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Development and Initial Validation of Perceived Research Environment Scale for Higher Education Academics

Dian R. Sawitri[1], Peter A. Creed[2], Harlina Nurtjahjanti[1], and Anggun R. Prasetyo[1]

Abstract

There is a growing interest in the perceived research environment for higher education academics. As there is no existing, psychometrically sound scale that directly measures perceived research environment for higher education academics, we designed and validated the Perceived Research Environment Scale for use with this population. In Phase 1, items were developed based on a review of literature, six focus groups, and expert judgment. In Phase 2, the items were then administered to a sample of Indonesian academics ($N = 306$, M age $= 42.29$ years). Item analysis and exploratory factor analysis were used to reduce the number of items and determine the factor structure. In Phase 3, confirmatory factor analyses were used on a hold-out sample ($N = 292$, M age $= 43.39$) to confirm this structure. In Phase 4, we provided evidence for construct validity. The practical uses of this newly developed scale are discussed.

Keywords

perceived research environment, scale development, academics, university, higher education

Introduction

Education, research, and service are the three key functions characterizing the academic profession in modern-day, higher education systems (Eam, 2015). However, academic research and publications have been increasingly emphasized at most universities around the world, as involvement in research-related activities is recognized as an effective means to upgrade a university's profile (Nguyen, Klopper, & Smith, 2016). Previous studies have demonstrated that engagement in research potentially improves teaching quality and enhances knowledge and competence, and this contributes to high-quality research supervision, which is critical for developing graduate students as independent researchers (Lindsay, Breen, & Jenkins, 2002).

[1]Diponegoro University, Semarang, Indonesia
[2]Griffith University, Southport, Australia

Corresponding Author:
Dian R. Sawitri, Faculty of Psychology, Diponegoro Univeristy, Jalan Prof. Soedarto, S.H., Tembalang, Semarang 50275, Indonesia.
Email: dian.r.sawitri@gmail.com

Reflecting this, there has been a continuing trend for universities in developed countries to increase their focus on research, and this tendency has spread to developing countries, where research is increasingly viewed as a high priority (Nguyen et al., 2016). Consequently, research has become an important function for academics everywhere, as research productivity is now a primary consideration in several important organizational decisions, such as hiring, maintenance of tenure, promotions, and salary increases for academics (Chen, Gupta, & Hoshower, 2006). As academics are required to publish their research results nationally and internationally in high-quality, peer-refereed journals (Nguyen et al., 2016), researchers and administrators have been interested in identifying the predictors of research involvement and performance in academics (e.g., Whelan & Markless, 2012).

This research has shown that, among the factors that influence research productivity, environmental factors are some of the most powerful ones (Bland & Ruffin, 1992), which has led researchers to identify the elements that characterize a good research environment (Holden, Pager, Golenko, & Ware, 2012). Owen (1992) identified four important components of a good research environment: research funding, research infrastructure, having active researchers, and the availability of supportive research administrators. White, James, Burke, and Allen (2012) demonstrated that a good research environment is one that provides opportunities to access key resources and support from colleagues and the wider university. More recently, Nguyen et al. (2016) conducted a qualitative study in Vietnam to examine the affordances, barriers, and motivations that drive research engagement in academics. Financial support for research activities was perceived as the main affordance, teaching load as the main hindrance, and having a collaborative research environment and supportive research policy settings and practices as key motivators for academics to engage in research.

The important role of the research environment for academics is consistent with Bronfenbrenner's (1979, 1986) ecological systems theory. This perspective emphasizes that, compared with the objective environment, perceptions of the environment are of primary significance, because it is these that affect and guide behavior. Bronfenbrenner argued that developing individuals are surrounded by interrelated systems. The inner circle, or microsystem, is where academics have direct, face-to-face contact with significant others, primarily their colleagues. Clusters of microsystems are called mesosystems (e.g., academics talking to colleagues from other departments constitutes a linkage between two systems). Beyond this are settings (i.e., exosystems) that are not experienced directly by the academics, but nonetheless influence their microsystem through links such as communications from management. Bronfenbrenner also described a macrosystem, which incorporated the wider society and culture. The influences here come via policy and reward systems in the university. Bronfenbrenner further proposed a chronosystem, which captures change over time in the characteristics of the individual (e.g., career-related transitions) and environmental change (e.g., national pressure to increase scientific publications and social conditions).

For the individual academic in the research-focused environment, a relational viewpoint, which focuses on the developing individual in a changing context, is considered a useful perspective from which to comprehensively understand occupational and career behaviors (Vondracek, Lerner, & Schulenberg, 1986). These theorists argued that due to the continually changing nature of the individual and the context, a dynamic interactional approach, or a developmental contextual perspective, should be applied to understand occupational and career development. A developmental contextual point of view proposes that the context is not only continually changing, but also that the changes are influenced by the individuals and their characteristics. When considered from this perspective, occupation and career development reflect an interactive process where individuals both affect and are affected by the features of their environment, including social, cultural, and physical conditions.

In line with Bronfenbrenner's (1979, 1986) ecological systems theory and Vondracek et al.'s (1986) person-context relationships proposition, individuals will function better, demonstrate adapted outcomes, and be more satisfied when their characteristics fit the demands of the environment. Individuals with a good person-environment fit are also likely to receive favorable feedback and input from the surroundings. Conversely, mismatched individuals will tend to demonstrate poorer outcomes and receive less positive feedback.

