasoning, and a vote was taken. After approximately an hour, the group was split in half and the remaining items divided up to speed the review process.

Items were eliminated on three criteria: 1) unanimous agreement could not be obtained on the correct answer, 2) the item was a duplicate, or 3) the mean estimated pass rate for the item was greater than 80% or less than 20%. Discarding items which met any one of these elimination criteria narrowed the pool to 197 questions.

Pilot Testing
The remaining items were divided into two pilot tests for pretesting. Version A contained 97 items while version B contained 100. Twenty seven soldiers in their fourteenth week of OSUT took version A while 25 took version B. Both groups had two hours to complete the test.

Item Analysis of Pilot
Item-total correlations and item difficulty (percent passing the item) were calculated for each of the 197 questions. Item-total
correlations ranged from -.36 to .75 with a mean of .18. Item
difficulty also had a wide range: .07 to 1.00 with a mean of .49.
Items were selected for a final version of the test if their item-total
correlation exceeded .25 and their difficulty estimate was between .20
and .80. However, since these item retention rules left several topic
areas unrepresented on the final test, nine items with item-total
correlations as low as .17 and difficulty levels ranging from .11 to
.92 were also selected. A total of 75 items were retained, leaving two
of the 34 topics unrepresented on the TKT.

The percentage of items devoted to each topic on the pilot and
revised test is presented in Table 1. A graphic illustration of topic
representation on the two test versions is provided in Figure 1. As
can be seen from Figure 1, the proportional representation of any topic
varied only slightly from pilot to revised test.

Test Administration

The Tank Knowledge Test was administered to five companies of
trainees in their final week of OSUT. The TKT was included as the
first of a set of experimental criterion measures. After instructions
were read out loud, participants had one hour to complete the test.
Instructions and test are reproduced in Appendix B.
CHAPTER IV

Results

Item Analysis

Item difficulty levels ranged from .16 to .92 with an average of .57. Item-total correlations ranged from -.04 to .42 with a mean of .20. Two items had negative item-total correlations (item 19 = -.02, item 60 = -.04). Table 2 presents the difficulty levels and item-total correlations for each item. Mean test score was 42.95 (standard deviation 8.29).

Insert Table 2 about here

Reliability

The internal consistency of the TKT, as measured by Cronbach's Alpha, was .79. The effect on test reliability of varying the number of items, using the Spearman-Brown formula, is presented in Table 3.

Insert Table 3 about here

Factor Analysis

The 34 topics comprising the TKT can be grouped into four broad
categories: driver's station, loader's station, gunnery, and maintenance. The items included in each of these divisions could form distinct subscales, perhaps helping to pinpoint the strengths and weaknesses of both the training program and of individual soldiers.

To examine the viability of the four factors, a common factor analysis with oblique rotation was performed using the Statistical Package for the Social Sciences, release 9 (Nie, Hull, Jenkins, Steinbrenner & Bent, 1975). According to Ford, MacCallum, and Tait (1986) common factor analysis is preferred when the measured variable is assumed to be a linear function of a set of unmeasured variables, as is the case with total TKT score and performance on each potential subscale. On the TKT, high scores within the subgroupings of items lead to a high total score and low scores within the four categories lead to a low total score. Ford et al. also recommend that oblique rotation be used unless the orthogonality of factors is a tenable assumption. In the present case it is reasonable to assume that individuals who do well and individuals who do poorly will do so in all four areas, resulting in at least moderate factor intercorrelations.

Results did not support a four factor solution. Ford et al. (1986) suggest using more than one decision rule to retain factors. Two accepted methods are setting a minimum eigenvalue of 1.0 and the scree test, in which discontinuities in the pattern of eigenvalues are examined. Applying the eigenvalue greater than one rule to the initial factor matrix would have resulted in the retention of 30 factors. Applying the scree test would have resulted in the retention of a single factor. Table 4 presents the eigenvalues and variance accounted
for by each factor.

