Assessing the Employability Skills of University of Kentucky College of Agriculture Graduates: A Comparison of Hard and Soft Science Disciplines

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Abstract

Employers of college graduates have indicated they value certain skills in employees and that they look for these skills when making hiring decisions. This study sought to assess University of Kentucky (UK) College of Agriculture (COA) Bachelor of Science graduates as to the perceived levels of importance they placed on and competence in performing select employability skills. Previous research has indicated that hard and soft science disciplines can be compared to each other; thus, the population of COA graduates was dichotomized and compared as such. Of the employability skills measured in this study, motivation was deemed the most important by both groups. Hard science graduates identified interpersonal relations as their greatest competency, while soft-science graduates identified listening. Excluding listening, no statistical differences existed among graduates' self-perceived abilities to perform the employability skills. Regardless of discipline, the quadrant analysis model revealed that the greatest deficiencies in perceptions between the groups (i.e., hard and soft sciences) were in the areas of motivation; problem solving and analysis; organization and time management; visioning; creativity, innovation, and change; and lifelong learning.

Introduction and Theoretical Framework

Entry-level graduates have commonly not acquired the necessary skills needed to be successful in the workplace (Peddle, 2000), in part, because they are accustomed to structure and formality in the college setting, which does not always exist in industry (Smith, 2003). As such, graduates lack the ability to transfer their learning from higher education institutions to the workplace (Billett, 1996; Billing, 2003; Crebert et al., 2004a; Smith, 2003).

Problem solving, teamwork, and communication are the skills employers expect graduates to transfer to their job (Becker, 1993; Billing, 2003; Brown et al., 2003; Candy and Crebert, 1991; Crebert et al., 2004a; Crebert et al., 2004b; Dunne and Rawlins, 2000; Evers et al., 1998; Peddle, 2000; Robinson et al., 2007; Schmidt, 1999; Tetreault, 1997). Yet, graduates struggle to make this transfer. Knight and Yorke (2003) suggested that one reason graduates are ill-prepared in employability skills is because college and university faculty are often more concerned with teaching technical content. Specifically, the authors stated that "higher education is primarily about developing advanced understanding of worthwhile subject matter, not about employability" (p. 8). As such, retraining for employability skills is necessary once graduates enter the workplace (Gorard and Selwyn, 2005).

Fuhrmann and Grasha (1983) stated that colleges and universities should always strive to adjust their teaching to meet the needs of students. Previous research has identified ways in which disciplines can be compared to each other (Biglan, 1973a; Biglan, 1973b; Donald, 1986; Neumann et al., 2002) (i.e., "hard" and "soft" science disciplines). Neumann et al. found that the soft sciences tend to focus on generalizable/transferable skills (i.e., analytic skills, creativity, and lifelong learning) but, with hard sciences, "the claim is rarely made for the development of widely transferable skills" (p. 410).

Hard science disciplines tend to focus on cumulative knowledge with a quantitative focus where the curricula are linear and hierarchical and the structure of the course is predominantly teacher-led and rigid. In contrast, soft science disciplines focus on holistic knowledge with a qualitative focus where the structure of the course is open and loose and student-oriented (Neumann et al., 2002). Historically, scholars representing hard disciplines had a greater preference for research; whereas, scholars representing soft disciplines had a greater preference for teaching (Biglan, 1973b). Further, Biglan (1973b) also found that hard science scholars sought out greater collaborative efforts among colleagues when teaching as opposed to their soft science counterparts. Therefore, assuming Biglan's thoughts are still valid today, it could be implied that differences might exist between how hard and soft science graduates perceive their ability to perform necessary employability skills based upon their discipline.

Through a series of qualitative interviews of industry employers, Evers et al., (1998) defined a series of employability skills needed for success in industry. Initially, the authors assumed that technical skills were most lacking and focused their intent on defining the ways to promote and advance gradu-

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ates' technical competencies. However, the data revealed that recent graduates lacked the non-technical skills demanded in the workplace. Eventually, through their research, the authors distilled 16 key employability skills demanded by employers (Table 1).

The theoretical framework for this study was based on Bandura's (1977) self-efficacy theory. Self-efficacy is the perception one has at performing certain tasks and serves as a guide for the way people ". . . feel, think, motivate themselves, and behave" (Bandura, 1993, p. 118). Perceived self-efficacy influences the amount of time and effort a person exerts on a given obstacle or experience (Bandura, 1982).

