

Building Stronger EMS Examinations by Randy Benner.

Part 1 of 2

Introduction:

When charged with showing that learning has occurred in the classroom, few educators have a stronger need to show performance than those that teach medicine, especially emergency medicine. Beyond the obvious we need to ensure that we graduate competent entry level EMS providers, we must also remain cognizant that if we deny access to a student to our programs (pretesting), initiate a corrective action plan for poor performance (formative testing), or dismiss a student from our program due to poor academic performance (formative and summative testing), then we may be denying them a career and an ability to support themselves and their family. Given the litigious society that we live in, it is not unheard that a former student brings legal action against their educational program for being dismissed due to poor academic performance, and overturn that decision. We as EMS educators must ensure that our exams are valid, reliable, and frequent enough that the EMS program can make informed and defensible decisions regarding student progression. This protects the public by allowing us to better assure cognitive knowledge and graduate better EMS providers. To this end, this article is designed to provide the EMS educator with an introductory understanding of the importance of test item evaluation, terms and concepts used in item analysis, and a framework for basing decisions on the test items evaluated. This article should be supplemented with additional knowledge about test item writing and more advanced statistics and indexes of item performance.

Objectives:

1. Define and discuss validity and reliability as they relate to examinations.
2. Discuss methods of item evaluation to include the difficulty and discrimination index, and distractor analysis.

3. Identify ways to improve EMS educational exams.

Validity and Reliability:

When considering examination items, the concept of validity relates to the content of the examination items. Another way of wording it would be to say does the test measure what it is supposed to measure. If for example, you were administering a test over brain and spinal trauma specifically, there should NOT be questions regarding OB/GYN or endocrine emergencies. There are several ways to help increase the validity of an exam:

- **Content (face) validity:** this is the extent to which the exam looks like it covers a concept it is supposed to. For example, does the ECG test have multiple ECG strips?
- **Construct validity:** Do the test items represent the instructional objectives of the curriculum? EMS educators need to assure the test does not over emphasize or under represent the curricular learning objectives. For example, a test over brain and spinal trauma should not exclude all questions about incomplete spinal cord injuries.
- **Criterion validity:** This allows prediction of the student's performance on an external or internal exam. For example, if a student passes your comprehensive final with a certain score, does that help predict first time pass rate on the licensing exam? The goal is that it does, or will become better at doing so with logical revisions.

Reliability is a concept that deals with the ability of the examination to consistently test what it is desired to test. In question form, reliability would ask if the examination can consistently measure the desired knowledge base? For example, the same student were to take two different exams over the same material, reliability in the questions would be considered if the scores between the two exams were close to the same.

NUGGET #1

Validity looks at content.....not scores.

Reliability looks at scores....not content.

No discussion of exam validity and reliability is ever complete without someone asking, “Can an exam be reliable, but not valid?” The answer to that question is an absolute “yes”. A common analogy explaining the relationship of validity and reliability is the household bathroom scale. To be valid, let’s say you want your scale to weigh you in pounds...and to be reliable, you would want your scale to weigh you at the same amount if you were to step on it twice in a row one morning – and the weight it displays you want to be accurate. If the scale weighed you in pounds, but the calibration was off so it consistently weighed you at different weights, then the scale would be considered to have validity (weigh you in pounds), but no reliability (no consistent weight). Likewise, if the scale displayed your weight at the same amount in kilograms, but you wanted pounds, then the scale would be reliable but not valid. This would be like an archer that consistently hits the target a foot away from bull’s-eye – they would have reliability but not accuracy. Consider Figures 1, 2 and 3:



Reliable
Not Valid

Figure 1: An exam with poor validity but good reliability would have a grouping of scores around a number.



Low Validity
Low Reliability

Figure 2: An exam with poor validity and poor reliability would have a scattering of scores.



Both Reliable
and Valid

Figure 3: An exam that has been written with good validity and found to be reliable would have a grouping of scores around a number, and be testing the information required.

From a relationship standpoint, an examination is written with validity in mind, and then is determined to be reliable.

NUGGET #2

An exam must be reliable if it is ultimately to be considered valid

Below are some ideas to help improve the exam validity while creating the test. Please remember that an exam is written to be valid *first*, and then determined to be reliable:

1. Use a blueprint of objectives to write exam questions from so as to ensure the required curriculum is adequately met
 - This increases construct validity
2. Review the exam items with other EMS faculty, Medical Director, and local experts
 - This increases the content (face) validity
3. Compare the outcomes to known variables such as first time pass rates on the National Registry of EMS exam
 - This contributes to improving criterion validity

After the exam is written to be as valid as possible, then follow the below recommendations to increase the examination reliability:

1. Prepare the student adequately
 - Write clear directions, prepare the student with how they should respond, keep exam room free from distractions (phones, temperature extremes, ambient noise, lighting).
2. Write longer exams
 - The greater number of question items, the easier to demonstrate reliability. If an exam only had one question about endocrine emergencies, then how could the educator say that the student understands diabetes, hyperthyroidism,

hypoadrenalism, etc? If a module exam is only 50 questions, but it covers 10 chapters in the book which represents 120 learning objectives, then majority of objectives are not evaluated and no assurance is there that the students understands everything.

3. Pay attention to item construction
 - Remove any bias or stereotypes that may be leading or misleading
4. Plan examination construction early
 - Avoid “convenience store” item construction, or using an exam that was prepared elsewhere, that was designed for a different purpose (this is similar to using the test items that sometimes accompanies the textbook, but never revising or analyzing the questions). This is akin stopping at a convenience store for dinner because you are in a hurry, only to find your options are limited and the food is not all that good anyway.
5. Look at examination performance (to be discussed next), and revise as appropriate.

NUGGET #3

Start with good exams...its easier

(Randall W. Benner has over 25 years combined experience in the delivery of pre-hospital medicine, critical care transport medicine, prehospital care education, and EMS curriculum design. His professional entrenchment is complimented with an associate degree in paramedicine, a baccalaureate degree in Emergency Medical Services, and a graduate degree in Education. Mr. Benner has contributed to numerous EMS journal publications, textbooks, instructor resource materials, online educational programs, as well as authored several of his own works. He is a charter member for the National Association of EMS Educators and has also been invited to contribute to the EMS national standard curricula on each of the past 3 revisions by NHTSA. He serves on several EMS related committees and presents regularly at local and national conferences on topics such as critical care transport medicine, prehospital medicine, and concepts in EMS

education. He has a full time faculty appointment at Cincinnati State as an EMS educator, and still works clinically part time as a flight paramedic for AirEvac Lifeteam.)