Problem solving by Gender, College, and Level among Students at Al-Imam Mohammad bin Saud Islamic University

Hussein Mohammad Ayoub
Assistant Professor in Measurement and Evaluation
Vice Rector ship for Development and Quality
King Khalid University
Abha, Saudi Arabia

Abstract

This study describes results of a problem solving skills test (PST) taken by students at Imam Mohammad bin Saud University in 2012. The test instrument which includes 45 items was based on the Graduate Skills Assessment, an assessment developed by ACER and used by Australian Higher Education. A random sample of 2120 students participated in the study, 855 from the Islamic Studies faculty, 620 from the Humanities faculty, and 645 from the Sciences faculty. Study subjects were relatively evenly distributed, with 1,003 male and 1,117 female participating in the assessment. The results reveal differences in scores of problem solving ability according gender, faculty, and level with statistically significant differences between male and female at the .05 level - female outperform males at statistically significant levels. Between clusters of academic disciplines (i.e., Islamic Studies, Humanities and Sciences) there was a statistically significant difference (F=172.7) at the .01 level.Sciences facultyoutperform others.A significant statistically differences at .01 level was found between academic levels as level 5 was better than level 1. There is no statistically significant difference between levels 1 and 8 and also levels 5 and 8.

Keywords: cognitive tests, problem solving,problem solving tests, Saudi universities, testing

Introduction

In the last few decades there has been a move away from institution-level inputs as the key determinants of higher education quality, to an emphasis more on teaching processes and learning outcomes (Coates & Edwards, 2009). This has been an important shift in which universities have played an internationally leading role exemplified by the development of several national (Ramsden, 1991; McInnis, Griffin, James & Coates, 2001; Radloff & Coates, 2010) and institution-specific feedback surveys.

More recently, tertiary institutions and systems across the world have started giving consideration to student learning processes and outcomes (Coates, 2009; OECD, 2010). This is a significant shift, for it suggests that monitoring learning has a central role to play in leading educational quality assurance and change. Projects are underway to develop and enhance routine forms of assessment, to capture data on how students are teaching (ACER, 2009), and to map student performance against stated learning outcomes (OECD, 2010).

The shift in emphasis towards outcomes, and also towards assessing and reporting performance more generally, is manifest clearly in the global rankings movement. Flourishing over the last decade (Coates, 2007a), these rankings have sharpened the focus of higher education institutions on identifying strategies for monitoring and improving their performance. Leading success change in higher education is a complex endeavour that typically requires considerable innovation and persistence. Commitment toward improving education and research, however, plays an important role in helping institutions grow and succeed and leads to new strategic objectives.

In recent years there has been an emphasis on the teaching of and practical thinking and problem solving skills in education as a result of a changing and more complex society .An individual's ability to think properly about challenging problems that they encounter is one of the main domains pursued for educational achievement. Instructors should reduce the time given to the teaching of discrete facts in order to increase their use of strategies in problem solving and analytical thinking (Southerland et al., 2003, p.669).

The Problem Solving Skills Test (PST) structure is based on the Graduate Skills Assessment, a similar assessment used in the Australian higher education system and developed by ACER. The test consists of 45 items of multiple choice to be answered in 65 minutes. This cross cultural in strumpet measures skills such as the ability to analyse and classify data, arrive at generalizations based on specific information, and utilize high level of mathematical reasoning.

The approach in developing the problem solving component has been to focus on generally applicable and accessible everyday problems that vary in complexity, and on the ability of students to identify, analyse, interpret, translate, reorganise and appropriately apply problem-related information. Through this component of the assessment, students are expected to display a logical and organised approach in the analysis and application of relevant information.

Whileaminimal level of numeracy is assumed, specialised mathematical, interpersonal and business administration problems are not addressed in this component, or in the PST generally.

The items for the problem solving component are multiple-choice in format and require students to:

Identify, comprehend, restate a problem; Identify and analyse information relevant to a problem;
Represent features of a problem; Translate, reorganise, synthesise and apply information relevant to a problem; Conceptualise and generate strategy, or identify solutions to problems; andEvaluate solution strategies and their outcomes.

Sample Characteristics

In the fall of 2012 a total of 2,120 students at Imam University took part in the Problem Solving Skills Test; 855 were in Islamic Studies, 620 in Humanities, and 645 in Sciences.Distribution of test candidates by gender was relatively evenly split, with 1,003 males and 1,117 females participating in the assessment.

