Paper Title Development of the Effective Mentoring of Student Researchers Scale

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Abstract

Mentoring is a critical aspect of graduate education, but few studies have explored the mentoring behaviors that specifically contribute to effective mentoring, making it difficult to train mentors to behave in a way that optimally supports students' development. The Effective Mentoring of Student Researchers Scale (EMSRS) was developed to identify graduate advisors' key mentoring behaviors. The survey instrument was distributed to graduate students at a large Midwestern university, items were finalized using exploratory factor analysis (principal axis factoring with promax rotation), and confirmatory factor analysis was conducted to confirm the factor structure. We identified four components of effective mentoring, as follows: Engaged, Positive, Professional, and Present. Implications for training new mentors and improving the mentoring of graduate students are discussed.

Purpose

Mentoring is a crucial component of graduate education (Roberts & Sprague, 1995) in which a faculty member teaches, guides, and provides supports to a graduate student (Johnson, 2002). Research suggests that faculty members' mentoring behaviors may influence students' perceptions of the quality of their graduate experience (Lechuga, 2011; Tenenbaum, Crosby, Gliner, 2001), but little is known about specific behaviors that characterize effective mentoring. In this presentation, we discuss development of a reliable and valid instrument to assess key behaviors that characterize effective mentoring in graduate education. This instrument could be potentially used to improve graduate mentoring and fine-tune mentoring trainings for specific groups of mentors.

Perspectives

Literature indicates that students' mentoring experiences are highly related to educational experiences and outcomes. Previous work (Raman, Geisinger, Kemis, & de la Mora, 2015) has shown that specific mentoring actions correlate strongly with overall program satisfaction for undergraduate researchers. At the graduate level, research has demonstrated that students believe mentoring is important, and that mentoring is related to students' overall satisfaction with their graduate school experiences (Clark, Harden, & Johnson, 2000; Tompkins, Brecht, Tucker, Neander, & Swift, 2016; Wilde & Schau, 1991). More specifically, mentoring has been shown to be related to students' academic stress levels (Ülkü-Steiner, Kurtz-Costes, & Kinlaw, 2000), students' research self-efficacy (Paglis, Gree, & Bauer, 2006), students' intention to remain in, or leave, graduate school (Golde, 2005; Jacks, Chubin, Porter, & Connolly, 1983; Ülkü-Steiner, Kurtz-Costes, & Kinlaw, 2000) students' scholarly productivity during graduate school (Hollingsworth & Fassinger, 2002; Reskin, 1979), scholarly productivity after graduate school (Paglis, Gree, & Bauer, 2006), students' decision to pursue a related career after graduation (Ülkü-Steiner, Kurtz-Costes, & Kinlaw, 2000), and students' ability to obtain and succeed in academic positions (Reskin, 1979).

While the literature establishes the importance of mentoring to students, much of the research related to graduate mentoring to date has focused on the effects of mentoring on graduate student experiences. Few studies have focused on specific mentoring behaviors that contribute to effective mentoring. In this study, we discuss the process of validating the Effective Mentoring of Student Researchers Scale (EMSRS) to reliably measure the behaviors of mentors that contribute to effective mentoring.

Methodology and Results

Study 1

Methods. This study was conducted to develop and validate a survey instrument based on previous work (de la Mora et al., 2014, Raman et al., 2015) which identified various actions or dimensions (e.g., attitudes, engagement, accessibility) characterizing key behaviors of successful mentoring. To revise and refine these actions or dimensions, we invited panels of students who worked closely with mentors to help expand on the dimensions previously identified by suggesting items and topics they felt were important in a mentoring relationship. After combining suggestions with the original items and reduction of redundant items, a total of 55 (half were worded negatively, and half were worded positively) items anchored by 1=strongly disagree and 5=strongly agree remained.

The survey was sent to graduate students at a Midwestern university that planned to graduate in summer 2015; a total of 117 students responded (41.9% female, 58.1% male).

Results. A principal axis factor (PAF) with promax (oblique) rotation analysis identified 10 factors with eigenvalues >1.0, explaining over 64% of the variance. Of the 10 factors, only four factors had items with loadings greater than 0.45. One of the 10 factors consisted only of the negatively worded items and the remaining five factors had items with loadings less than 0.30. While results are promising in finding similar factors previously reported (e.g., engagement, attitudes, etc.), there were others issues that needed to be addressed: 1) would we get similar results from graduate students that were in various stages of their studies? 2) would the results differ if we eliminate negatively worded items?

Study 2

Methods. Based on results from study 1, all negatively worded items were phrased positively, and two redundant items were removed, resulting in a revised scale of 53 items. Study 2 involved 1) examination of the initial factor structure of the revised scale, 2) finalizing item selection for factors identified, and 3) determine reliability (i.e., internal consistency) of the items representing the factors identified.

A revised scale was sent to graduate students (n=2712) that did not participate in our previous survey regardless of their expected graduation date in Spring 2016. Of the total 617 valid responses received, 43.6% were female and 56.1% were male; 55.1% were domestic students and 44.9% were international students; 40.6% were master's degree students and 59.4% were doctoral students.

