CLEAR Exam Review

Volume XXVII, Number 2
Winter 2017-18

A Journal

CLEAR Exam Review is a journal, published twice a year, reviewing issues affecting testing and credentialing. CER is published by the Council on Licensure, Enforcement, and Regulation, 108 Wind Haven Drive, Suite A, Nicholasville, KY 40356.

Design and composition of this journal have been underwritten by Prometric, which specializes in the design, development, and full-service operation of high-quality licensing, certification and other adult examination programs.

Subscriptions to CER are sent free of charge to all CLEAR members and are available for $30 per year to others. Contact CLEAR at (859) 269-1289 or cer@clearhq.org for membership and subscription information.

Advertisements and Classified (e.g., position vacancies) for CER may be reserved by contacting CLEAR at the address or phone number noted above. Ads are limited in size to 1/4 or 1/2 page, and cost $100 or $200, respectively, per issue.

CLEAR Exam Review

VOLUME XXVII, NUMBER 2 WINTER 2017-18

Contents

 ISSN 1076-8025

Integrating Competency Modeling with Traditional Job and Practice Analysis

MARK RAYMOND, Ph.D.
research director &
principal assessment scientist
National Board of
Medical Examiners

Competency modeling (CM) has gained prominence as a way for businesses to guide human resource functions such as personnel selection, training, performance evaluation, and compensation benchmarking. Because job analysis serves as the foundation for all of these functions, it is not surprising that in some quarters traditional job analysis has been replaced by competency modeling as the way to determine what qualifications workers ought to have. As a consequence, test blueprints may now consist of competencies such as *leading & deciding* and *interprofessional collaboration* (Bertram, 2005; Englander et al., 2013) in addition to or in place of content like *numerical reasoning* and *pathology*.

The influence of CM recently has stretched into the not-for-profit sector, with competency frameworks being promoted in professions such as accounting, engineering, executive assistants, nursing, and psychology. One example is the CanMEDS framework adopted by the Royal College of Physicians and Surgeons of Canada (Frank et al., 2015). CanMEDS specifies seven roles of the competent physician: medical expert, communicator, collaborator, leader, health advocate, scholar, and professional. Here is one of several subcompetencies under *Health Advocate*: "Appreciate the possibility of competing interests between the communities served and other populations." While this is an admirable quality for any health care professional, many test developers and psychometricians often react to such competencies by wondering how they can be objectively and reliably assessed. Another concern is that competencies such as these are not very good at discriminating between jobs because they apply to many occupations (Lievens et al., 2005). For example, one recent review of competency frameworks reported that many of the same competencies were deemed essential for each of the 10 health professions studied (Englander et al., 2013). Findings such as this, if taken literally, suggest test blueprints for these different professions would be very similar. And yet, we know this not to be the case. There seems to be a mismatch between what competency models deem as important and what actually ends up on credentialing tests. Despite these and other limitations, competency models have their benefits and are probably here to stay. The purpose of this paper is to suggest an approach to job analysis that addresses broad competencies while maintaining the rigor of traditional job analysis and the specificity of good test blueprints.

Some Background

Testing for competence on important outcomes rather than for cognitive abilities appears to have its roots in education (Glaser, 1963) and psychology (McClelland, 1972). However, the terms *competence* and *competencies* as used today really gained traction with the publication of the now ubiquitous "The Core Competence of the Corporation" in the *Harvard Business Review* (Prahalad & Hamel, 1990). Although that article focused

on competencies as qualities of entire organizations, the language of competencies was soon adopted by human resource managers to describe the desired qualities of workers. The definitions of *competency*, as applied to people instead of organizations, are numerous and varied (Schippmann et al., 2000). One early advocate of CM defined a competency as "a combination of motives, traits, self-concepts, attitudes or values, content knowledge or cognitive behavior skills; any individual characteristic that can be reliably measured or counted and that can be shown to differentiate superior from average performers" (Spencer et al., 1994). What this definition has in common with many others is that any single competency is seen as the product of multiple knowledges, skills, and other attributes (KSOAs). CM is similar to what has been called worker-oriented job analysis, which seeks to identify the necessary human characteristics required for successful job performance. However, the difference is that worker-oriented job analysis relies on well-established psychological constructs (Raymark et al., 1997) such as conscientiousness or mechanical aptitude, while with CM subject matter experts (SMEs) often propose "constructs" in an ad hoc manner using lay terminology.