Consistent with the above, Pranulis and Gortner (1985) identified several characteristics of highly productive university departments: faculty competent in research skills, research valued as desirable outcome goal, time for faculty to engage in research activities, compatibility between faculty research activities and organizational mission and goals (i.e., reflected in research support and rewards), support and encouragement of faculty's efforts to seek research funding, administrative support for research, and a psychosocial climate supportive of research and beginning investigators. Duffy, Torrey, Bott, Allan, and Schlosser (2013) interviewed 17 of the most research-productive counseling psychologists in the American Psychological Association. These scholars had received mentorship while in graduate school, chose research topics that they were passionate about, managed their time effectively, had good collaborations with others, had structured strategies for writing, worked in a supportive environment, and spent time outside of work with family or engaged in hobbies. In both these examples, the work environment was one of the main contributing factors. However, despite this, no measure has been created specifically to assess the perceived research environment of university academics.

Previous Measures of Research-Related Environments

While there is no scale suitable to measure the research environment from the perspective of academics in a university setting, Young and Rice (1983) devised the Research Environment Scale, a 24-item, 6-point, Likert-type scale, specifically for nurses. This scale measures aspects of the clinical research environment, such as educational opportunities for nurses to learn about the research process (sample item: "Nurses have qualified mentors for conducting research"). Marsh and Brown (1992) modified this scale by removing six items and applying an 18-item version. Holden et al. (2012) devised the Research Capacity and Culture Tool to measure indicators of research capacity in health professionals at the individual, team, and organization levels. Sample items are "Find relevant literature" (individual level), "Provide resources to support staff research training" (team), and "Has a plan or policy for research development" (organizational; 10-point rating scale).

Previous studies also have demonstrated that the research environment is critical for advancing graduate student productivity (Royalty, Gelso, Mallinckrodt, & Garrett, 1986). For example, the research training environment is an important factor in the training of graduate students in applied areas in psychology (Kahn & Gelso, 1997). Gelso (1979) suggested that there were 10 ingredients in the research training environment that contribute to positive outcomes, including modeling appropriate research behaviors and attitudes, positive reinforcement and support for research efforts, early and minimally threatening involvement in research, decoupling research and statistics, facilitating inward reflection for research ideas, emphasizing that science can be a partly social experience, teaching that all research is flawed and limited in some way, teaching varied investigative approaches to research, teaching how science and clinical practice can be wedded, and focusing on how scholarly activities can be accomplished in practice settings.

Royalty et al. (1986) devised the 45-item Research Training Environment Scale (RTES) to measure nine of the 10 ingredients that Gelso (1979) indicated were influential in promoting students' research interest (focusing on how scholarly activities can be accomplished in practice settings was omitted, as it was considered an advanced skill). Then Gelso, Mallinckrodt, and

Judge (1996) revised this measure by broadening the "decoupling research and statistics" component to "teaching relevant statistics and the logic of research design." A sample item for this in their 54-item Research Training Environment Scale–Revised (RTES-R) is "My advisor offers much encouragement to me for my research activities and accomplishments."

Kahn and Gelso (1997) introduced the idea of instructional and interpersonal factors within the research training environment. Interpersonal factors included early involvement, faculty modeling, positive reinforcement, and research as a social experience; and instructional factors included that all experiments are flawed, looking inward, teaching relevant statistics, varied investigative styles, and wedding of science and practice. Kahn and Miller (2000) created a short, 18-item form of the RTES-R by selecting one positively worded item and one negatively worded item from each subscale based on corrected item-total correlations.

To the authors' knowledge, a perceived research environment scale suitable for academics has yet to be published in the peer-reviewed literature. We addressed this gap by designing a brief, multidimensional, and psychometrically sound instrument that could be applicable to universities and other research institutions regardless of specific disciplines.

Present Study

We employed a standard, classic test development approach (cf. DeVellis, 2016) to develop and provide initial validation for the Perceived Research Environment (PRE) Scale for academics. We conducted a literature review to determine the underlying domains for the construct and held focus group discussions with higher education academics to validate these domains and ensure that the items developed would be specific to the population's experience. The independent reviewers who rated the suitability of the items consisted of one professor in psychology who had expertise in career development and test development and three doctoral-level psychology academics who had expertise in test development. They independently reviewed the discussions and determined the core ideas, and the team met to synthesize the results. The team identified five salient aspects of beneficial social relationships, positive reinforcement, support, encouragement, and role modeling.

Next, we generated a list of approximately 70 items, had a group of experts rate them to examine their content validity, and administered the items along with supporting validity scales to a large sample of university-based academics. We then used item and exploratory factor analysis (EFA) on one half of the data to trim the number of items to 25 and determine the factor structure, and applied confirmatory factor analyses (CFA) on the second half of the data to confirm the factor structure. Reliability and initial validity were then assessed.

