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The use of concept mapping in measurement development and evaluation: Application and future directions

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ABSTRACT

The past decade has seen an increase of measurement development research in social and health sciences that featured the use of concept mapping as a core technique. The purpose, application, and utility of concept mapping have varied across this emerging literature. Despite the variety of uses and range of outputs, little has been done to critically review how researchers have approached the application of concept mapping in the measurement development and evaluation process. This article focuses on a review of the current state of practice regarding the use of concept mapping as methodological tool in this process. We systematically reviewed 23 scale or measure development and evaluation studies, and detail the application of concept mapping in the context of traditional measurement development and psychometric testing processes. Although several limitations surfaced, we found several strengths in the contemporary application of the method. We determined concept mapping provides (a) a solid method for establishing content validity, (b) facilitates researcher decision-making, (c) insight into target population perspectives that are integrated a priori, and (d) a foundation for analytical and interpretative choices. Based on these results, we outline how concept mapping can be situated in the measurement development and evaluation processes for new instrumentation.

1. Introduction

Concept mapping is framed as an inclusive, participatory, collaborative, and inductive social science research process (Kane & Trochim, 2009). The methodology's flexibility is recognized as a strength, and the number of topics for which the method could be applied seems virtually limitless. It enables both detailed idea generation by stakeholders and higher-level conceptual representation. Although sophisticated multivariate analyses are employed, the results are visual and intuitive, thereby enhancing interpretation and use (Kane & Trochim, 2007; Trochim, 1989). Over its 25 year history, concept mapping has been used in an array of fields to develop theory, plan for programs and social interventions, evaluate social programs, and develop measures and scales (Kane & Trochim, 2009).

The foundation for the use of concept mapping in measurement was outlined in the early development and articulation of the method. Drawing from Campbell (1966); Campbell (1986) ideas about the natural coherence between observable patterns in both theory and reality, Trochim (1985) framed social research as a pattern matching exercise that involves correspondence between conceptual and operational domains. This provided the philosophical and epistemological basis for concept mapping as a technique for explicating a conceptual domain. Later writings concentrated on the methodological tenets of concept mapping as an integrated, mixed-methods approach that enabled groups to conceptualize an issue of relevance (Trochim & Linton, 1986; Trochim, 1989). The publication of a special issue in *Evaluation and Program Planning* in 1989 introduced concept mapping to the broader community of evaluators and researchers, and offered a practical and useful conceptualization tool for managing diverse perspectives and distributed group knowledge. Two early studies highlighted the application of concept mapping to measurement development (e.g., scales, measures, questionnaires). Galvin (1989) used the method to organize a stakeholder-produced conceptual framework from which an evaluation questionnaire was directly constructed. In generating additional content of relevance, vander Waal, Casparie, and Lako, 1996 used concept mapping to

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purposefully include representatives of the intended targets of the measure, and emphasized their contributions to the clarity and validity of the instrument. Although these studies lacked a complete description of the practical, step-wise application of concept mapping in the context of traditional scale development and psychometric testing procedures, they suggested the flexibility of the method to support and enhance measurement quality.

Since 2000, a body of measurement development research within the social, behavioral, and health sciences that includes concept mapping as a primary technique has emerged. Several aspects of the method have likely contributed to its presence in the literature. The generation of a large set of ideas, structuring of ideas based on judgments made about their interrelationships, graphical representations of scaled similarities among theoretical ideas, and identification of clustered sets of like items are some practical features that align concept mapping with general approaches for measurement development (Kane & Trochim, 2009). In their contemporary 8-stage mixed-methods framework for instrument development, Velozo et al. (2012) recommended concept mapping as a structured qualitative method for conceptualizing the construct(s) to be measured and developing representative items. They further emphasized the method's value in synthesizing literature findings, operationally defining constructs, and generating hypotheses about the scope and content of the scale. Previous research has demonstrated concept mapping to be a valid and reliable conceptualization approach in general (Rosas & Kane, 2012). However, little guidance or understanding is available on how concept mapping can and should be integrated in the measurement development process. Furthermore, despite the purported epistemological, methodological, and ontological value of concept mapping, little has been done to critically review how researchers have approached the application of the method in applied measurement development research.