This emphasis on global competencies concerned many personnel psychologists. In the late 1990s, the Society for Industrial and Organizational Psychology convened a task force to study job analysis and CM. As part of its effort, the task force surveyed human resources (HR) specialists and asked them to compare job analysis and CM on 10 criteria such as source of data (e.g., surveys, focus groups), types and detail of job descriptors, level of documentation, and so on. The only criterion for which CM was deemed superior was "Links job behaviors to business goals and strategies," with traditional job analysis being more effective on the remaining nine criteria. However, CM continued to gain in popularity in HR departments and with professional associations, particularly in health care, where core competencies were well infused into the Institute of Medicine's (2003) series of influential reports on quality care. By 2009, it appeared as if the traditional job analysts finally waved a symbolic white flag with an article by Sanchez and Levine (2009) acknowledging that CM was a necessary and overdue adjunct to job analysis.

Job Analysis versus Competency Modeling

Various papers have highlighted the differences between CM and traditional approaches to job and practice analysis (Clauser & Raymond, 2017; Sanchez & Levine, 2009; Schippmann et al., 2000). Some of the more notable distinctions are:

- Job analysis seeks to objectively document work-related behaviors, while CM seeks to influence behaviors. The former is descriptive, while the latter is prescriptive.
- Job analysis tends to be bottom up, with workers revealing their daily activities, while CM is more top down, with the organization communicating the behavioral themes that it values and expects workers to demonstrate.
- Job analysis focuses on present work activities and worker qualifications, while competency modeling is aspirational and oriented toward future goals of the organization.
- Job analysis addresses typical performance of a competent worker, while CM inspires maximum performance.
- Job analysis identifies relatively independent, well-circumscribed knowledge and skill domains, while CM integrates multiple KSOAs into broad competencies.
- Traditional job analysis emphasizes work-related activities that are most amenable to measurement (the KS part of KSOAs), while CM encompasses attributes such as leadership, resilience, emotional intelligence, and other personal qualities (the OA part of KSOAs).
- The result of job analysis is a listing of the discreet tasks, knowledge, and skills that highlight what makes a job or profession unique, whereas competency models list behavioral themes common to multiple jobs and/or professions (Englander et al., 2013).
- Job analysis relies on the language of knowledge and skill taxonomies (Fleishman & Quaintance, 1984) that, while rich and informative to assessment specialists, often lacks meaning for end-users. In contrast, CM summarizes performance in terms of broad skills (Bartram, 2005), using terminology that resonates with leadership and employees (Sanchez & Levine, 2009).

With its aspirational outlook, CM can help professions stay current, relevant, and competitive. Thus, it is not surprising that CM has been so readily adopted by association managers who must ensure the continued viability of their respective professions. One positive, unintended consequence is that, because CM emphasizes

personal qualities and performance in the workplace, credentialing agencies that adopt competency frameworks may end up considering the use of innovative assessment methods capable of measuring such qualities. Thus, CM can nudge a credentialing agency in the direction of assessing noncognitive skills and performance testing.