A strong sense of self-efficacy toward accomplishing a task equates to a higher level of performance (Bandura, 1982), while a lower sense of self-efficacy equates to lower levels of performance. In fact, Bandura (1993, p. 118) suggested: "People's beliefs in their efficacy influence the types of anticipatory scenarios they construct and rehearse. Those who have a high sense of efficacy visualize success scenarios that provide positive guides and supports for performance. Those who doubt their efficacy visualize failure scenarios and dwell on the many things that can go wrong."

Purpose and Objectives

The purpose of this study was to assess UK COA graduates from January 2005 to May 2006 as to the perceived levels of importance they placed on and competence in performing the 16 necessary employability skills (as originally identified by Evers et al., 1998). Graduates were dichotomized and compared according to whether they were from hard or soft science disciplines in an effort to test Neumann's et al. (2002) claim that soft-science disciplines tend to focus on transferable skills and hard science disciplines do not. The following research objectives guided the study:

1. Describe the responding COA graduates by academic major according to hard- and soft-science disciplines.
2. Prioritize, using the Borich needs assessment model, hard and soft science graduates' self-perceived levels regarding the importance of and competence in performing the employability skills.
3. Identify the employability skills, according to the quadrant analysis model, with the greatest amount of differences between hard and soft science graduates.
4. Compare hard and soft science graduates' as to their self-perceived competence to perform the employability skills.

Additionally, a series of independent t-tests were conducted to determine statistical differences between how hard and soft science graduates perceived the 16 employability skills. The null hypothesis stated that no statistically significant differences ($p < .05$) existed between graduates in hard and soft science disciplines on their self-perceived competence related to performing the employability skills (Ho: $\mu 1$ hard = $\mu 2$ soft).

Methods

The design of the study was descriptive survey research that employed a questionnaire which asked graduates to simultaneously rate their perception on the importance of and competence in performing the employability skills at their job. The instrument employed in this study was comprised of 16 employability skills developed by Evers et al. (1998). The instrument was later modified by Robinson et al. (2007) to improve semantics (Table 1). As such, the modified version was used in this study because of its previous use with COA graduates (Robinson et al., 2007). Each of the 16 skills had sub-skills related to the skill category. The scale ranged from 0 – no importance (or competence) to 3 – major importance (or competence). The 16 skill areas consisted of problem solving and analysis; decision making; organization and time management; risk taking; oral communication; written communication; listening; interpersonal relations; managing conflict; supervision; coordinating; creativity, innovation, and change; visioning; ability to conceptualize; lifelong learning; and motivation.

In order to simultaneously determine where discrepancies existed between the graduates' self-perceived ratings on the importance and competence constructs, the Borich (1980) needs assessment model was implemented. The Borich model analyzes data in a three-step process. First, the mean competence rating is subtracted from the mean importance rating for each employability skill and each individ-

Table 1. Employability Skills Originally Defined by Evers et al. (1998) and Later Modified by Robinson et al. (2007)

Evers et al. (1998) Employability Skills	Robinson et al. (2007) Revised Employability Skills
1. Problem-solving/analytic	1. Problem Solving and Analytic
2. Decision-making	2. Decision Making
3. Planning and organizing	3. Organization and Time Management
4. Personal organization/time management	4. Motivation
5. Risk-taking skills	5. Risk Taking
6. Oral communication	6. Oral Communication
7. Written communication	7. Written Communication
8. Listening	8. Listening
9. Interpersonal skills	9. Interpersonal Relations
10. Managing conflict	10. Managing Conflict
11. Leadership/influence	11. Supervision
12. Coordinating	12. Coordination
13. Creativity/innovation/change	13. Creativity, Innovation, and Change
14. Visioning	14. Visioning
15. Ability to conceptualize	15. Ability to Conceptualize
16. Learning skills	16. Lifelong Learning

ual to determine a series of discrepancy scores. Second, a weighted discrepancy score is determined by multiplying the discrepancy score of each employability skill with the overall mean importance rating. Third, a mean weighted discrepancy score (MWDS) is then calculated by adding all weighted discrepancy scores and dividing by the total number of participants in the study. Once MWDS have been calculated, self-perceived ratings of items can be ranked from high to low for the purpose of targeting areas in need of curricular enhancement and modification (Garton and Chung, 1997).