To that end, we systematically reviewed the literature on concept mapping to identify where and how the method was applied in the context of measurement development and evaluation. In this review we examine the practice of integrating the concept mapping methodology into processes for establishing new measurement tools in accordance with generally accepted development and testing procedures based on established psychometric principles. From this examination we assess the current practice of using concept mapping in applied measurement development research, noting the strengths, limitations, and future directions for the field.

1.1. Scale and measurement development in social science research

To begin, it is useful to broadly outline the measurement development and psychometric evaluation process within social, behavior, and health sciences research. This multi-step process generally involves the (a) articulation of construct(s) of interest and their context, (b) specification of the response format and selection of the initial items, (c) collection of data from a set of target respondents, and (d) examination of the psychometric properties and determination of quality (DeVellis, 2011; Furr, 2011; Simms, 2008).

Formal development activities are conducted to protect against two types of error: measuring less than the proposed construct (i.e., construct underrepresentation) and measuring more than the proposed construct (i.e., construct irrelevant invariance). Rigor in the process of conceptualization and definition is required to avoid the first type of error. Establishing content validity – the minimum psychometric requirement for measurement adequacy – relies on sufficiently capturing the specific domain of interest, while simultaneously containing no extraneous content (Netemeyer et al., 2003; Schriesheim, Powers, Scandura, Gardiner, & Lankau, 1993). Rigor in psychometric analysis is required to avoid the second type of error. Reliability and validity are fundamental facets of psychometric quality and researchers strive to provide evidence regarding the nature and strength of these characteristics (Furr, 2011). Psychometric quality is further demonstrated in the assessment of the instrument's performance in the sample being studied through results that truly reflect the hypothetical construct(s) it purports to measure (DeVellis, 2011). It is within this ongoing, iterative process, that use of concept mapping as a core method in measurement development and evaluation is reviewed.

2. Method

2.1. Review sample selection

Our review began with a literature search to identify a sample of published studies where concept mapping was employed as a principal method in the measurement development process. Due to the range of fields where concept mapping has been used, we determined a broad search was warranted using several highly-cited publications as sources. We identified three seminal publications, Trochim and Linton (1986), Trochim (1989), and Kane and Trochim (2007) as the most frequently referenced source publications for the concept mapping methodology. Using these three sources as the point of reference, a Google Scholar search returned lists of 152, 894 and 323 other works (i.e., published literature, grey literature, reports, etc.) citing these publications, respectively. We further narrowed the three lists by filtering each through the following search string: “scale development OR measurement OR content validity OR psychometric testing”. This filtering step returned 145, 434, and 99 works, respectively. From these results, we then applied specific criteria for inclusion into our review set. First, the work had to be a published study in a peer-reviewed journal. Second, the study either (a) outlined the development of a conceptual measurement model/framework using concept mapping, or (b) referenced the development of a conceptual measurement model/framework using concept mapping. Third, a new measurement tool was created and psychometrically evaluated, either within the same study or in a subsequent publication. Several studies initially identified specifically mention the use of concept mapping and the construction of a scale based on the results of the process (cf. Armstrong & Steffen, 2009; Iris, DeBacker, Benner, Hammerman, & Ridings, 2012; Shorkey, Windsor, & Spence, 2008; Shorkey, Windsor, & Spence, 2009). However, this group of studies lacked a complete examination of psychometric properties and a separate validation study of the scale could not be found elsewhere in the literature. Thus, they were not included.

2.2. Review sample

In applying the aforementioned criteria, we identified 23 published studies between 2001 and 2014. The use of concept mapping in measurement development and evaluation appears to be a fairly recent practice, with all identified studies occurring after 2000. Two studies identified in the initial query were not included in the review, but are noteworthy. These studies were unique in the application of concept mapping for examining and improving *existing* scales. White and Farrell (2001) used concept mapping with a small sample of experts to revise an original conceptual model and conduct an analysis of secondary data using confirmatory factor analytic techniques to determine the most parsimonious structural representation of items. Sepúlveda Carrillo, Meneses Báez, and Goldenberg, 2014 used concept mapping post-hoc to evaluate the conceptual structure and item sequence of a

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