# Applying Generalizability Theory to Provide Validity Evidence for a Pharmaceutics Course Grade: Combining Exam Reliability Coefficients

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## Purpose

- Demonstrate use in pharmacy education of Generalizability Theory (G-theory) to combine reliability from three separate exams into an overall course-grade reliability

## Key Findings *[Implications]*

- G-theory integrated reliability from multiple exams
  - ➢ Reliability of final course-grades was okay but could be improved
  - ➢ Reliability improved if:
    - ✓ More examinations (occasions)
    - ✓ Can have fewer MCQ on each exam (AND fewer MCQ over all exams combined!)
- G-theory provides vital generalization evidence for course-grades
- By extension, reliability for grade-point-average of an entire program will likely be improved further by combining multiple courses

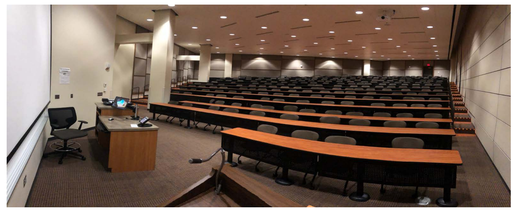
## Why did we do this study? *[Background]*

- Pharmacy colleges/schools should be generating validation evidence for assessments used to make important decisions[1]
- Kane's Framework of validation[2]
  - •Scoring ➢ Generalization ➢ Extrapolation ➢ Implications
- The vast majority of pharmacy education uses Classical Test Theory (CTT), where reliability is limited to each exam's scores[3]
  - ➢ In CTT, individual exam reliabilities cannot be combined from multiple exams/occasions[4]
- While rarely reported in pharmacy education,[3] Generalizability Theory (G-theory) can combine results from multiple exams—reliability can be estimated for more complex measures

## What did we *do*? *[Methods]*

- First-year PharmD students took a pharmaceutics course
  - 12 weeks of lectures
  - Three exams
- Kuder-Richardson Formula-20 (KR20) estimated the CTT-based reliability of each exam
- For G-theory, we used G-String-IV
  - G-theory model was: ***students*** *crossed with* ***items*** *nested within* ***occasions/exams*** (p x i:o)

## What did we find? *[Results]*



101 students took two midterms and one final-exam
- •Exam1=50MCQ (KR20=0.685)
- •Exam2=43 MCQ (KR20=0.647)
- •Exam3=67 MCQ (KR20=0.665)

Our combined G-coefficient/reliability of course-grade was **0.710**

**Our Variation Sources (%)**

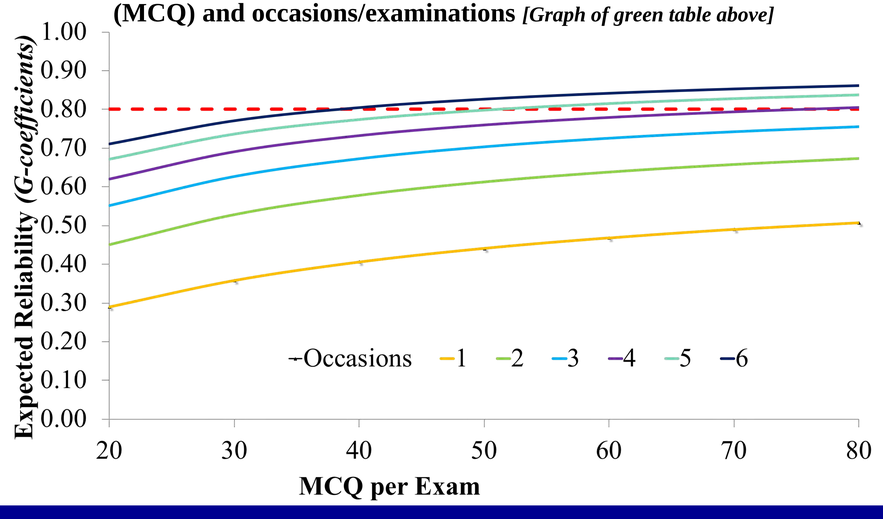
| Sources | % |
|---|---|
| student | 2 |
| occasion | 0 |
| item:occasion | 21 |
| student x occasion | 1 |
| student x item:occasion (& other error) | 76 |

**Our reliability changes (G-coefficients) by number of occasions & items per occasion**

| Occasions \ Number of Items | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|
| 1 | 0.290 | 0.359 | 0.406 | 0.442 | 0.469 | 0.490 | 0.508 |
| 2 | 0.450 | 0.528 | 0.578 | 0.613 | 0.638 | 0.658 | 0.673 |
| 3 | 0.551 | 0.626 | 0.672 | 0.703 | 0.726 | 0.743 | 0.756 |
| 4 | 0.621 | 0.691 | 0.732 | 0.760 | 0.779 | 0.794 | 0.805* |
| 5 | 0.672 | 0.736 | 0.774 | 0.798 | 0.815* | 0.828* | 0.838* |
| 6 | 0.710 | 0.770 | 0.804* | 0.826* | 0.841* | 0.852* | 0.861* |

**Threshold=0.800**

**Our expected reliability with increased multiple-choice questions (MCQ) and occasions/examinations** *[Graph of green table above]*




## References

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3. Hoover MJ, Jung R, Jacobs DM, Peeters MJ. Educational testing validity and reliability in pharmacy and medical education literature. *Am J Pharm Educ*.2013; 77(10):article 213.
4. Peng SK. Classical versus Generalizability theory of measurement. *Examinations Research*. 2007; 4:009.