Phase 1—Item Development

The aim of this phase was to create sufficient items to form the basis for the new scale, which was anticipated, for practical research purposes, to be approximately 25 items in length. We wrote approximately twice as many items as would appear in the final measure (Hinkin, 1998; Kline, 2000). Items were generated based on a review of the literature (e.g., Gelso, 1979) and a series of six focus groups, where we engaged with target participants, validated the underlying domains of the construct identified in the literature review, and enhanced content validity of the scale items (Vogt, King, & King, 2004). The 42 academics included in the focus groups consisted of six professors, 12 associate professors, 12 assistant professor, six lecturers, and six junior lecturers from one large state university in Central Java, Indonesia, who were requested to reflect on and discuss their own experiences and to give their opinions regarding characteristics of their university environment that might motivate or impede them in the conduct of research-related activities. We recorded the focus groups for later reference.

From the focus groups, we confirmed the five broad domains of perceived research environment, which were consistent with those identified from the literature review for being salient to academics (i.e., beneficial social relationships, positive reinforcement, support and expectations, focus on research, and having positive role models). We then created 70 positively worded items (i.e., to minimize response bias; Salazar, 2015), which were written in English to represent these five domains. Four independent reviewers rated the suitability of each item to reflect a specific dimension of the construct. We removed 10 items that were considered overlapping or irrelevant, and adjusted several others, leaving a final list of 60 items.

Following Ægisdóttir, Gerstein, and Cinnarbas (2008), the first author translated the items into Bahasa Indonesia, and two Indonesian academics examined the written expression. The items were then back-translated blindly into English by two bilingual Indonesian academics. All authors compared the back-translated versions with the originals and adjusted the inaccuracies. The final items were then piloted with five Indonesian academics to check for readability.

Phase 2—Item Analysis and EFA

The aim of this phase was to identify items to be retained in the scale and to determine the final factor structure. We used item analysis and EFA procedures.

Method

Participants

We obtained data from 598 academics who were recruited from four universities in Central Java, Indonesia, and divided this sample into two subsamples using a random split procedure to allow for a cross-validation test of results and to reduce sample-specific effects that could potentially influence reliability and validity (Byrne, 2010). Sample A from the split ($N = 306$) was used for Phase 2, and Sample B ($N = 292$) was used for Phase 3 and Phase 4. All academics in this setting had research components to their roles.

Sample A consisted of 50.3% female academics (3.9% did not report gender), whose mean age was 42.29 years ($SD = 10.12$; 52.3% did not report age). A large majority (69.3%) had a master's degree and 21.6% a doctorate (9.2% did not report education level). Only a small proportion (1.3%) were professors, 22.5% were associate professors, 27.8% assistant professors, 16% lecturers, and 4.6% junior lecturers (27.8% did not report position). The mean tenure was 16.57 years ($SD = 10.04$; 14.5% did not report tenure).

Sample B consisted of 54.1% female academics (3.4% did not report gender). The mean age was 43.39 years ($SD = 9.74$; 49% did not report age), most (62.7%) had a master's degree and 29.5% a doctorate (7.9% did not report education level). One percent were professors, 20.5% associate professors, 35.6% assistant professors, 15.4% lecturers, and 3.1% junior lecturers (24.3% did not report position). Mean tenure was 16.68 years ($SD = 9.67$; 13% did not report tenure).

There were no differences between Sample A and Sample B on any of the demographic variables: age, $t(1060) = 0.46$, $p = .65$, gender, $\chi^2(1) = 0.82$, $p = .37$, tenure, $\chi^2(2) = 6.93$, $p = .06$, level of education $\chi^2(2) = 0.20$, $p = .65$, and institution $\chi^2(3) = 6.31$, $p = .10$. The total scores of the research involvement scale items for Sample A and Sample B did not differ significantly, $t(596) = –.33$ ($p = .74$).

Materials

The 60 items generated in Phase 1, which were expected to reflect the five domains of PRE, were administered in a questionnaire along with the organizational Culture/Support for Research Scale

and the Research Involvement Scale, which were used to test for construct validity. Higher scores reflect higher levels of each construct.

Perceived research environment. This was assessed using the 60 items generated in Phase 1. Example items: "At my university, academics often informally discuss research ideas in their day-to-day discussions" (beneficial social relationship), "At my university, successful researchers have high status" (positive reinforcement), "My university assists researchers to publish by helping them with manuscript preparation (e.g., writing workshops)" (support and expectations), "At my university, academics think research is important" (focus on research), and "At my university, many academics publish their research in high-quality academic journals" (positive role models); 6-point scale of 1 = *strongly disagree* to 6 = *strongly agree*.

Organizational culture/support for research. We used the 20-item Organizational Culture/Support for Research Scale (OCSR; Kortlik, Bartlett, Higgins, & Williams, 2002) to assess academics' perceptions of the organizational culture or support for conducting research. A sample item from this measure is "My peers support my efforts to publish in refereed research journals"; 6-point scale of 1 = *strongly disagree* to 6 = *strongly agree*. Cronbach's alpha was reported as .88, and validity was supported by finding positive correlations with scales of research confidence (Kortlik, Bartlett, Higgins, & William, 2002).