The benefits of CM are offset by a few notable limitations. One of them is the Facebook effect: Competency models are prone to positive response bias associated with social desirability and inflated perceptions of value—a form of self-presentation bias. When competencies are included on a survey, most of them tend to be rated as very important regardless of the job (Morgeson et al., 2004; Raymond & Neustel, 2006). A second limitation is that competencies lack the specificity required for item writing. One can only imagine the broad range of items that would be produced if SMEs were asked to write on the topic of "advocacy" or "collaboration."[1] A third problem is that competencies represent complex combinations of multiple constructs. For example, the competency called communication skills includes a smattering of personality constructs such as agreeableness, conscientiousness, and empathy, as well as expressive and receptive language fluency. A fourth problem is that competencies tend to overlap with one another; this complicates item classification and test assembly and results in highly redundant subscores. Finally, competency models are aspirational and seek to inspire superior performance. However, these goals are not consistent with the purpose of many credentialing programs: to protect the public by ensuring minimal competence of entry-level practitioners. Competency models could result in tests that emphasize skills like leadership over technical knowledge, or in the establishment of unrealistically high performance standards.

Strategies for Combining Job Analysis and CM

To be useful for credentialing programs, CM needs to be integrated with traditional job analysis procedures (Clauser & Raymond, 2017; Lievens et al., 2004; Sanchez & Levine, 2009). The remainder of this article describes five strategies for managing some of the limitations of competency modeling:

- Identify or create a working competency model.
- Anchor the competency model with traditional job activities.
- Specify the KSOAs associated with each competency domain.
- Apply empirical methods to evaluate the structure of the competency framework.
- Format the test blueprint as a two-way table (e.g., a content-by-process matrix).

I'll illustrate these, using parts of the framework known as the ACGME competencies, named after the Accreditation Council for Graduate Medical Education. The ACGME framework comprises six major competency domains: Medical Knowledge, Patient Care, Communication and Interpersonal Skills (shortened to Communication here), Professionalism, Systems-Based Practice, and Practice-Based Learning and Improvement (Swing, 2007). These six competencies guide physician education and assessment in the United States.

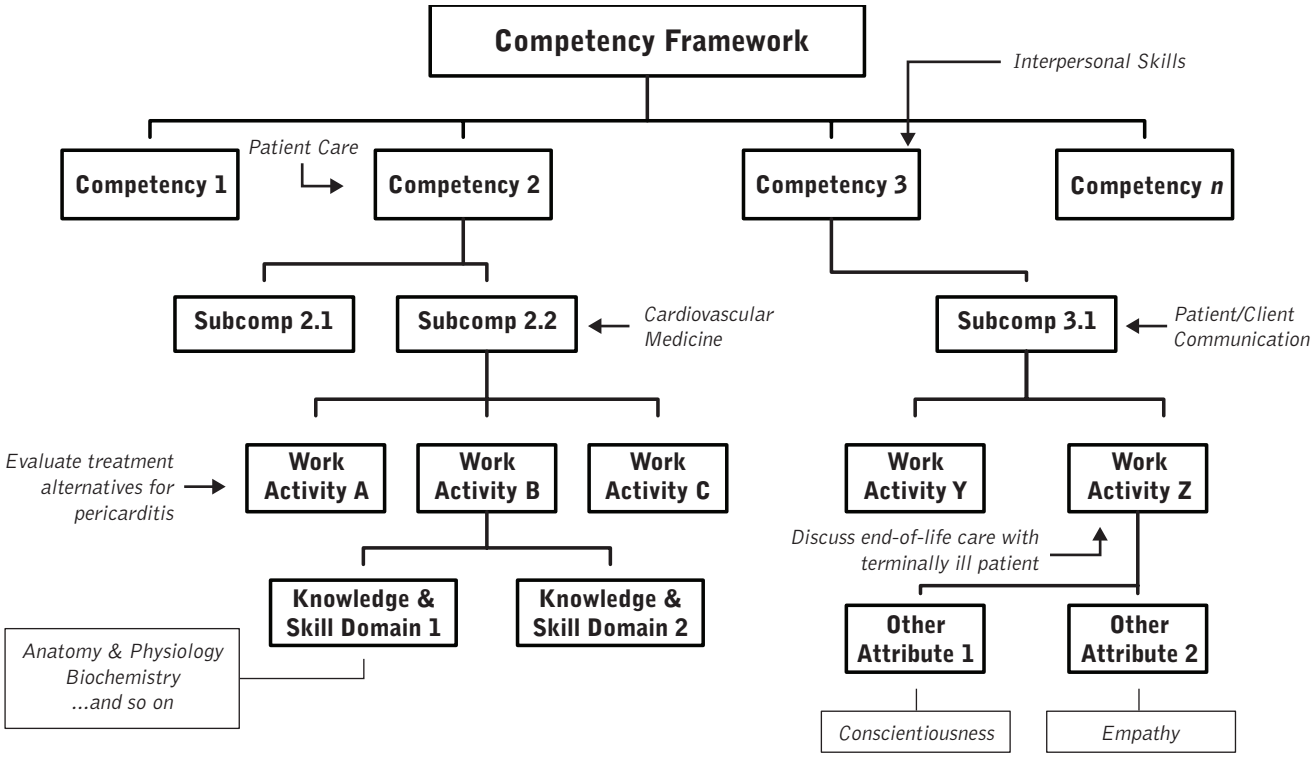
Identify or create a working competency model. Sometimes an occupation will have an existing competency framework to use as a starting point. If a suitable competency model does not exist, then it will be necessary to spend a day or so with SMEs developing a framework. A first step is to supply SMEs with generic competency models (e.g., Bartram, 2005) or one from related occupations. SMEs also should read any previous job analyses for the occupation being studied. Then, it is a matter of leading SMEs through a group exercise involving flipcharts, post-it notes, or some other method for recording and organizing their ideas, until a suitable list of competencies is developed. Given that competencies are often broadly defined, it may be necessary to specify subcompetencies or enabling competencies. For example, the competency domain of Communication might have subcompetencies such as Interprofessional Communications and Patient/Client Communications.