Table1: Students taking the Problem Solving Skills Test by Faculty,College, Gender, and Level

Faculty	College	Level 1		Level 5		Level 8		Total
		male	female	male	female	male	female	
Islamic Studies	Sharia	67	58	10	41	22	26	224
	AsoulAddeen	158	66	20	53	14	90	401
	Dawa and Mass Communication	67	35	55	33	18	22	230
Humanities	Languages and translation	12	51	11	26	8	28	136
	Social Sciences	11	70	39	32	3		155
	Economy and administrative Sciences	26	34	13	42	36	22	173
	Arabic	44	34	13	21	9	35	156
Sciences	Medicine	33		45				78
	Engineering	64		10				74
	Sciences	65	55	28	33	12	17	210
	Computer Science	59	67	25	73	6	53	283
	Total	606	470	269	354	128	293	2120

Results

The scaled score has been calculated by application of the following linear equation:

Scaled Score = Standardised Ability estimate (z-score | mean = zero/SD = 1)*20 + 100.

The application of this formula results in a scale with a mean of 100 points and a standard deviation of 20 points for each scale based on the responses of the achieved sample.The distributions are roughly normal as expected for samples of these sizes.

Gender

Approximately equal numbers of males and females participated in the PST. The weighted scaled score mean performances by sub-domains and gender are shown in Table 2below. On average, females outperformed males. Since both scales are weighted the size of the relative group samples contributes to the outcome in both domains. The results of the assessment display a statistically significant difference of .016.

Table 2: T-Test Score, by Gender

	Problem Solving				
Gender	**N**	**Mean**	**SD**	**T- test**	**sig**
Male	1003	98.3	20.5	-2.40	.016
Female	1117	100.7	18.8		
Total	2110	99.5	19.7		

The results display astatisticallysignificant difference between males and females,benefits for females. The t –test score = -2.40which is a significant in .05 level.

Faculty

Students enrolled in one of three main faculties were involved in the PST: Islamic Studies, Humanities, and Sciences. Each of these faculties includes a range of subjects and colleges. The mean scaled score for the faculties is shown on Table 3.

Table 3: Weighted Mean Score and Standard Deviation (SD) on PST by Faculty

	N	**Mean**	**SD**
Islamic Studies	850	94.04	18.18
Humanities	625	96.69	18.85
Sciences	645	111.17	18.42

These results showthat students from the Sciences faculty outperformed the other two faculties on the PST.

Table 4: ANOVA for Problem Solving Scale score by Faculty

	Sum of Squares	DF	Mean Square	F	Sig.
Between Groups	117573.88	2	58786.94	172.70	.000
Within Groups	720613.67	2117	340.39		
Total	838187.55	2119			

Table 4results display a statistically significant difference (F=172.7, significant at the .01 level) between cluster of faculty (Islamic Studies, Humanities, and Sciences).

Table 5.TukeyPost Hoc Tests used to compare Problem Solving Scale score by faculty and College

Multiple Comparisons

Dependent Variable: ProblemSolvingScalescore

Tukey HSD

(I) cluster	(J) cluster	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Islamic_Studies	Humanities	-2.65238*	.97216	.018	-4.9324	-.3723
	Sciences	-17.13482*	.96343	.000	-19.3944	-14.8752
Humanities	Islamic_Studies	2.65238*	.97216	.018	.3723	4.9324
	Sciences	-14.48244*	1.03555	.000	-16.9112	-12.0537
Sciences	Islamic_Studies	17.13482*	.96343	.000	14.8752	19.3944
	Humanities	14.48244*	1.03555	.000	12.0537	16.9112

*. The mean difference is significant at the .05 level.

The results in Table 5 display statistically significant difference between the cluster of faculty and collegesat the .05 level. TheSciences faculty performed higher on the PST than Islamic Studies and Humanities. Humanities ranked higher than Islamic Studies.

Academic Level

An important component of this research is to examine the differences in outcomes of students on measures of problem solving across cohorts of students by academic level. As such, three cohorts of students have been focused on in this study – those at Level 1, Level 5 and Level 8.

Table 6: ANOVA for PST Scaled Scores by Academic Level

	Sum of Squares	DF	Mean Square	F	Sig.
Between Groups	9544.607	2	4772.304	12.192	.000
Within Groups	828642.94	2117	391.423		
Total	838187.55	2119			

Table 6 shows a statistically significant difference(F=12.19which is significant at the .01level).between by level(1, 5 and 8)

Table 7: Tukey Post Hoc Tests: PST Scaled Scores by Academic Level

Multiple Comparisons

Dependent Variable: ps

Tukey HSD

(I) level	(J) level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1.00	5.00	-4.85874*	.99602	.000	-7.1948	-2.5227
	8.00	-2.60767	1.13733	.057	-5.2751	.0598
5.00	1.00	4.85874*	.99602	.000	2.5227	7.1948
	8.00	2.25107	1.24821	.169	-.6764	5.1786
8.00	1.00	2.60767	1.13733	.057	-.0598	5.2751
	5.00	-2.25107	1.24821	.169	-5.1786	.6764

*. The mean difference is significant at the .05 level.

Table 7 above shows that there is a statistically significant difference at the .05 level between levels (Is advantage for level 5 comparing with level 1). There is no statistically significant difference between levels 1 and 8 and between levels 5 and 8.