Insert Table 4 about here
CHAPTER V

Discussion

The intent of this research effort was to develop a criterion measure useful for training program evaluation and assessing trainee competence. Thus two broad objectives were set in Chapter II: to maximize criterion relevance (content validity) and reliability (internal consistency). These goals were approached through a careful process of test development, piloting, and revision. The variable of interest was the measurement of the amount of tank information taught in the last six weeks of OSUT that was retained by trainees. A written test was chosen as the mode of measurement for several reasons: 1) performance measures in use at this time allow trainees to refer to manuals and thus do not measure knowledge retention, 2) some knowledge taught in classroom training is never practiced in a hands-on setting, making performance tests inappropriate, and 3) a written test is much more cost-effective than performance testing all the material of interest. A knowledge test would therefore complement the performance measures currently in use.

SMEs involved in the training developed individual test items for all topics drawn from a thorough survey of training materials. According to Ghiselli, Campbell, and Zedeck (1981) "the adequacy with
which we can judge the validity of a test from its content is a function of the adequacy of the definition" of the variable of interest (p. 276). Ghiselli et al. also state that judgements of test validity "must take into account the extent to which the elements or items that make it up cover all aspects and facets of the" variable of interest (p. 276). By these criteria, the procedures followed in this study should have built content validity into the TKT: the training domain was defined as the material covered in a specified period of OSUT, and items were generated for all portions of that domain. Furthermore, it cannot be assumed that equal representativeness of all parts of a domain is sufficient for content validity (Ghiselli et al., 1981). Therefore, the proportional representation of topics in the item pool was determined through importance ratings made by SMEs. The greater a topic's rating, the larger its representation in the item pool. Topic representation on the TKT itself was very similar to that in the original item pool.

The second objective, reliability, was quantitatively assessed. A moderate but acceptable level of reliability was found for the TKT, as indicated by a .79 coefficient alpha. A possible explanation for the moderate observed reliability is the large number of topics covered by the test. To the extent that the topic areas are not homogenous and have low covariances, coefficient alpha will be lower. Trainees might score differently on different topics due to instructor variability or other uncontrolled factors. The result would be less covariation among the topics and a lower estimate of internal consistency.
Reliability could be improved by lengthening the measure, although at 75 items the test already requires one hour to administer. Longer versions might require excessive administration times. Reliability could also be improved by dropping or revising items with very low item-total correlations. The preferred option would be retaining and rewriting the poor items. In this manner the representativeness of the training domain would be maintained within the test.

The ability of the test to discriminate among trainees was enhanced by instructing SMEs to formulate items which half of OSUT trainees would pass (that is, items with difficulty levels of .50). An item with a difficulty level of .50 can maximally discriminate among test takers (Ghiselli et al., 1981). The success of the SMEs in meeting this request was reflected by the mean difficulty level of .49 for items in the original item pool. The items comprising the TKT also approached a mean difficulty level of .50, although a wide range of difficulty levels was exhibited. Variability in item difficulties is not unusual; it is difficult to have each item obtain a .50 difficulty level (Ghiselli et al., 1981). Fortunately, this variability in item difficulty can be used to advantage: by ordering items from least to most difficult, the test anxiety of participants may be reduced. Ghiselli et al. recommend this procedure for most achievement tests. Retaining items of varying difficulties also allows reliable discrimination among individuals at either end of the distribution of ability levels, i.e., among high performers and among low performers, in addition to discrimination between high and low performers.

The other considerations in criterion development noted in Chapter
II (i.e., practicality and cost) are not major concerns here. For example, the practicality of data collection is quite high: only one hour of a class of trainees' time is required and the small cost of printing tests and answer sheets. The TKT can be easily hand-scored. Furthermore, the costs associated with further refining the instrument (reordering items and revising certain items) would be minimal.

The possibility of deriving subscales for clusters of items pertaining to maintenance, loader, gunner and driver tasks was not supported by factor analysis. A common, or classical factor analysis revealed a factor structure consisting of one general factor accounting for approximately 8% of test score variance and many smaller factors, each accounting for less than 4% of test score variance. Thus, only total test score is useful for assessing a particular soldier's tank knowledge.