It can be helpful to organize the competencies into the three domains of Bloom's Taxonomy—the cognitive, psychomotor, and affective domains. Alternatively, just two categories may suffice; one corresponding to technical knowledge and skills (KS) and the other corresponding to other attributes (OA) and personal qualities. This latter approach was adopted for Figure 1, which is explained below.

Anchor the competency model with job activities. This is an important way to add substance and credibility to a competency model. For each competency domain, SMEs

[1] To be fair, it is important to acknowledge that in recent years health-care organizations (e.g., professional associations, medical schools) have undertaken efforts to add specificity to broad competency frameworks such as the ACGME competencies or CanMEDS.

FIGURE 1. Competency and job analysis map for a health profession. The text outside the boxes represents specific examples of a competency, subcompetency, work activity, and KSOA (knowledge, skill, or other attribute).



are asked to list specific work activities that represent instances of that competency. For example, the competency Professional Development might consist of activities such as *Attend a continuing education seminar*; the competency Resilience might include an activity like *Revise and resubmit a previously rejected report*. Figure 1 illustrates this process for two of the six ACGME competencies (Patient Care and Communication). Note that the left side of Figure 1 represents technical job activities, while the right side lists personal qualities.

The third level down in Figure 1 specifies work activities (it could be level 2 or level 4 depending on the competency framework). The important thing about Figure 1 is that it provides documentation that there are actual job behaviors that relate to each competency. For example, the fact that physicians sometimes "*Discuss end-of-life care with terminally ill patient*" offers logical support for the competency of Communication. At this point, the job analyst could declare that the project has been completed and stop there. Better yet, the job analyst could ask a different panel of SMEs to independently verify that each work activity belongs to each competency. However, the preferred option would be to develop a traditional job analysis survey based on the work activities and have a large sample rate each activity in terms of its importance and/or the frequency with which it is performed.

Specify the KSOAs associated with each competency domain. This activity really boils down to decomposing work activities into the psychological constructs (KSAOs) required to complete those activities. For more technically oriented work activities, this is a matter of specifying traditional knowledge and skill domains (the KSs)—the stuff that workers need to learn to practice their occupation. For the personal qualities (the OAs), it is helpful to translate those competencies and job activities into time-tested psychological constructs. For example, Kyllonen (2016)

describes how a fuzzy, politically-driven competency framework known as 21st Century Skills can be reframed as well-supported psychological constructs such as the Big Five personality traits.

