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Psychometric analysis of lecturers' self-efficacy instrument

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The Lecturers' Self-Efficacy instrument was administered to 106 lecturers in a Teacher Education Institute. About 36.8% of the respondents are male and 63.2% are female. The aim of this study is to test the psychometric properties of Lecturers' Self-Efficacy instrument (LSE). The LSE with 80 items measures self-efficacy and it uses anchors of 'not confident at all' and 'very confident' on a 7-point scale. The data derived from a teacher training institution were subjected to Principal Component Analysis with Varimax rotation. The analysis extracted three distinct factors: (1) teaching, (2) research and (3) service. These three factors explained most of the variance (69.39%). The reliability coefficient was determined using Cronbach Alpha that showed the coefficient is .98. The results clearly documented that LSE has adequate convergent validity and discriminant validity as well as high level of construct reliability. Practical implications and direction for future research using the LSE for lecturers are also discussed.

Keywords: self-efficacy, lecturer, construct validity, Principal Component Analysis

Introduction

Psychometric analysis is always performed to validate instruments measuring psychological constructs to ensure the validity and reliability of the instrument and interpretability of the information obtained (Linn & Gronlund, 1995). Principal Component Analysis is one of the frequently used methods to perform the psychometric analysis. The aim of this study is to examine the psychometric soundness of Lecturers' Self-Efficacy instrument (LSE) using Principal Component Analysis.

Higher educational institutions in Malaysia are geared towards achieving excellence in all aspects of education to realise the vision and mission of the Ministry of Higher Education Malaysia (MOHE). One of the main areas of concern of these institutions is their human resource capacity (Hamid, Leen, Pei & Ijab, 2008). The human resource capacity in these universities is measured mainly in three areas, namely teaching, research and academic services (Simrit, 2009; Hemmings & Kay, 2009; Simrit & Chapman, 2008; Kauchak & Eggen, 2005). Each university has set Key Performance Indicators (KPI) for their lecturers, and the weights vary according to the position held by the lecturers, as well as the status the university claims (Aw, 2009). A university which claims research institute status has higher weighting for research. Deans have higher weights on services compared to teaching while lecturers with heavy teaching loads have higher weights on teaching. The lecturers' appraisal and increments are awarded based on the achievement of the KPI set (Abdullah & Yahya, 2007; Hamid, Leen, Pei & Ijab, 2008). Currently, research reveals that the demands and challenges in higher institution are overwhelming to the extent that the lecturers have

difficulties in balancing their workload amongst teaching, research and service activities (Aw, 2009; Hemmings & Kay, 2008). Thus, lecturers in higher education institutes having low morale for teaching also have low commitment due to their struggle to find a balance with spare time across their job scope (Baron, H. 2000; Wan Kamarud-din & Ibrahim, 2009; Hemmings & Kay, 2009). Therefore, it is timely to take appropriate action to prevent further deterioration of the lecturers' morale.

Self-efficacy is a psychological construct grounded in Social Cognitive Theory. According to Bandura (as in Kauchak & Eggen, 2005) self-efficacy is an individual's belief in his own capability to organize and complete a course of action required to accomplish a specific type of task. Self-efficacy is also a strong predictor for motivation and a strong determinant of an individual's performance in all their undertakings (Heslin & Klehe, 2006). Heslin & Klehe (2006) noted that if an individual has low self-efficacy, the individual will become demoralised, and it will lead to low job performance, hopelessness and ineffectiveness. Therefore, self-efficacy is a set of beliefs that determine how people feel, think, motivate themselves and behave. A strong sense of efficacy enhances human accomplishment and personal well-being in many ways. Perceived self-efficacy has a major influence on a person's functioning in the environment, coping with challenges, self-development and adaptability to change (Bandura, 2006). Measuring lecturers' self-efficacy with a valid instrument will be beneficial for educational institutions. A validated Lecturers' Self-Efficacy Measure (LSE) can serve as a diagnostic tool for institutions to measure the self-efficacy of lecturers and take appropriate action or corrective actions in helping the lecturers to be efficacious if it is necessary. Furthermore, the LSE may be utilized in future studies with regard to lecturers' self-efficacy towards their profession. The LSE may benefit the institution for recruiting lecturers (Hemmings & Kay, 2009) and to seek information on faculty members' needs for staff development activities. Lecturers with a strong sense of self-efficacy would probably increase individual performance (Heslin & Klehe, 2006) and it will help the institution's effort to achieve excellence and to realise the vision and mission of the Ministry of Higher Education Malaysia. Self-efficacy is situational and task specific (Ritchie a& Williamon, 2007); thus the LSE has to be developed based on the area of interest (Heslin, 2006). It was reported that research on lecturers' self-efficacy in Malaysian higher institutions is lacking (Wan Kamarud-din & Ibrahim, 2009). It is timely to develop LSE which will be very beneficial for institutions to conduct need analysis for professional development and to strengthen the lecturers' sense of self efficacy which may improve their moral and job performance.