The results of the factor analysis indicated that the domain of measurement consists of a number of distinct knowledges. This finding was not expected; the fact that all items on the test refer to a single vehicle leads one to predict a large general factor and perhaps other factors associated with clusters of related items. The observed results may have been due to the approach used in the training: each trainee is taught by a number of different instructors and experiences a variety of training techniques (e.g., classroom, hands-on, field observation). The technique utilized depends on the topic and the availability of equipment. Differences in techniques and instructors may have outweighed the topical relationships of the items.
In summary, the Tank Knowledge Test is a reliable, content valid and sensitive measure of trainee tank knowledge retention. With minor modifications, the TKT could provide a useful assessment of how much of the extensive information presented to trainees is actually retained. As such, TKT score could be utilized as an additional criterion in determining a trainee's readiness for field placement. For the purposes of program evaluation, the proportion of trainees achieving a minimum score could serve as a criterion for gauging training effectiveness.
References


Table 1

Percentage of Items on Pilot Test and TKT for Each Topic

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Figure Caption

Figure 1. Proportional representation of topic areas on pilot test and TKT.
Appendix A
AGENDA:

KNOWLEDGE TEST DEVELOPMENT WORKSHOP
24 MARCH, 1986

I. Introductions

II. A. Purpose of project:

The purpose of this research project is to document the Excellence Track (ET) program and to describe the differences between the ET and non-ET (NT) soldier at the end of OSUT.

B. Purpose of today's workshop:

You are all here as Subject Matter Experts (SMEs) on the normal training which all trainees receive between weeks 8 and 14 of OSUT. Our goal in this and the follow-up workshop Friday, 28 MAR, is to generate a pool of multiple choice test questions based on the content of OSUT weeks 8 through 14. Today we will:

1. rate each topic on its relative importance;
2. estimate the number of hours of training a student receives on each topic; and
3. assign topics to each member of the group for which they will be responsible for writing test questions.

On Friday we will edit the questions, make sure we all
agree on the correct answer, and choose between any duplicates.

III. Each SME will have 20 to 30 minutes to fill out the rating form. The form requires you to estimate the amount of training time each student receives on a topic and then to rate the topic's relative importance.

IV. Some instructions and rules of thumb for writing test questions will be discussed. For example, things to avoid, good and bad ways to phrase a question, etc.

V. Topics will then be assigned to each SME. You will be asked to write 2 or 3 questions on each of the topics assigned to you.

VI. We ask that you have your questions ready by 1100 on Thursday, 27 March. We will collect them at that time so that we can make master lists of all the questions for each of the workshop participants to use on Friday.
INSTRUCTIONS FOR WRITING TEST QUESTIONS

1. When you write a question, remember that this test is not going into the trainee's records nor will it affect his graduation.

2. The question should be not too easy or too difficult. Try to make the question hard enough so that about half the students would be able to answer it correctly and about half would get the question wrong.

3. Don't make your distractors (the wrong answer choices) obviously incorrect. The distractors should be believable, realistic alternatives. But don't make them virtually identical to the correct answer choice, either. Two alternative answers should not be so similar that the student has to read them several times just to spot the difference between them.

4. You don't want the student to be confused by the structure of the question. For example, avoid "double negatives." A double negative is when the question says something like "Which of the following is NOT part of process X" and you have an answer choice which says "not doing Y." Both the question and the answer choice are negative. This is very confusing to the student.

You should also try not to use a lot of "All of the above," "None of the above", or "Both A and C" type of answer choices.