Results. To determine the number of factors that can be extracted from the 53 items, a principal axis factoring (PAF) analyses were conducted employing varimax (orthogonal) and promax (oblique) rotation methods. Varimax rotation assumes factors are uncorrelated, whereas promax rotation assumes some non-zero correlation exists between factors. Our analysis found that correlation coefficients between extracted factors ranged from 0.55 to 0.73, therefore, PAF analysis with promax rotation yielded factors that were more interpretable. PAF with promax rotation yielded a five factors with eigenvalues >1.0 and in combination explained over 64% of the variance.

Items for the final version were selected if they had at least a 0.40 factor loading on the factor (Costello & Osborne, 2005) and if the item loaded on only a single factor (Pett, Lackey, Sullivan, 2003). One of the factors was removed as the item factor loadings were all less than 0.30. Therefore, based on these criteria, 25 items were retained. The four factors identified are *Engaged, Positive, Professional* and *Present*. Descriptions of the factors are as follows:

Engaged (factor one) is comprised of 13 items. This factor reflects students' perception that their major professor is engaged in their work and provides guidance and opportunities for development, including major professor's expectation toward students and academic guidance. Items with the highest loadings on this factors are 1) my major professor's expectations regarding my work are clear, and 2) my major professor takes time to make sure I understand new concepts. The factor loadings of items of this factor

range from 0.43 to 1.00.

Positive (factor two) is comprised of five items. This factor reflects students' perception that their major professor holds positive attitude. Items with the highest loadings on this factor are (1) my major professor is maintains a positive attitude, and (2) my major professor is open-minded. The factor loadings of items of this factor range from 0.72 to 0.89.

Professional (factor three) is comprised of four items. This factor reflects students' perception of their major professor's professionalism and ethical behavior when providing academic guidance. Items with the highest loadings on this factor are (1) my major professor never makes assumptions about my professional abilities due to my gender or ethnicity, (2) my major professor has never asked me to conduct research or manipulate results in a way I feel was unethical. The factor loadings of items of this factor range from 0.41 to 0.69.

Present (factor four) is comprised of three items. This factor reflects students' perception of their major professor's accessibility. Items with the highest loadings on this factor are (1) my major professor is readily available if I have questions, and 2) my major professor and I are able to meet as frequently as I would like. The factor loadings of items of this factor range from 0.74 to 0.89.

Cronbach's alpha indicated adequate levels of reliability for all four subscales: Engaged (α=0.95), Positive (α=0.89), Professional (α=0.75), and Present (α=0.88). The correlations among the four subscales ranged from 0.52 to 0.78, indicating positive association between the four factors.

Study 3

Methods. The purpose of study 3 was to a) replicate the factor structure and reliability results obtained in Study 2 with a different sample, and b) examine the validity of the EMSRS.

In summer 2016, we shared the survey with a different sample of approximately 4344 graduate students. This sample included students that had been omitted unintentionally (i.e., students that indicated they were mostly taking courses online, students that did not want their personal information publically disseminated) and non-respondents from previous studies. Of the 598 valid responses received from students, 50.6% were female, 48.7% were male; 69.2% were domestic students, 30.8 % were international students; 44.6% master's degree students and 55.4% doctoral students.

Results. We conducted a confirmatory factor analysis on the 25 items using a maximum-likelihood estimation method available in Mplus 7.31 (Muthén & Muthén, 1998-2015). As suggested by Hu and Bentler (1999), three fit indices were used to evaluate whether the model fits the data: the comparative fit index (CFI, a value of 0.95 or greater indicates good model fit); the root-mean-square error of approximation (RMSEA, a value of 0.05 or smaller indicates good model fit); and the standardized root-mean-square residual (SRMR, a value of 0.05 or smaller indicates good model fit).

In order to assess whether the four factors identified in Study 2 comprised distinct constructs, we tested a one-factor model. The results of the CFA showed that the one-factor model did not fit to the data: $\chi^2(273, n=598) = 1453.54$, $p<0.001$, CFI=0.88, RMSEA=0.08 (95% CI [0.08, 0.09]), SRMS=0.05, indicating that the 25 items reflect different constructs. We then tested the four-factor model which showed that the model fits to the data well: χ^2 (267, N=598) =718.16, $p<0.001$, CFI=0.96, RMSEA=0.05 (95% CI [0.08, 0.09]), SRMS=0.04.

Cronbach's alpha indicated adequate levels of reliability for all four subscales: Engaged (α=0.95), Positive (α=0.89), Professional (α=0.70), and Present (α=0.84).

After confirming that the 25 items represent four constructs well, we assessed discriminant validity of the EMSRS. Brown (2006) suggests that discriminant validity can be assessed by examining the correlation between factors, and factor correlations greater than 0.85 indicates poor discriminant validity. The correlation coefficients among the four factors (*Engaged, Positive, Professional* and *Present*) ranged from

0.32 to 0.54, providing evidence of discriminant validity of the scale. Further studies are needed to test predictive validity of the mentoring scale on other related student outcomes (e.g., satisfaction with graduate program/mentor).

Scholarly significance

It has been well documented that advisor's mentoring is crucial for graduate education, yet few studies have previously explored the behaviors of mentors that specifically contribute to effective mentoring. This work extends the literature in this field by validating a scale that measures four key behaviors that are critical to successful mentoring in graduate education. The EMSRS could be potentially used to fine-tune mentoring trainings for specific groups of mentors.

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