Factors that influence self-efficacy include perceptions of ability, social comparisons, attributions, ethnic differences, academic achievement, time availability, environment and perceived importance (Kauchak & Eggen, 2005; Schunk & Pajares, 2001; Lane, Hall & Lane, 2002; Hemmings & Kay, 2009; Pajares & Urdan, 2005). Furthermore, demographic factors such as age, gender, academic qualification, academic position as well as experience have contributed to self-efficacy (Wan Kamarud-din & Ibrahim, 2009; Ramly, 2009; Hemmings & Kay, 2009; Jingsong McCormick & Hoekman, 2008). Schunk (1999) noted that giving feedback on performance is persuasive information to self-efficacy and such feedback strengthens self-efficacy. Moreover, rewards and goal setting will further strengthen self-efficacy (Punnet, Corbin & Greenidge, 2007). Self-efficacy is correlated with academic achievement, self-regulation, cognitive strategy (Pajares & Urdan, 2005; Cheung, 2006), competency and with goals for achievement (Judge, Jackson & Shaw, 2007; Zimmerman & Bandura,1994). Furthermore, the lecturers' academic qualification influence

their personal teaching efficacy and competency (Wan Kamarud-din & Ibrahim, 2009). A study conducted in Beijing, involving ten randomly selected universities, reported that gender and discipline were predictors of self-efficacy (Jingsong et. al., 2008). In this study females showed lower efficacy towards research compared to males. In terms of discipline, faculty members of natural sciences reported to have higher self-efficacy towards research compared to social sciences (Jingsong et. al., 2008). Lecturers' personal reflection and lecturers' peer-to-peer assessment are reported to be motivating factors too. The personal reflection and peer assessment have given fruitful information for faculty members about their strength and weaknesses, and it has contributed towards improvement in deploying their classroom skills as well as better preparation in their subject (Andreu, Canos, de Juana, Manresa, Rienda & Tari, 2006).

In brief, self-efficacy has great impact on one's performance and career advancement. A lecturer with strong sense of self-efficacy may perform very well in all the three main areas of lecturers' tasks, namely teaching, research and service activities. As such it may contribute towards the institution's performance and achievement. Lecturers' self-efficacy which represents the lecturers' belief in their confidence to perform the task is influenced by several factors as illustrated in the conceptual framework in Figure 1. This study focuses on testing the psychometric soundness of LSE by determining the internal consistency, and reports the convergent validity evidence, discriminant validity evidence and construct reliability.
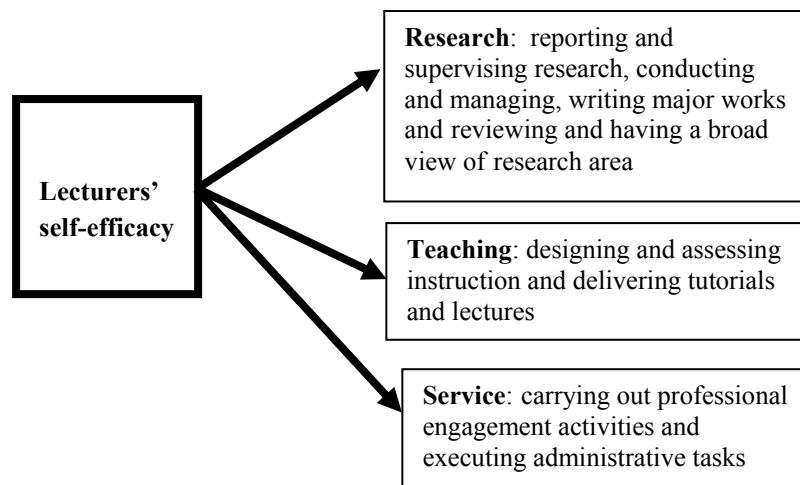
Figure 1: Conceptual Framework for Lecturers' Self-Efficacy