Research involvement. We used the 24-item Research Involvement Scale (RI; Whelan et al., 2013) to assess participants' level of engagement in research. A sample item from this measure is "Participating in research as part of a collaborative team"; 6-point scale from 1 = *not at all* to 6 = *a great deal*. Cronbach's alpha has been reported as .98, and construct validity has been supported by finding positive correlations with evidence of greater research output (Whelan, Copeland, Oladitan, Murrells, & Gandy, 2013).

Procedure

The survey was administered by the chief researchers and assistants during working hours. This study was conducted with approval from the authors' university ethics committee, and participants gave their permission to participate.

Results

Item Analysis

We assessed item skew to identify any item whose distribution indicated floor or ceiling effects; the inter-item correlations to identify any pairs of items that were too highly correlated ($r \geq .80$), which might indicate redundancy; the corrected item-total correlations to identify any items with a weak or negative correlation with the total scale ($r < .30$), which might indicate items that were not tapping the construct of PRE; and age, gender, position, tenure, and level of education in relation to each item to identify items that might be responded to differently depending on demographic variables (Kline, 2000). No items were identified as problematic; thus, no items were eliminated.

EFA

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy (.94) and statistically significant Bartlett's test of sphericity ($p < .001$) confirmed that the 60 items were suitable for factor analysis. The common variance is of interest in determining the underlying factor structure; thus,

we used common factor analysis (i.e., principal-axis factor analysis; Hair, Black, Babin, & Anderson, 2010). As the five anticipated factors were expected to be correlated aspects of an overall perceived environment measure, we utilized a direct oblimin rotation (Hair et al., 2010). Following Hayton, Allen, and Scarpello (2004), we used several criteria to determine the number of factors: the scree plot, Velicer's minimum average partial test, parallel analysis (O'Connor, 2000), at least three items loading on a factor (Costello & Osborne, 2005), and factor interpretability (Hinkin, 1998).

In the first EFA, the scree plot indicated five factors with eigenvalues > 1.0. Velicer's minimum average partial test and the parallel analysis also suggested a five-factor solution. The first eigenvalues were 14.93, 5.20, 2.38, 1.83, and 1.61. We accepted this solution as these five groupings were interpretable theoretically and reflected the five domains initially identified. Then, 35 items were deleted from the solution because their factor loadings were $<.4$ and/or less than twice as strong on the appropriate factor as on other factors, or they did not load meaningfully on any factor (Hinkin, 1998). The final five-factor solution accounted for 65.58% of the variance: Factor 1 = 32.94%, Factor 2 = 15.56%, Factor 3 = 6.81%, Factor 4 = 5.40%, and Factor 5 = 4.86%. Table 1 displays the results of the item analysis and Table 2 displays factor loadings and eigenvalues.

Factor 1 (five items; "beneficial social relationship") represents the situation where individuals perceive that their social relationships support their participation in research ($\alpha = .88$, $M = 23.01$, $SD = 3.85$). Factor 2 (five items; "positive reinforcement") refers to the situation where individuals perceive positive social and nonsocial reinforcement for achievements in research ($\alpha = .92$, $M = 20.62$, $SD = 5.90$). Factor 3 (five items; "support and expectations") reflects perceived support and expectations from the university for conducting research ($\alpha = .86$, $M = 24.85$, $SD = 3.21$). Factor 4 (5 items; "focus on research") includes perceived emphasis on research-related activities ($\alpha = .92$, $M = 22.69$, $SD = 4.53$). Factor 5 (5 items; "positive role models") reflects perceived availability of positive research role models ($\alpha = .89$, $M = 21.81$, $SD = 4.36$). The correlations among the five factors (range .10 to .47; all $p < .001$) were in line with the results from the EFA indicating that the subscales were somewhat independent, but with overlap among them. Cronbach's alpha for the full scale was .92.

Phase 3: CFA

This phase aimed to validate the factor structure of the PRE Scale with Sample B. Using CFA (AMOS Version 4.0; Arbuckle & Wothke, 1995). We examined the 5-factor structure identified in Phase 2, and then compared this model with a one-factor model, a hierarchical, second-order model, and a bifactor model (Reise, Bonifay, & Haviland, 2013). In Sample B, Cronbach's alpha for the full scale was .93 ($M = 112$, $SD = 16.65$), Factor 1 ($\alpha = .90$, $M = 22.87$, $SD = 4.29$), Factor 2 ($\alpha = .94$, $M = 20.36$, $SD = 6.22$), Factor 3 ($\alpha = .87$, $M = 24.44$, $SD = 3.70$), Factor 4 ($\alpha = .91$, $M = 22.53$, $SD = 4.80$), and Factor 5 ($\alpha = .89$, $M = 21.79$, $SD = 4.59$).

We used the χ^2 statistic, the normed χ^2 (χ^2/df), the comparative fit index (CFI), Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA) to examine model fit. A significant χ^2, $\chi^2/df < 3.0$, CFI and TLI values $> .92$, and RMSEA $< .08$ indicate satisfactory fit when sample size > 250 and observed variables number between 12 and 30. We then compared the different models using the χ^2-difference test and the Akaike information criterion (AIC), where the lower value indicates a better fit (Hair et al., 2010).

The five-factor model identified in Phase 2 generated satisfactory fit statistics (see Table 3 for fit statistics for all models). All factor loadings were statistically significant ($p < .001$) and ranged from .72 to .84 (beneficial relationship), .83 to .91 (positive reinforcement), .55 to .89 (support and expectations), .76 to .89 (focus on research), and .70 to .89 (positive role models). Correlations among the latent variables ranged from .10 to .62.