The bottom row of Figure 1 illustrates how the competencies and job activities can be mapped to more familiar KSOAs. This type of mapping is useful because we know how to develop tests around the types of KSOA domains depicted at the bottom of Figure 1 (Raymark et al., 1997). This can be especially important for personal qualities because it is easier to purchase or develop an assessment of *conscientiousness* than a test of *leading & deciding*.

Apply empirical methods to evaluate the structure of the competency framework. Figure 1 could readily be converted to a test blueprint or table of specifications. The only additional step would be for SMEs to assign weights (e.g., number of test items) to each KSOA domain. However, recall that this initial competency framework was a *working model* and may not be the most effective way to represent the occupation being studied. Consider the CANMeds and ACGME frameworks. These two very different competency models both claim to describe the qualified physician, but perhaps one of them is more effective for assessment purposes. Competency frameworks are instances of behavioral taxonomies (Fleishman & Quaintance, 1984) and, if not well structured, can lead to some of the test development and scoring challenges mentioned earlier.

It is a good idea to subject the working competency framework to empirical verification, and straightforward methods exist for doing this. One useful approach relies on SME judgments but provides a systematic way to elicit and integrate those judgments (Raymond & Neustel, 2006; Schaefer et al., 1992; Sireci & Geisinger, 1995). Such an approach was undertaken a few years back on a statewide assessment for mathematics (D'Agostino et al., 2011). The state-endorsed framework consisted of competencies such as algebra, data analysis, measurement, and number reasoning. The study questioned whether that framework best captured the way that children learn math skills. So, researchers asked SMEs (math teachers) to sort test items into categories based on their perceived similarity. The sorting data were then subjected to multivariate analysis. The result was a very different competency framework—one that produced more meaningful subscores than the original state-endorsed framework.

I recently collaborated on a competency-driven practice analysis for the International Council for Veterinary Assessment. As part of the project, 25 SMEs used a simple online tool to sort more than 100 veterinary job activities into categories based on their perceived similarity. The results of the sorting activity were then subjected to multidimensional scaling, cluster analysis, and SME review. The product was used as the competency framework for the North American Veterinary Licensing Examination (ICVA & NBME, 2017). Raymond and Neustal (2006) describe several ways to elicit similarity judgments.

Another approach to evaluating competency frameworks is called a linkage activity—a systematic process for connecting each work activity to the KSOAs necessary to complete that activity (Wang, Schnipke, & Witt, 2005). These linkages are implicit at the bottom of Figure 1. However, establishing the linkages explicitly, by asking 10 or 20 or even 50 SMEs for their judgments, provides additional validity evidence. In principle, the linkage activity asks SMEs to verify statements such as "empathy is necessary because workers discuss end-of-life care options with families of terminally ill patients." In practice, a linkage exercise is completed by asking a panel of SMEs to rate the strength of the relationship between each job activity and the KSOA domains with which it is assumed to be associated. When assigning ratings, SMEs use rating scales to answer questions such as:

- How important is knowledge of topic X for performing task Y?
- What level of knowledge is required of topic X to be minimally proficient at task Y?
- If someone is deficient in this particular KSOA, how likely are they to demonstrate inadequate performance on task Y?

The primary use of the linkage exercise is to confirm that each KSOA and competency domain is required for at least one job activity. But another use is to subject the linkage judgments to statistical analyses to confirm the accuracy of frameworks like those in Figure 1. And yet an additional use is to combine the linkage judgments with task ratings from the job analysis survey to derive the number of test items for each category of the test blueprint (Kane, 1997; Raymond & Neustel, 2006; Wang et al., 2005).