Methodology

Sample
The LSE validated in this study is meant to measure self-efficacy of lecturers in higher education institutes. The questionnaire was administered in one of the teacher education institutes in Kuala Lumpur. This institute offers a bachelors degree in teaching as well as a post-graduate diploma in teaching for pre-service primary school teachers. About 150 questionnaires were distributed to all 14 departments in this institute. 106 questionnaires (71%) were returned, which is within the acceptable response percentage (Fink, 2003).

Kaiser-Meyer-Olkin (KMO) and Bartlett tested for sample adequacy recorded, (.827), indicating the sample size is adequate to run the Factor Analysis (Anderson, Hair, Black & Babin, 2010).

Demographic information of the respondents

Table 1 displays the demographic information of the respondents whom participated in this study. The majority of the respondents are lecturers, and most have masters' degrees as the highest academic qualification. The respondents serve 14 different departments and have varied area of expertise. The teaching experience of these respondents range from 1 to 34 years with mean 18.99 and SD = 8.59.

Table 1: Respondents Demographic Information

		Frequency	Percentage %
Gender	Male	39	36.8
	Female	67	63.2
Academic Position	Head of Department	14	13.2
	Senior Lecturer	24	22.6
	Lecturer	68	64.2
Highest Academic	PhD	8	7.5
Qualification	Masters	92	86.8
	Degree	6	5.7

Instrument

The LSE was adapted from the lecturers' self-efficacy instrument developed by Hemmings & Kay (2008) in Australia. The LSE has three sections. The first section is composed of demographic information of the respondents, which includes gender, years of teaching, highest educational level attained, department or faculty where they currently serve and academic position. The second section has 80 items and consists of all 70 original items and 10 new items. Ten new items were added based on the tasks lecturers are required to perform in the local institution. These 80 items made up 27 tasks related to teaching, 32 tasks related to research and 21 tasks related to academic services. Some of the tasks are listed in Table 2. The respondents were asked to indicate their level of confidence in performing these tasks on a 7-point scale, with 0 representing 'Not Confident at all' and 6 representing 'Very Confident'. Hemmings and Kay (2008) measured the level of confidence on a ten point scale, but in this study, the level of confidence was measured using seven-point scale with reference to feedback from six senior lecturers that checked the instrument on the face validity and content validity. The last section concerns the respondents' perceived importance towards teaching, research and service, time spent on each dimension and their scholarly publication.

Construct Validity Evidence and Reliability for LSE

The psychometric soundness of LSE was tested by running the Principal Component Analysis, determining number of underlying factors, internal consistency index, Cronbach Alpha and item analysis. Convergent validity and discriminant validity evidence for this instrument were also determined using the following formula.

$$AVE = \frac{\sum \lambda^2}{\sum \lambda^2 - \sum \varepsilon}$$

λ = loading for each item

ε = error = $(1 - \lambda^2)$

AVE = average variance extracted

Anderson et al. (2010) noted that if average variance extracted (AVE) obtained is more than .5, it means the instrument has adequate convergent validity evidence. If the AVE is more than the squared variance (SV), r^2, it indicates that this instrument has adequate discriminant validity evidence. The construct reliability was computed based on the following formula:

$$Construct\ Reliability = \frac{(\sum \lambda)^2}{(\sum \lambda)^2 - \sum (\varepsilon)^2}$$

λ = loading for each item

ε = error = $(1 - \lambda^2)$

Missing data
The missing data were treated using complete data method. This method is based on list-wise deletion and it excludes cases that have incomplete data (Schumacker and Lomax, 1996).