Table 1. Factor Loadings for the PRE Scale; Sample A ($N = 306$).

Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
1. At my university, academics are willing to involve their colleagues in research projects	**.86**	−.10	−.04	−.07	−.01
2. At my university, academics support one another in their research projects	**.83**	.11	.13	−.04	.01
3. At my university, academics often informally discuss research ideas in their day-to-day discussions	**.83**	−.09	−.04	.03	−.01
4. There is a sense at my university that academics enjoy their research activities	**.71**	.06	.04	.05	.22
5. At my university, researchers actively involve students in their research projects	**.70**	−.09	−.01	.20	−.01
6. My university rewards successful researchers	.03	**−.90**	−.01	.07	.01
7. My university is well known for its research expertise	−.01	**−.89**	.01	−.03	.04
8. At my university, researchers who do well are highly respected by their colleagues	.04	**−.85**	.09	−.01	−.02
9. At my university, there are incentives for successful research activities (e.g., getting published or obtaining a research grant)	−.01	**−.83**	.03	.11	−.09
10. At my university, we all celebrate when a colleague is successful (e.g., gets published or obtains a research grant)	.08	**−.76**	.13	−.09	.11
11. My university sets clear expectations regarding research output for academics	.01	.01	**.82**	−.06	.01
12. My university has specific programs and funds to help new academics get their research started	.04	.01	**.79**	−.02	.05
13. My university assists researchers to publish by helping them with manuscript preparation (e.g., writing workshops)	−.01	−.03	**.78**	.02	−.03
14. My university has clear expectations that academics will engage in research	.09	−.08	**.76**	.07	−.05
15. Academics at my university know it is expected of them that they attend conferences and present their research	−.08	−.07	**.68**	.11	−.05
16. At my university, academics are encouraged to use a wide variety of research methods in their research	−.01	.05	.06	**−.91**	−.01
17. At my university, researchers are always on the look-out for research collaborators	.06	−.02	.04	**−.86**	.03
18. At my university, academics think research is important	.03	.02	.03	**−.85**	−.04
19. At my university, new faculty members are encouraged to publish as soon as they commence work	−.05	−.14	−.08	**−.79**	.09
20. At my university, the opportunity for academics to actualize themselves in research is wide	.08	.16	.08	**−.78**	.07
21. Academics at my university give high priority to their research	.02	.04	.14	−.03	**.86**
22. At my university, many academics publish their research in high-quality academic journals	.01	−.03	−.06	−.01	**.86**
23. Academic at my university are strongly focused on research	−.13	.03	−.05	.09	**.83**
24. Academics at my university strive to publish their research in high-quality journals	.13	.01	.10	−.01	**.77**
25. Many academics at my university are working on important research projects	.14	−.05	.01	.04	**.70**
Eigenvalues	8.57	4.21	2.06	1.69	1.55
% variance explained	32.94	15.56	6.81	5.40	4.86

Note. Main loadings highlighted in bold. PRE = Perceived Research Environment; Factor 1 = Beneficial social relationships; Factor 2 = Positive reinforcement; Factor 3 = Support; Factor 4 = Encouragement; Factor 5 = Role model.

Table 2. Results of Item Analyses; Sample A ($N = 306$).

Item	Skewness	Kurtosis	*M*	*SD*	Item-total correlation
1	−1.18	2.00	4.57	0.93	.62
2	−1.20	2.43	4.61	0.97	.64
3	−1.05	1.48	4.56	0.97	.51
4	−0.73	1.17	4.61	0.83	.63
5	−0.97	1.16	4.66	0.97	.62
6	−0.90	0.14	4.20	1.35	.63
7	−0.81	0.10	4.05	1.36	.55
8	−1.17	0.63	4.28	1.32	.56
9	−0.99	0.29	4.21	1.34	.52
10	−0.55	−0.43	3.88	1.34	.65
11	−0.69	0.93	4.96	0.78	.41
12	−0.80	1.17	5.15	0.73	.37
13	−0.78	0.38	4.96	0.92	.39
14	−0.68	0.70	4.90	0.83	.50
15	−0.58	0.79	4.87	0.76	.39
16	−1.08	1.32	4.52	1.03	.73
17	−0.83	1.10	4.44	1.02	.72
18	−1.08	1.38	4.67	1.08	.65
19	−0.81	0.71	4.41	1.03	.69
20	−1.08	1.14	4.53	1.08	.74
21	−0.34	0.03	4.08	1.02	.41
22	−0.35	−0.46	4.20	1.20	.33
23	−0.55	0.15	4.35	1.06	.56
24	−0.61	0.22	4.52	1.01	.58
25	−0.69	0.91	4.66	0.92	.51

The second-order model (correlations with second-order factor = .43 to .87) and the bifactor model, but not the one-factor model, also had satisfactory fit statistics. However, the best-fitting model was the bifactor model, which was statistically different from the five-factor model, and generated the lowest AIC. Item loadings here for Factor 1 ranged from .28 to .62, Factor 2 from .80 to .89, Factor 3 from .30 to .80, Factor 4 from .53 to .80, and Factor 5 from .32 to .55. Item loading for the perceived research environment bifactor ranged from .35 to 77. The bifactor model included a general latent variable (i.e., dependent on all 25 items) and five subscale latent variables (i.e., five uncorrelated factors dependent on their respective five items). This model showed that each item is an indicator of both a total and subscale aspect, with the results for the total variable representing common sources of variance after controlling for subscale variances, and the subscale variables representing variances after controlling for the total variance (Reise et al., 2013).