Format the test blueprint as a two-way table. Traditional test blueprints are simple outlines of topic categories (e.g., biochemistry, principles of accounting). Such blueprints describe a test in terms of its *content*. In contrast, some blueprints describe the human processes required to successfully complete each assessment task. Although these *processes* often correspond to cognitive competencies (e.g.,

FIGURE 2. Portion of a hypothetical content-by-process matrix for a health profession. Values in the bottom row and last column (Total) specify the emphasis or importance (e.g., number of test items) allocated to each competency and topic.

Competencies ➡	Patient Care			Communication		*and so on*	Total
⬇ Topics	Interpret Diagnostic Studies	Evaluate Treatment Options	*and so on*	Patients / Clients	Other Staff		
Cardiovascular angina pericarditis *and so on*	4	3	…	2	1	…	20
Gastrointestinal acute gastritis appendicitis *and so on*	2	2				…	12
and so on	…	…	…	…	…	…	…
Total	20	15	…	10	8	…	200

Each cell value indicates the number of test items, amount of emphasis, or strength of the linkage.

knowledge, analysis), it is becoming increasingly common for blueprints to consist of competencies from the psychomotor or affective domains (e.g., procedural skills, leadership). For clients that want to adopt a competency framework, I recommend a two-way table of specifications known as a content-by-process matrix. A two-dimensional blueprint provides a good way to apply a competency framework without sacrificing traditional content and KSOAs.

Figure 2 presents a portion of a hypothetical two-way test blueprint in medicine. A two-way blueprint enhances a traditional topic-oriented test blueprint by giving context to the assessment task. Item writers are asked to ensure not only that their test items address certain topics but also that the items require application of some specific competency. Such items are more likely to be job-related. Another nice feature of the content-by-process matrix is that subscores can be reported along both dimensions, assuming that each category has a sufficient number of items to produce reliable subscores. It is possible to add additional dimensions or layers to a content-by-process matrix; however, test blueprints with multiple dimensions usually require a deep item pool and computer-assisted test assembly software.

The two-way test blueprint sometimes ends up being a natural outgrowth of the linkage exercise described above—both attempt to integrate what examinees know with what they are expected to do with that knowledge. The two-way test blueprint might even be regarded as a substitute for the linkage activity. The cells of the matrix specify the linkage between a content area and the competency that requires knowledge of that content. Meanwhile, the number of items in the cell corresponds to the importance of each linkage.

Closing Comments

When a credentialing agency issues a request for proposal (RFP) for a job analysis these days, it likely will specify that the project in some way address competencies. The strategies suggested in this article can be applied alone or in conjunction with each other to add substance to a competency model. I have found these strategies to be useful in my limited experience with CM; however, a few years from now we may find that some were effective while others were not. Or, we may find that competency modeling turned out to be just an interesting diversion.

With all of the limitations of competency modeling, it also is useful to acknowledge some benefits. Including competencies as part of the test blueprint can encourage the development of test items that require application of knowledge rather than simple recognition memory. Also, because of its emphasis on workplace performance, adopting a competency model can trigger a self-reflection process whereby a credentialing agency must critically evaluate the claims it makes about examinees who pass its test and earn a credential. If such claims involve more than cognitive knowledge and skill, then the agency must further reckon with the possibility of adopting innovative or non-traditional assessment formats. Such self-reflection can have a positive impact on test score validity by broadening the constructs we target and the methods for assessing those constructs.

References

Bartram, D. (2005). The Great Eight competencies: A criterion-centric approach to validation. *Journal of Applied Psychology, 90*(6), 1185-1203.

Clauser, A.L. & Raymond, M.R. (2017). Specifying the content of credentialing examinations. In S. Davis-Becker & C.W. Buckendahl (Eds.), *Testing in the Professions* (pp. 64-84). New York, NY: Routledge.

D'Agostino, J., Karpinski, A., & Welsh, M. (2011). A method to examine content domain structures. *International Journal of Testing, 11*(4), 295-307.

Englander, R., Cameron, T., Ballard, A.J., Dodge, J., Bull, J., & Aschenbrener, C.A. (2013). Toward a common taxonomy of competency domains for the health professions and competencies for physicians. *Academic Medicine, 88*(8), 1088-1094.