Data analysis and discussion

The aim of the study is to examine the psychometric soundness of the Lecturers' Self-Efficacy instrument (LSE). This was established by finding the reliability and validity of the instrument using SPSS 17.0. Principal Component Analysis (PCA) with Varimax rotation was performed to find the underlying dimension of the instrument with minimal loss of information. The extracted factors and factor loadings and component matrix were matched with the conceptual framework derived from literature review. Reliability test and item-analysis were also performed to describe the psychometric soundness of the LSE.

Test of normality
A normality test was conducted and then compared to the statistics for descriptive analysis, outliers and percentiles. Normal Q-Q Plots for all the 80 items were examined. The descriptive analysis indicated that the ratio of Skewness /Std. Error of skewness for all the research items were within the range of -2 and +2, but many of the items representing teacher dimension T33 to T36, T39 to T58 and two items representing services S72, S73 were exhibiting skewness less than -2 (out of the normality range). Therefore the distribution was considered normal for items representing research and service dimension but skewed for teaching dimension (Ananda, 2009).

Analysis revealed that the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was .89, indicating that the study had fulfilled sampling adequacy requirement (Anderson et. al.,

2010). Further analysis for sphericity, using the Bartlett's Test of Sphericity is also statistically significant, $p<.0001$. Both the tests gave good indication that the data is suitable for factor analysis. Anderson et al. (2010) noted that partial correlation between items should be more than .7. The Anti-image correlation value which examines measure of sampling adequacy (MSA) was more than .7 for most of the items, except for R1, R4, R12, T37, S70 and S74 where the correlation coefficient valuse were between .6 and .7. However, these values are all above .5, which exceed minimum acceptable MSA levels (Anderson et al., 2010). The communalities for most of the 80 items are .7, indicating all items are adequately accounted for by the factor solution (Anderson et al., 2010) except for item S74 which has lowest communality (.53).

The underlying dimension of Lecturers' Self-Efficacy
PCA analysis performed on the 80 items of LSE, by setting eigenvalue more than 1 and factors were rotated with Varimax rotation. Initially PCA extracted three factors accounting for 61.20%. The sample size is 106, relatively small for an instrument with 80 items; therefore items which were loading more than .5 were assigned for factor solution (Anderson, et. al., 2010). Closer examination of the Factor Matrix revealed that there are several items cross loading, namely R22, R23, R24, R27, R28, R31, R32, T50, S61, S62, S64, S69, S74 and S80. All cross loading items were removed and Factor Analysis was repeated. Finally, PCA with varimax rotation produced three factor solutions with 60 items (Table 2) and this explained 69.93% of the variance. The overall reliability coefficient, Cronbach Alpha, was .98, indicating LSE has relatively high reliability evidence. Moreover, for each dimension the Cronbach alpha was also relatively high, ranging from .95 to .99 (Table 2). The finding is in agreement with Hemmings and Kay (2008) except for the number of items for each dimension differs. With reference to rotated component matrix (Table 2), Factor 1 labelled as teaching dimension has 26 items loading more than .6, mainly representing designing and delivering teaching and assessment. Factor 2, labelled as research dimension is comprised of 22 items representing planning, conducting, reporting and publishing research. Factor 3 is labelled as academic services with 12 items representing administrative tasks and professional engagement in the institution as well as outside the institution.

Table 2: Rotated Component Matrix

Items		Component		
		1	2	3
t45	Preparing assignments	**0.89**	.210	.162
t41	Facilitating student discussion in class	**0.86**	.185	.177
t46	Marking assignments	**0.85**	.251	.184
t55	Using a variety of assessment strategies	**0.85**	.183	.200
t44	Setting exams	**0.85**	.216	.139
t42	Consulting with students	**0.84**	.197	.137
t47	Assessing students' skills	**0.83**	.254	.287
t56	Motivating student with low interest	**0.83**	.085	.170
t35	Preparing tutorials	**0.82**	.288	.104
t51	Responding to student feedback	**0.82**	.157	.297
t57	Crafting higher order thinking questions	**0.81**	.215	.196