5. Here are some examples of poor questions:

Which of the following would not cause an "Equipment Not
Ready/Available" report?
A. All rubber missing on road wheel
B. 50% rubber not missing on all road wheels
C. Missing road wheel
D. A bird's nest in the 105mm main gun
E. None of the above

The problems with this question are 1) there are two "double negative" answer choices (B and E) and 2) answer choice D is a waste of time--it is so clearly wrong that it serves no purpose, so why include it? A better version of this question would be:

Which of the following causes an "Equipment Not Ready/Available" report?
A. All rubber missing on road wheel
B. 50% rubber missing on all road wheels
C. Wear plate missing on road wheels
D. Missing road wheel

Here is another example:

Vehicle master power switches are located on the __________.
A. Driver's master panel & commander's control panel
B. Driver's master panel & loader's panel
C. Commander's control panel only
D. Both A and C
E. Neither A, B, nor C

The problem here is the last two answer choices. Answer choice D makes this question very confusing; Imagine a student saying to himself, "Well, A is right... but then D would be too, except that
C says 'only'... but C is included in A..." Chances are he would never get around to answering the question, even though he knew that there are master power switches on the driver's master panel and the commander's control panel. E is also a poorly written alternative: it is not clear that E completely rules out answer choice D. It is best to not to use choices like E and D, or at least use them very sparingly. A better version of this question would be:

Vehicle master power switches are located on the _________.

A. Driver's master panel and commander's control panel
B. Driver's master panel and loader's panel
C. Commander's control panel only
D. Driver's master panel only
AGENDA:
KNOWLEDGE TEST DEVELOPMENT WORKSHOP II
28 MARCH, 1986

I. Purpose of today's workshop:

This is a follow up workshop to our first meeting, Monday, 24 March. Our goal today is to polish up the pool of test questions which you have produced. Specifically, there are four things we need to do:

1. edit and/or clarify each question as necessary;
2. make sure we all agree on the correct answer;
3. independently estimate what percent of students will get each item correct; and
4. choose between duplicate questions.

II. The first thing which needs to be done is for each of you to indicate on the master list which will be passed around, the correct answer to each of the questions YOU wrote.

III. Each of you has a master list of all the questions which have been written (including some from a previous test) organized by topic. We will begin with the first question and simply work our way through the list.

1. Each question will be read out loud, including what the correct answer is **supposed** to be.
2. Then we'll go around the table and each person will
have an opportunity to speak if they feel the question could be worded better or if they disagree with the answer.

3. After we have gone around the table, we'll take a vote on any changes. If necessary, we will refer to the TM or lesson plans to double check answers.

4. Pencil in any changes that are made on your copy of the question.

IV. As a decision is made on each question, each of you should independently estimate what percentage of OSUT students would get that question right on a test.

V. After we have gone through all the questions for a particular topic, we will go back and choose between duplicate questions.

1. The duplicates will be read out loud;
2. Each person will state their preference and why;
3. We will vote on each question.
Appendix B
DO NOT OPEN THIS TEST UNTIL YOU ARE TOLD TO DO SO

This test contains questions on many of the subjects you have studied over the last six or seven weeks of your training. There are 75 questions. Read each question carefully and choose the best answer.

MARK YOUR ANSWERS ON THE ANSWER SHEET PROVIDED. USE A NUMBER 2 PENCIL ONLY.

DO NOT WRITE ON THE TEST.

When you finish, raise your hand and the test administrator will come and collect your test.

DO NOT BEGIN UNTIL TOLD TO DO SO.
1. Class III leak will be reported to organizational maintenance on DA Form ________.
   a. 2404-1
   b. 2408-4
   * c. 2404
   d. 1970

2. When checking stabilization for drift in EMERGENCY mode and drift is present, what are your actions?
   a. use AZ and EL knobs to null out drift
   * b. notify organizational maintenance
   c. perform computer self-test
   d. take cadillac controls off and adjust drift with a screwdriver

3. What hydraulic pressure is required for normal operation of the turret?
   * a. 1500-1700 lbs
   b. 870-950 lbs
   c. 1250-1350 lbs
   d. 1150-1500 lbs

4. If you correct a fault, you will
   a. discard the 2404
   * b. write in corrective action and initial on items corrected
   c. leave the space on the form blank

5. When performing duties as a driver of an M1 tank and the fire command "MISSILE" is given by the TC, you would
a. turn on GAS particulate
* b. start evasive action by making radical turns and alternating speed
c. alert the crew
d. wait for instructions from TC