Fleishman, E.A., & Quaintance, M. (1984). *Taxonomies of human abilities: The description of human tasks*. Orlando, FL: Academic Press.

Frank J.R., Snell, L.S., & Sherbino, J. (2015). *CanMEDS 2015 Physician Competency Framework*. Ottawa, CA: The Royal College of Physicians and Surgeons of Canada.

Glaser, R. (1963). Instructional technology and the measurement of learning outcomes: Some questions. *American Psychologist, 18*(8), 519-521.

Institute of Medicine. (2003). *Health professions education: A bridge to quality*. Washington, DC: National Academies Press.

International Council for Veterinary Assessment (ICVA) and National Board of Medical Examiners (NBME) (2017). *NAVLE Veterinary Profession Practice Analysis*. Bismarck, ND: ICVA. Retrieved November 2017 from: https://www.icva.net/navle-general-information/navle_practice_analysis/

Kane, M.T. (1997). Model-based practice analysis and test specifications. *Applied Measurement in Education, 10*(1), 5-18.

Kyllonen, P. (2016). Designing tests to measure personal attributes and noncognitive skills. In S. Lane, M. Raymond, & T. Haladyna (Eds.). *Handbook of test development*, 2nd ed. (pp. 190-211). New York, NY: Routledge.

Lievens, F., & Sanchez, J.I. (2007). Can training improve the quality of inferences made by raters in competency modeling? A quasi-experiment. *Journal of Applied Psychology, 92*(3), 812-819.

Lievens, F., Sanchez, J.I., & DeCorte, W. (2004). Easing the inferential leap in competency modeling: The effects of task-related information and subject matter expertise. *Personnel Psychology, 75*(4), 891-904.

McClelland, D.C. (1973). Testing for competence rather than for "intelligence." *American Psychologist, 28*(1), 1-14.

Morgeson, F.P., Delaney-Klinger, K., Mayfield, M.S., Ferrara, P., & Campion, M.A. (2004). Self-presentation processes in job analysis: a field experiment investigating inflation in abilities, tasks and competencies. *Journal of Applied Psychology, 89*(4), 674-686.

Prahalad, C.K., & Hamel, G. (1990). The core competence of the corporation. *Harvard Business Review*, May-June, 79-91.

Raymark, P.H., Schmit, M.J., & Guion, R.M. (1997). Identifying potentially useful personality constructs for employee selection. *Personnel Psychology, 50*(3), 723-736.

Raymond, M.R., & Neustel, S. (2006). Determining the content of credentialing examinations. In S.M. Downing & T.M. Haladyna (Eds.). *Handbook of test development* (pp. 181-223). Mahwah, NJ: Lawrence Erlbaum Associates.

Sanchez, J.I., & Levine, E.L. (2009). What is (or should be) the difference between competency modeling and traditional job analysis? *Human Resource Management Review, 19*(2), 53-63.

Schaefer, L., Raymond, M.R., & White, A.S. (1992). A comparison of two methods for structuring performance domains. *Applied Measurement in Education, 5*, 321-335.

Schippmann, J.S., Ash, R.A., Battista, M., Carr, L., Eyde, L.D., Hesketh, B., et al. (2000). The practice of competency modeling. *Personnel Psychology, 53*, 703-740.

Sireci, S.G. & Geisinger, K.F. (1995). Using subject-matter experts to assess content representation: An MDS Analysis. *Applied Psychological Measurement, 19*, 241-255.

Spencer, L.M., McClelland, D.C., & Spencer, S. (1994). *Competency assessment methods: History and state of the art*. Boston: Hay-McBey Research Press.

Swing, S.R. (2007). The ACGME outcome project: Retrospective and prospective. *Medical Teacher, 29*(7), 648–654.

Wang, N., Schnipke, D., & Witt, E.A. (2005). Use of knowledge, skill and ability statements in developing licensure and certification examinations. *Educational Measurement: Issues and Practice, 24*(1), 15-22.