t43	Designing subject assessment	**0.81**	.237	.136
t54	Coordinating subjects	**0.81**	.154	.223
t53	Supervising the teaching in a subject	**0.81**	.164	.256
t52	Consulting with colleagues about coursework	**0.81**	.108	.262
t34	Keeping up to date and revising lecture materials	**0.8**	.293	.062
t49	Providing feedback on student performance	**0.8**	.203	.318
t48	Providing feedback on assessment items	**0.8**	.226	.314
t33	Delivering lectures	**0.78**	.315	.085
t40	Revising teaching strategies	**0.77**	.277	.197
t39	Preparing hand outs	**0.76**	.295	.161
s73	Mentoring students	**0.74**	.097	.413
t59	Developing subjects	**0.72**	.191	.376
t58	Exploring new teaching strategies	**0.71**	.253	.157
s72	Supervising students during practicum	**0.67**	.116	.371
t38	Selecting reading materials	**0.58**	.357	.363
r8	Collecting data	-.030	**0.86**	-.089
r6	Conducting pilot studies	.160	**0.85**	.181
r11	Leading research projects	.220	**0.81**	.159
r16	Preparing conference papers	.216	**0.8**	.267
r15	Presenting invited research papers in other departments and universities	.192	**0.8**	.306
r7	Adhering to research ethics requirements	.147	**0.79**	-.010
r5	Designing research	.154	**0.79**	.141
r14	Delivering research findings at staff seminars	.229	**0.79**	.277
r2	Generating research ideas	.113	**0.79**	.204
r18	Delivering conference papers	.266	**0.78**	.273
r3	Reviewing literature for research projects	.270	**0.77**	.127
r10	Analysing research results	.071	**0.76**	.060
r19	Writing for an academic audience	.302	**0.76**	.294
r17	Attending conferences	.252	**0.75**	.130
r13	Working with research assistants	.311	**0.75**	.203
r20	Writing journal articles	.298	**0.74**	.298
r26	Supervising students' research projects	.332	**0.71**	.280
r25	Examining theses	.158	**0.7**	.385
r21	Writing research-based books	.183	**0.67**	.401
r9	Using computer software	.307	**0.66**	.009
r4	Expressing ideas in writing	.169	**0.65**	.095
r1	Keeping up to date	.344	**0.55**	-.026
s78	Serving on an editorial board	.204	.146	**0.84**
s75	Liaising with external agencies about research	.169	.250	**0.83**
s66	Answering public inquiries	.131	.204	**0.82**

s77	Editing journals	.206	.205	**0.77**
s65	Responding to media	.198	.153	**0.77**
s71	Consulting professionally	.382	.152	**0.76**
s76	Liaising with external agencies about coursework	.288	.168	**0.73**
s68	Organising conferences/symposia	.255	.317	**0.71**
s67	Advising prospective students	.474	.182	**0.66**
s70	Entertaining visitors on campus	.224	.070	**0.66**
s79	Reporting on a colleague for tenure or promotion	.400	.226	**0.65**
s63	Participating in professional associations	.380	.413	**0.62**
	% variance explained	**31.06**	**24.07**	**15.25**
	Cronbach Alpha	**.99**	**.97**	**.95**

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 10 iterations.

Among the three dimensions, the respondents in this institution have a high level of self-efficacy for teaching compared to other tasks and it is in agreement with the findings reported by Schoen and Winocur (1988) and Hemmings and Kay (2009). The mean item score for teaching dimension is 5.3 (SD=.14), which is significantly higher than 3, the mid-point of 0 to 6 point scale (t>1.66, α=.05), indicating strong sense of self-efficacy towards teaching. The mean item score for research dimension (mean=4.16, SD=.22) and services dimension (mean=4.38, SD=.30) are significantly above the mid-point of the confidence scale used in this study (Table 3). The results revealed that the lecturers in this institution have a relatively high sense of self-efficacy in all three dimensions; however the sense of self-efficacy towards teaching is the strongest of all. This finding is in line with the institution's focus on teaching. It is also a good indication that the lecturers in this institution are able to cope well with job demands - especially in teaching and have potential for adapting to change and to work towards career advancement (Bandura, 2006; Heslin and Klehe, 2006). Should the institution consider improving the lecturers' self-efficiency in the research dimension, the institution could organise relevant professional development programmes for the lecturers.