6. The precleaner is attached to the hull by
   a. 4 clamps
   b. 4 clamps and a butterfly latch
* c. 4 butterfly latches and a hose clamp
d. 4 butterfly latches

7. The aiming point for a battlesight engagement is
   a. base of visible mass
   b. center of mass
   c. imagined base of mass
* d. center of visible mass

8. What are two techniques of direct fire?
   a. precision, battlesight
* b. precision, degraded mode
c. degraded mode, battlecary
d. multiple engagements, simultaneous engagements

9. The loader's hatch should not be operated when
   a. turret is moving
   b. hull is moving
* c. tank is moving
d. none of the above

10. When preparing loader's station for operation the spent case ejection guard is in the _________ position.
ejection guard is in the ________ position.

a. up  
b. down  
* c. forward  
d. rear

11. When the position of an unservicable track block is correct for removal it would be
   a. between the drive sprocket and #7 roadwheel  
b. midway between the compensating idler wheel and support roller  
* c. midway between the compensating idler wheel and #1 roadwheel

12. The correct nomenclature for the VRC mount is
   a. CX-4722  
b. AM-2060  
* c. MT-1029  
d. CG-1773

13. What is the tactical idle speed for the M1 tank?
   a. 870-950  
b. 1500-1700  
* c. 1250-1350  
d. 1100-1500

14. The 2 second delay between throttling the engine up and the tank moving out can be avoided by doing what?
   a. setting the transmission to low  
b. turning the bilge pump on
* c. turning on the tactical idle switch
d. holding the starter only switch for 20 seconds

15. After the track support assembly is installed you should
   a. remove center guide
   b. remove end connectors
   * c. release track tension

16. After the new track block is installed you should
   * a. adjust track tension
   b. install center guides
c. install end connectors.

17. What size socket is used to remove center guides?
   a. 25 mm
   * b. 30 mm
c. 50 mm
d. 15 mm

18. When firing the M240 machine gun and a stoppage occurs, you must
determine if it is a hot gun or a cold gun. What constitutes a
hot gun?
   a. 150 rounds in 2 minutes
   * b. 200 rounds in 2 minutes
c. 200 rounds in 15 minutes
d. 200 rounds in less than 2 minutes

19. Adjusting the breech operating cam will
   a. make the breech operate easier
   * b. regulate ejection speed of cartridge case
c. help to open breech manually
20. What is the purpose of the breechblock crankstop?
   a. to hold the breechblock in the open position
   b. to make contact for the firing circuits
   * c. to keep the breechblock from traveling beyond the bottom limit
   d. to keep the breechblock from traveling beyond the upper limit

21. To secure the precleaner the position of the turret should be
   a. over the back deck
   b. over the front slope
   * c. over the left side

22. When cleaning the precleaner you should use
   a. MO GAS
   * b. water
   c. CLP

23. The breechblock's spring tension adjuster has how many adjuster notches?
   a. 1 notch
   b. 2 notches
   * c. 3 notches
   d. 4 notches

24. How many gas ports are located on the main gun inside the bore evacuator?
   a. 2
   * b. 4
   c. 1
25. What is the minimum number of rounds used to calibrate an M1 tank?
   a. 1
   * b. 2
   c. 3
   d. 4

26. When performing GPS adjustments reticle drift will not be more than half a mil in ________ seconds.
   a. 5
   b. 10
   c. 15
   * d. 20

27. When performing computer data check and barometric pressure is not available use
   * a. 29.92
   b. 92.29
   c. 29.29
   d. 92.92

28. When firing main gun and palm switches are released ______ will not work.
   a. control handles
   b. laser buttons
   c. triggers
   * d. all of the above

29. The coaxial machine gun should be fired in ______ to ______ round bursts.
30. Which socket head key(s) (allen wrench) is required to service the bore evacuator?
   a. 3/16"
   * b. 3/16" and 5/32"
   c. 5/32" and 1/8"
   d. 1/8" and 3/16"