Academic Level by College

Examining the academic level data by faculty on the PST, a general trend suggesting improved outcomes between first and third years among Imam University students is apparent for all faculties.At level 8 the decrease is marginal and may be an artefact of the range of abilities shown in a relatively small convenience sample. This is evident in the cases of each faculty with some decline in outcomes between level 5 and 8 was recorded by the assessment in each college.

Table 8: Mean Performance on PST by Academic level, Gender, and College

	Level 1		Level 5		Level 8	
College	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Sharia	97.9	104.8	93.4	103.2	97.0	101.8
UsoolAddeen (Theology)	87.1	96.4	91.4	95.8	83.9	95.5
Dawa and Mass Communication	90.7	86.9	91.6	88.0	99.6	92.3
Languages and Translation	102.8	105.2	109.9	104.9	108.8	102.8
Social Sciences	80.3	88.7	93.8	92.5	87.7	
Economy and Administrative Science	95.1	108.3	98.7	102.2	101.2	110.0
Arabic	89.8	91.2	85.8	88.4	99.8	89.6
Medicine	117.4		120.9			
Engineering	113.0		117.4			
Sciences	99.2	100.0	112.4	107.4	99.6	113.0
Computer and Information Science	104.3	112.9	123.2	118.4	117.7	114.8

The results in the Table 8above show that students from the Sciences college outperformed all other students over the three year period. The trends between colleges at each level are very similar in general order with the Sciences college showing the highest mean scaled score at each level and in each domain, and the students from the Islamic Studies college displaying the lowest mean scaled score in each domain and at each Level.

Conclusion

The analyses of the results of students taking the Problem Solving Test show that there is variation in outcomes of students, especially in terms of the faculty and colleges in which they were studying, and their level.

The results reveal that women outperform men at statistically significant differences. Sagir and Uluicinar (2011) found that in graduate school women were better in problem solving. In contrast, Suwannimitr et al. (2010) found no statistically significant difference attributable to gender differences.

Students from the Sciences faculty recorded the highest scaled scores indicating superior problem solving skills. Students from Humanities faculty were observed to have higher mean scaled scores at each level than students in the Islamic Studies faculty, but both overall lower than the Sciences. Sagir and Uluicinar (2011) found that Faculty of Science students had the best capabilities in solving problems than students from other colleges.

Suwannimitr, et al. (2010) found that students in the health sciences have greater problem solving abilities than students in Humanities and Social Sciences.

In the present study students in Medicine scored highest among all colleges with a scaled score of 120.9. Since this is a new program there were no students at level 8. Badcock et al. (2010) found limited evidence that problem-solving skills progress at a steady rate over the years of the study.

References

ACER,"ACER(2009).**annualreport**"(2010).http://research.acer.edu.au/ar/10

Badcock Paul B. T., E. Pattison Philippe and Harris Kerri- Lee(2010). Developing generic skills through university study : a study of arts science and engineering in Australia **; Higher Education Journal**, Oct, 70(4),441-458.

Coates, H. (2007a). Universities on the Catwalk: Models for performance ranking in Australia. **Higher Education Management and Policy**,19(2),1-17.

Coates, H. (2007b). Developing generalizable measures of knowledge and skill outcomes in higher education. Paper presented at **the Australian Universities Quality Forum**. Tasmania, Australia.

Coates, H. (2009). What's the difference? A model for measuring the value added by higher education in Australia. **Higher Education Management and Policy**, 21(1),69-88.

Coates, H. & Edwards, D. (2009). **The 2008 Graduate Pathways Survey**: Graduates' education and employment outcomes five years after completion of a bachelor degree at an Australian university. Canberra: Department of Education, Employment and Workplace Relations.

McInnis, C., Griffin, P., James, R. & Coates, H. (2001). **Development of the Course Experience Questionnaire**. Canberra: Department of Education, Training and Youth Affairs.

OECD. (2010).**Assessment of Higher Education Learning Outcomes: Feasibility Study**. Paris: Organisation for Economic Cooperation and Development.

Radloff, A. & Coates, H. (2010**). Doing More for Learning: Enhancing engagement and Outcomes**. Australasian Student Engagement Report. Camberwell: Australian Council of Educational Research.

Ramsden, P. (1991). A performance indicator of teaching quality in higher education: The Course Experience Questionnaire**. Studies in Higher Education**, 16(2),129-150.

Sagir, &SafakUlucinar(2011).Research in problem solving skills of teacher candidate, **e-journal of new world sciences academy** 6(4),2482-2494.

Southerland , A.S, et al(2003).Portraying Science in the classroom : the manifestation of Scientists Beliefs in Classroom Practice, **Journal of Research In Science Teaching** ,40 (7),669-691

SuwannimitrAmron, DeeromramChoochart and JundeekrayomSuwadee, (2010). The Development of Potential Problem Solving of Students , Mahasarakham University **, Journal of Social Sciences** 6(1),47-49.