As our results supported multidimensionality of the scale (i.e., the five-factor, second-order, and bifactor models all had acceptable fit statistics), it needed to be determined whether the scale should best be interpreted at the global or subscale level. To do this, we calculated the bifactor model-based reliability estimates and compared the variances explained for the total and subscale interpretations. Following Rodriguez, Reise, and Haviland (2016), we used the Bifactor Indices Calculator (Dueber, 2017) to compute Omega, OmegaH, Relative Omega, and the explained common variance (ECV). Omega, the estimate of the proportion of variance accounted for when

Table 3. Model Fit Indices of the Three-Factor, One-Factor, Second-Order Factor, and Bifactor Models for Sample B ($N = 292$).

Model	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA	χ^2_{Diff}	AIC
5-factor	559.69***	256	2.19	.94	.94	.06	—	697.69
1-factor	2324.78***	270	8.61	.63	.59	.16	$p < .001$	2434.78
2nd order	749.03***	269	2.78	.91	.90	.08	$p < .001$	861.03
Bifactor	513.33***	244	2.10	.95	.94	.06	$p < .001$	675.33

Note. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; χ^2_{Diff} statistics refer to differences with five-factor model; AIC = Akaike information criterion.
***$p < .001$.

considering all items in a factor, was .96 (general factor), and .91, .94, 86, .92, and .90 (specific factors), indicating high reliability for the general factor and sound to high reliability for the specific factors, and suggesting all factors have acceptable reliability. OmegaH, the proportion of unique variance explained by a factor, was .71 (general factor), and .37, .62, and .52, .62, and .25 (specific factors). Relative Omega, the proportion of reliable variance in the multidimensional composite due to a factor, was .74 (general factor), and .41, .68, .60, .67 and .28 (specific factors), indicating the majority of reliable variance in the total scores resides within the general factor. Last, the ECV, the proportion of all common variance explained by a factor, was .40 (general factor), and .09, .21, .10, .14, and .06 (specific factors), suggesting a moderately strong global factor, with much less variance explained by the specific factors. Thus, it can be concluded that interpretation at the total level (and not the subscale level) will give the more useful measure of PRE, as the total factor will account for more meaningful levels of variance in the construct.

Phase 4: Construct Validity

This phase aimed to evaluate the initial construct validity of the scale by correlating scores from the PRE Scale with scores from the organizational Culture/Support for Research and Research Interest Scales. Individuals who reported stronger research training environments were more likely to perceive their environment to be more research supportive (Kahn & Miller, 2000), and those who perceived a more research supportive work environment were more likely to report a positive attitude toward research and greater research engagement (Royalty et al., 1986). Thus, we expected the PRE Scale to be associated positively with the OCSR and RI Scales. These analyses were conducted using Sample B ($N = 292$). All correlations were statistically significant and in the expected directions, as reported in Table 4. The results demonstrated that the PRE Scale was associated with the two other constructs as expected, supporting convergent validity.

Discussion

We devised and reported initial validity evidence for a psychometrically sound, 25-item scale to assess PRE for higher education academics: The Perceived Research Environment (PRE) Scale. We operationalized PRE as the organizational environment perceived by academics, which enables and supports them to learn and conduct research-related activities and yield scientific publications. The salient domains identified were beneficial social relationships, positive reinforcement, support and expectations, focus on research, and positive role models. Content validity was supported by a review of the literature, focus groups, pilot testing, and use of expert reviewers, whereas construct validity was supported by the EFAs and CFAs, which indicated that the new scale reflected the five anticipated intercorrelated domains. The PRE scale is internally

Table 4. Summary Data for Sample B ($N = 292$; Correlations Above Diagonal).

Indonesian												
Scale	*M*	*SD*	Range	α	1	2	3	4	5	6	7	8
1. Full scale	112.00	16.65	28-145	.93	—	.81***	.65***	.63***	.80***	.64***	.47***	.49***
2. Subscale 1 (beneficial social relationship)	22.87	4.29	5-30	.90		—	.40***	.48***	.52***	.54***	.30***	.35***
3. Subscale 2 (positive reinforcement)	20.36	6.22	5-30	.94			—	.12*	.49***	.10*	.14*	.24**
4. Subscale 3 (support and expectations)	24.44	3.70	6-30	.87				—	.38***	.49***	.38***	.32***
5. Subscale 4 (focus on research)	22.53	4.80	5-30	.91					—	.39***	.54***	.58***
6. Subscale 5 (positive role models)	21.79	4.59	5-30	.89						—	.35***	.27**
7. organizational culture/support for research	67.24	15.40	24-144	.93							—	.54***
8. Research involvement	100.82	21.12	18-108	.97								—

*$p < .05$. **$p < .01$. ***$p < .001$.

reliable, and the positive associations with the organizational Culture/Support for Research and the Research Interest Scales support its convergent validity. Last, CFA model comparisons suggested that it can be applied most productively at the global, rather than subscale, level.