31. When setting headspace and timing on the M2TT, what is the sequence of the gauges?
   * a. GO, NO GO, NO FIRE, FIRE
   b. FIRE, NO FIRE, NO GO, GO
   c. NO GO, GO, FIRE, NO FIRE
   d. NO FIRE, FIRE, GO, NO GO

32. What are the 3 tactical positions of the tank?
   * a. HIDE, TURRET DOWN, HULL DOWN
   b. HULL DOWN, CAMOFLAUGED, COVER
   c. HIDE, COVER, CONCEALMENT

33. How many tanks does it take to tow a disabled tank with final drives disconnected?
   a. 1 M1 tank
   b. 1 M88 recovery vehicle
   * c. 2 M1 tanks, 1 in front and 1 in back
   d. 3 M1 tanks, 2 in front and 1 behind
34. How many vehicles are required to upright an overturned tank?
   a. 1
   b. 2
   * c. 3
   d. 4

35. What kind of brush do you use to clean the fire sensor lens?
   a. soft paint brush
   b. sash brush
   * c. camel hair brush
   d. both a and c

36. To prepare the M250 grenade launcher for travel:
   a. load the grenade launcher
   b. do a circuit test then load
   * c. unload and place covers on

37. What must you do when the third adjustment notch is being used on the spring adjustment of breech tension?
   a. check operation of breech
   * b. notify organizational maintenance
   c. note on the 2408-4

38. On a short halt in a road march of M1s, what type of maintenance should the operators conduct?
   a. after checks
   b. before checks
   c. concurrent checks
   * d. during checks

39. What is the preferred method of payment to soldiers after initial
entry training?
   a. check--to your unit
   b. check--to you at an address you designate
   c. cash--to you at your unit
  * d. sure pay/direct deposit

40. The loader checked the hydraulic system oil reservoir; oil level on the reservoir oil level gauge was low. What type of oil does the oil reservoir take?
   a. Mi L-L-23699
   b. CLP
   c. OEA
  * d. FRH

41. The driver checked the compensating idler wheel, and the oil was more than 1/2 inch low. What type of oil does the compensating idler wheel take?
  * a. OE/HDO-30
   b. 10-W-40
   c. OE-5
   d. TS0

42. When adjusting track tension, which of the following is true?
   a. It is not necessary to add tension unless the compensating idler wheel moves forward a full inch.
   b. The engine should be running at approximately 870-950 RPMs.
  * c. The parking brake should be released.
   d. The rotary shocks should have already been greased.
43. The coax machine gun ready box can hold _________ rounds.
   a. 1500
   b. 3000
   * c. 4800
   d. 5000

44. When loading the main gun ready ammo compartment, you will
   * a. pull and turn locking shaft 1/4 turn clockwise
   b. ensure turret hydraulic pressure gauge shows zero.
   c. remove quick release pin from slide rack.

45. The first step in loading the M250 grenade launcher is
   a. remove cover
   b. get grenades
   * c. tell TC to set turret power switch to off
   d. check for dirt or sharp objects in discharger tubes

46. When loading the main gun, the loader's seat back is
   a. placed up
   * b. taken off
   c. placed down
   d. installed

47. The main gun status lights are controlled by
   a. gun/turret drive switch
   b. main gun safe switch
   * c. ejection guard
   d. loader's power switch

48. When loading the main gun semi ready ammo compartment, you will ensure
a. turret power is on
  b. TC backguard is removed
  c. the loader's knee switch is in down position

49. After loading the hull ammo, you will ensure
  a. the hull ammo doors are open
  b. the locking pin and quick release pin are installed
  c. the locking pin is removed

50. How many rounds are stowed for 105 mm?
  a. 21 ready, 22 semi ready, 8 hull
  b. 22 ready, 22 semi ready, 6 hull, 3 turret rack
  c. 21 ready, 21 semi ready, 8 hull, 4 turret rack
  * d. 22 ready, 22 semi ready, 8 hull, 3 turret rack

51. Main gun maximum recoil is how far?
  a. 10 inches
  b. 24 inches
  * c. 13 inches
  d. 16 inches

52. After loading main gun and before announcing "up", you must
  a. move ejection guard to rear
  b. check red armed light
  c. move ejection guard forward
  * d. both b and c

53. You are checking headspace on the M2HB machine gun. What are your actions if the NO GO gauge fits in the T-slot?
  a. Unscrew barrel 1 click and try again.
  * b. Screw barrel in 1 click and try again.
c. Remove back plate and turn adjusting screw all the way down.

d. Insert Go end of gauge into T-slot.