The t-test revealed that there is no significant difference in self-efficacy with reference to gender, which is not in agreement with findings reported by Jingsong et. al. (2008). However the One Way ANOVA analysis showed that there is a significant difference in self-efficacy in terms of highest academic qualification, $F(2, 106)= 11.312, p < .0001$. The PhD and masters degree holders have higher self-efficacy compared to the bachelors degree holders. Lecturers with higher academic qualifications have a stronger sense of self-efficacy. The findings suggest that the institution may recruit lecturers with higher degrees and create more opportunities to the existing masters degree holders to upgrade their academic qualifications.

Reliability and Item Analysis
Reliability test and item-analysis performed for each factor and the outcomes are reported in Table 3. The reliability for each factor ranging from .95 to .99 is very satisfactory, indicating all the factors are internally consistent. The inter-item correlation mean is also presented in Table 3, ranging from .64 to .71 and all are significant at the .01 level.

Table 3: Item Analysis of the LSE

Result	LSE Items		
	1	2	3
Mean Item Score	5.33	4.16	4.38
Min	5.02	3.6	4.06
Max	5.55	4.51	4.94
Variance (SD)	.02 (0.14)	.05 (.22)	.09 (.55)
t score, α=.05	171.32	54.28	25.84
Statistics for Scale (Mean , SD)	144.02, 20.35	86.95, 19.36	52.56, 11.48
Inter-item correlation mean	.71	.63	.64
Min inter-item correlation	.49	.39	.44
Max inter-item correlation	.90	.92	.88
Cronbach Alpha	.99	.97	.95

Construct Validity Evidence and Reliability for LSE

The average variance extracted (AVE) for Factor 1 is .63, Factor 2 is .53 and Factor 3 is .55. The AVE for all three factors are more than .5, thus the instrument has adequate convergent validity (Anderson et al., 2010). The squared variance (SV = r^2) for Factor 1 versus Factor 2 is .10, Factor 1 versus Factor 3 is .18 and Factor 2 versus Factor 3 is .10. The AVE values for all three components are greater than the SV values. Therefore the LSE has adequate discriminant validity evidence. The construct reliability (CR) for Factor 1 is .98, Factor 2 is .96 and for Factor 3 is .94. All CRs are above .9 indicating that LSE has significantly high level of construct reliability and has adequate convergence validity in measuring lecturers' self-efficacy (Anderson et al., 2010).

Conclusion

This preliminary research project aims to test the psychometric soundness of the adapted instrument that measures lecturers' self-efficacy in the Malaysian Higher Education Institute. The data analysis revealed that LSE has high internal consistency with reliability coefficients more than .9, and has adequate construct validity evidence i.e. adequate convergent validity and discriminant validity evidence (Hemmings & Kay, 2009). There are three underlying dimensions to lecturers' self-efficacy construct measured in this instrument, namely teaching, research and service activities, and the analysis replicates and complements existing findings.

Lecturers' self-efficacy towards teaching is highest compared to self-efficacy towards research and service. This may be due to the fact that regularity in performing teaching is higher compared to research and other services in this institution (Hemmings & Kay, 2009). The study revealed that lecturers' confidence level in conducting research is moderate (just above the midpoint of the seven-point scale). Most studies reported that self-efficacy predicts job and task performance (Judge et al., 2007). Hence, the institution may consider ways to increase lecturers' self-efficacy towards research either by conducting relevant training for skills in research, motivate by giving rewards, setting goals, and giving encouragement (Schunk, 1985; Schunk & Ertmer, 1999).

The LSE may be useful in conducting need analysis among the lecturers for professional development as well as for recruiting new lecturers. The LSE may help higher education

institutions to strengthen the human capital resources and to realise the vision and mission of the institute. However, it is recommended that LSE is further tested for its psychometric soundness with a larger sample size and with more diverse demographics as well in other higher educational institutions.

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