Previous research has shown the importance of PRE for academics and research institutions (e.g., Duffy et al., 2013). The present study provided a comprehensive measure of PRE, which assesses all identified aspects of the PRE construct. At 25 items, the scale is practical and will be suitable to be used simultaneously with other scales in both research and practice. Extending PRE research using this scale has the potential to add to our knowledge and understanding of the PRE from the perspective of higher education academics, for example when designing research studies, identifying its nomological network, and examining its across-time correlates.

Practitioners can use the scale for conducting systems-level needs assessments and planning for departmental/organizational change. The PRE Scale also will be of use to those who work with academics at any stage of their career when they have issues with research-related interest and performance. The scale will be helpful to show to academics so that they can explore the supports and barriers that are influencing their research-related progress and achievement. This could be helpful for both early-career academics and those at mid- and late-career stages. At the organizational level, the scale can be used for human resource mapping as a foundation for formulating policies at department, research center, and university levels, and for identifying strategies that might be helpful to foster a more research-focused academic environment.

Limitations

Our study was conducted using a sample of higher education academics from several universities in Central Java. Hence, the conclusions of this study need to be tested on other academic populations. We examined content and construct validity of the scale, and future researchers could focus on establishing predictive validity by, for example, testing the longitudinal associations between scores on the scale at one point in time and subsequent outcomes. We showed that the scale was unrelated to several demographic variables (e.g., age, gender, tenure, level of education, and institutions), suggesting no inherent bias based on these characteristics; however, we had missing demographic data, and future studies need to confirm this and examine structural invariance on these and other variables to support the usefulness of the scale.

We only had a very small number of professors in the samples, and the number of associate professors, assistant professors, lecturers, and junior lecturers were not proportional. Future studies need to consider the proportions in their samples when collecting data on academics, as this might affect responses regarding perceived research environment.

Finally, further developments, such as testing the relationships with other constructs, measures, and criterion variables would be useful to establish the nomological network and construct validity of scores from this measure.

Conclusion

This research demonstrated support for a scale to measure PRE in higher education academics, although future studies are needed to extend support for its validity and to test its applicability on more diverse populations. Our findings contribute to the body of literature on academic PRE, and open the way for improved career counseling for academics, research development interventions, and organizational policies.

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References

Ægisdóttir, S., Gerstein, L. H., & Cinnarbas, C. D. (2008). Methodological issues in cross-cultural counseling research: Equivalence, bias, and translations. *The Counseling Psychologist*, *36*, 188-219. doi:10.1177/0011000007305384

Arbuckle, J. L., & Wothke, W. (1995). *Amos 4.0 user's guide*. Chicago, IL: Small Waters.

Bland, C. J., & Ruffin, M. T. (1992). Characteristics of a productive research environment: Literature review. *Academic Medicine*, *67*, 385-397. doi:10.1097/00001888-199206000-000-10

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Bronfenbrenner, U. (1986). Recent advances in research on the ecology of human development. In R. K. Silbereisen, K. Eyferth, & G. Rudinger (Eds.), *Development as Action in Context: Problem Behavior and Normal Youth Development* (pp. 287 – 309). New York, NY: Spronger-Verlag.

Byrne, B. (2010). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. New York, NY: Routledge.

Chen, Y., Gupta, A., & Hoshower, L. (2006). Factors that motivate business faculty to conduct research: An expectancy theory analysis. *Journal of Education for Business*, *81*, 179-189. doi:10.3200/JOEB.81.4.179-189

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation*, *10*, 1-9. Retrieved from http://pareonline.net/pdf/v10n7.pdf

DeVellis, R. F. (2016). *Scale development: Theory and applications* (Vol. 26). Los Angeles, CA: Sage.

Dueber, D. M. (2017). *Bifactor indices calculator: A Microsoft excel-based tool to calculate various indices relevant to bifactor CFA models*. Retrieved from http://sites.education.uky.edu/apslab/resources/

Duffy, R. D., Torrey, C. L., Bott, E. M., Allan, B. A., & Schlosser, L. Z. (2013). Time management, passion, and collaboration: A qualitative study of highly research productive counseling psychologists. *The Counseling Psychologist*, *41*, 881-917. doi:10.1177/0011000012457994

Eam, P. (2015). Investigating relationship among research self-efficacy, research outcome expectations, and research interest of Cambodian faculty: Testing social-cognitive theory. *International Journal of Sociology of Education*, *4*, 199-224. doi:10.17583/rise.2015.1752

Gelso, C. J. (1979). Research in counseling: Methodological and professional issues. *The Counseling Psychologist*, *8*, 7-35.

Gelso, C. J., Mallinckrodt, B., & Judge, A. B. (1996). Research training environment, attitude toward research, and research self-efficacy: The revised Research Training Environment Scale. *The Counseling Psychologist*, *24*, 304-322. doi:10.1177/0011000096242010

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate data analysis. *A global perspective*. (7th ed.). New Jersey, NJ: Prentice Hall.