54. When entering the gunner's station, you will ensure
   a. the gun/turret drive switch is in the powered position
   * b. spent case ejection guard is in the safe position
   c. the ready ammo door is open

55. The fire control system is designed to function normally at _______ to _______ volts.
   * a. 18 to 30
   b. 12 to 16
   c. 6 to 12

56. The gunner's hydraulic pressure gauge should read
   a. 1700 to 2000 PSI
   b. 1100 to 1500 PSI
   * c. steady, 1500 to 1700 PSI
   d. 2000 PSI or more

57. When powering down gunner's station, the _______ switch is set to safe before turret power is turned off.
   a. gun select
   b. thermal test
   c. thermal mode
   * d. laser range finder

58. When performing a fire circuits test, the main gun should be
   a. loaded
   b. in the safe position
59. Which switch must be set to standby for 5-15 minutes to cool down the TRV prior to operating the TIS?
   a. CCP power switch
   b. thermal test pattern switch
   * c. thermal mode switch
   d. polarity switch

60. When in MOPP level 4, what would you use to decontaminate your gloves with when using the latrine?
   a. M11 decontamination apparatus
   b. mark V injectors
   * c. M58A1 skin decontamination kit
   d. M9 paper

61. ________ mode is a backup for normal mode.
   a. Manual
   b. Power
   * c. Emergency
   d. Hydraulic

62. ________ mode disables the power control handles.
   * a. Manual
   b. Power
   c. Emergency
   d. Hydraulic

63. The automatic lead system works only in the ________ mode.
   a. Manual
   * b. Normal
c. Emergency

d. Power

64. After setting the engine shut off switch down, the engine will coast to a stop in ________ to ________ seconds.
   a. 10 to 20
   b. 60 to 70
   * c. 30 to 60
   d. 45 to 50

65. When driving an M1 tank at night, which night vision device is used?
   a. PVS-5
   * b. AN/VVS-2
   c. infrared lens
   d. driver's periscopes

66. When powering down and securing gunner's station, all of the following switches are positioned correctly except
   a. gun select on trigger safe
   b. thermal mode switch on off
   c. MRS switch to out
   * d. LRF switch on first return

67. The GPS reticle is
   a. fixed ballistic reticle
   b. painted nonballistic reticle
   c. standard nonballistic reticle like the M60 series
   * d. projected nonballistic reticle

68. The M1's transmission has how many forward gears?
69. Switch must be set to ON for fire extinguisher system to operate automatically.
   a. First shot
   b. Turret power
   * c. Vehicle master power
   d. First and second shot

70. When installing track move tank so that the #7 road wheel is over the ________ track shoe from the rear.
   a. 7th
   b. 2nd
   * c. 13th
   d. 9th

71. How many track shoes are normally on the tank?
   a. 205 blocks
   b. 110 blocks
   * c. 156 blocks
   d. 172 blocks

72. When performing mouth to mouth, how many breaths do you give per minute?
   * a. 12
   b. 5
   c. 10
73. The gunner's primary sight has a magnification power of _______ and ________.
   a. 5x and 10x
   b. 3x and 15x
   c. 2x and 8x
   * d. 3x and 10x

74. The multiple return symbol will appear when the laser range finder receives more than ________ return(s).
   a. 2
   b. 4
   * c. 1
   d. 3

75. Where is the cable located that plugs into the AN/VVS-2?
   a. behind the steering control connected to a dummy plug
   b. by the right knee connected to a dummy plug
   * c. by the left knee connected to a dummy plug
   d. behind the driver's seat by the hull networks box connected to a dummy plug