Hayton, J. C., Allen, D. G., & Scarpello, V. (2004). Factor retention decisions in exploratory factor analysis: A tutorial on parallel analysis. *Organizational Research Methods*, *7*, 191-205. doi:10.1177/1094428104263675

Hinkin, T. R. (1998). A brief tutorial on the development of measures for the use in survey questionnaires. *Organizational Research Methods*, *1*, 104-121. doi:10.1177/109442819800100106

Holden, L., Pager, S., Golenko, X., & Ware, R. S. (2012). Validation of the Research Capacity and Culture (RCC) tool: Measuring RCC at individual, team, and organisation levels. *Australian Journal of Primary Health*, 18, 62-67. doi:10.1071/PY10081

Kahn, J. H., & Gelso, C. J. (1997). Factor structure of the Research Training Environment Scale–Revised: Implications for research training in applied psychology. *The Counseling Psychologist*, *25*, 22-37. doi:10.1177/0011000097251004

Kahn, J. H., & Miller, S. A. (2000). Measuring global perceptions of the research training environment using a short form of the RTES-R. *Measurement and Evaluation in Counseling and Development*, *33*, 103-119. Retrieved from https://search.proquest.com/docview/195607998?pq-origsite=gscholar

Kline, P. (2000). *The handbook of psychological testing* (2nd ed.). London, England: Routledge

Kortlik, J. W., Bartlett, J. E., II, Higgins, C. C., & Williams, H. A. (2002). Factors associated with research productivity of agricultural education faculty. *Journal of Agricultural Education*, *43*, 1-10. doi:10.5032/jae.2002.03001

Lindsay, R., Breen, R., & Jenkins, A. (2002). Academic research and teaching quality: The views of undergraduate and postgraduate students. *Studies in Higher Education*, *27*, 309-327. doi:10.1080/03075070220000699

Marsh, G. W., & Brown, T. L. (1992). The measurement of nurses' attitudes towards nursing research and the research environment in clinical settings. *Journal of Clinical Nursing*, *1*, 315-322. doi:10.1111/j.1365-2702.1992.tb00425.x

Nguyen, Q., Klopper, C., & Smith, C. (2016). Affordances, barriers, and motivations: Engagement in research activity by academics at the research-oriented university in Vietnam. *Open Review of Educational Research*, *3*, 68-84. doi:10.1080/23265507.2016.1170627

O'Connor, B. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods*, *32*, 396-402. doi:10.3758/bf03200807

Owen, M. (1992). Research at small Canadian universities. *The Canadian Journal of Higher Education*, *22*, 1-14. Retrieved from http://journals.sfu.ca/cjhe/index.php/cjhe/article/view/183130/183106

Pranulis, M. F., & Gortner, S. R. (1985). Researchmanship: Characteristics of productive research environments in nursing. *Western Journal of Nursing Research*, *7*, 127-131. doi:10.1177/009200 55X8500700112

Reise, S. P., Bonifay, W. E., & Haviland, M. G. (2013). Scoring and modeling psychological measures in the presence of multidimensionality. *Journal of Personality Assessment*, *95*, 129-140. doi:10180/00223891.2012.725437

Rodriguez, A., Reise, S. P., & Haviland, M. G. (2016). Evaluating bifactor models: Calculating and interpreting statistical indices. *Psychological Methods*, *21*, 137-150. doi:10.1037/met0000045

Royalty, G. M., Gelso, C. J., Mallinckrodt, B., & Garrett, K. (1986). The environment and the student in counseling psychology: Does the research training environment influence graduate students' attitudes toward research? *The Counseling Psychologist*, *14*, 9-30. doi:10.1177/0011000086141002

Salazar, M. (2015). The dilemma of combining positive and negative items in scales. *Psicothema*, *27*, 192-199. doi:10.7334/psicothema2014.266

Vogt, D. S., King, D. W., & King, L. A. (2004). Focus groups in psychological assessment: Enhancing content validity by consulting members of the target population. *Psychological Assessment*, *16*, 231-243. doi:10.1037/1040-3590.16.3.231

Vondracek, E W., Lerner, R. M., & Schulenberg, J. E. (1986). *Career development: A life-span developmental approach*. Hillsdale, NJ: Erlbaum.

Whelan, K., Copeland, E., Oladitan, L., Murrells, T., & Gandy, J. (2013). Development and validation of a questionnaire to measure research involvement among registered dietitians. *Journal of the Academy of Nutrition and Dietetics*, *113*, 563-568. doi:10.1016/j.jand.2012.08.027

Whelan, K., & Markless, S. (2012). Factors that influence research involvement among registered dietitians working as university faculty: A qualitative interview study. *The Academy of Nutrition and Dietetics*, *112*, 1021-1028. doi:10.1016/j.jand.2012.03.002

White, C. S., James, K., Burke, L. A., & Allen, R. S. (2012). What makes a "research star"? Factors influencing research productivity of business faculty. *International Journal of Productivity and Performance Management*, *61*, 584-602. doi:10.1108/17410401211249175

Young, K., & Rice, M. (1983, January). Measurement of attitudes toward the nursing research environment in the university setting. *Paper presented at the First Annual Scientific Meeting on Research on Nursing Education*. San Francisco, CA. January.