Further, a 2x2 quadrant analysis model was used to plot the MWDS of each employability skill of hard and soft science graduates. The y-axis represents the hard science graduates, and the x-axis represents the soft science graduates. Quadrant I indicates the greatest need for curricular enhancement due to the greatest amount of discrepancy. Quadrant II represents a "moderate" need for curricular enhancement. Quadrant III represents a "low" need, and quadrant IV represents a "negligible" need for curriculum enhancement (Robinson et al., 2007).

Finally, t-tests were conducted and effect sizes were calculated in order to assess the statistical and practical differences between hard and soft science disciplines as they related to graduates' self-perceived competence at performing said employability skills. Jones et al. (2002) stated that an "effect size is the size of the difference that the study is designed to detect" (p. 244). Cohen (1992) posited that "for the tests of the significance of the difference between independent means, correlational coefficients, and proportions, the Ho is that the difference equals zero" (p. 156). Cohen (1988) categorized effect sizes as small (.2), medium (.5), and large (.8).

A frame of UK COA graduates from January 2005 to May 2006 was accessed from the institution's office of academic programs (N = 594). A random sample (n = 235) was obtained from the population (Krejcie and Morgan, 1960). Dillman's Total Design Method (2004) was used to collect data. Two attempts were made, via postcard, to verify graduates' addresses and affirm that the instrument would accurately reach its correct destination. Four complete mailings consisting of a cover letter, questionnaire, and stamped return envelope were sent to participants. However, in the end, 57 usable questionnaires were returned for a 24% response rate.

Non-response error was calculated using a t-test to compare early and late respondents (Miller and Smith, 1983) as to responses to variables related to the study. Specifically, the first 25% of respondents to the questionnaire was compared to the last 25% of respondents, as a means of comparing two distinct groups (Ary et al., 2002). The t-tests revealed there were no differences between these two groups, and as such, the findings of this study should hold true for the population.

Results

Objective one sought to describe the responding COA graduates by academic major. There were 32 graduates from hard science disciplines and 25

Table 2. Responding COA Graduates by Academic Major (n = 57)

Academic Major	Hard-Science *f*	Hard-Science %	Soft-Science *f*	Soft-Science %
Agricultural Biotechnology	5	15.6	---	---
Agricultural Economics	---	---	8	32.0
Agricultural Education	---	---	4	16.0
Agricultural Communications	---	---	4	16.0
Animal Science	11	34.4	---	---
Forestry	3	9.4	---	---
Family Studies	---	---	1	4.0
Individualized Agric. Studies	1	3.1	---	---
Landscape Architecture	2	6.3	---	---
Natural Resources	4	12.5	---	---
Plant and Soil Sciences	5	15.6	---	---
Production Agriculture	1	3.1	---	---
Public Service Leadership	---	---	8	32.0
Total	32	100	25	100

Table 3. Hard Science Graduates' Perceptions of the Importance of the Employability Skills and Their Competence at Performing the Skills (n = 32)

Employability Skill Constructs	Importance[a] *M*	Importance[a] *SD*	Competence[b] *M*	Competence[b] *SD*	MWDS[c]
1. Problem Solving and Analysis	2.54	.36	2.27	.42	.70
2. Motivation	2.63	.42	2.39	.42	.63
3. Organization and Time Management	2.45	.40	2.22	.39	.54
4. Managing Conflict	2.25	.75	2.06	.63	.42
5. Decision Making	2.29	.43	2.10	.47	.41
6. Listening	2.59	.43	2.42	.44	.37
7. Creativity, Innovation, and Change	2.16	.63	1.99	.64	.36
8. Lifelong Learning	2.48	.48	2.34	.43	.34
9. Visioning	1.82	1.02	1.64	.90	.34
10. Ability to Conceptualize	2.13	.55	2.00	.59	.27
11. Risk Taking	2.13	.64	2.05	.53	.15
12. Supervision	2.13	.81	2.12	.65	.03
13. Coordination	2.05	.79	2.06	.75	-.03
14. Interpersonal Relations	2.43	.50	2.44	.49	-.05
15. Oral Communication	2.16	.66	2.18	.54	-.05
16. Written Communication	1.92	.80	1.99	.61	-.14

[a]0 = No Importance, 1 = Minor Importance, 2 = Moderate Importance, 3 = Major Importance
[b]0 = No Competence, 1 = Minor Competence, 2 = Moderate Competence, 3 = Major Competence
[c]Mean Weighted Discrepancy Score

Table 4. Soft Science Graduates' Perceptions of the Importance of the Employability Skills and Their Competence at Performing the Skills (n = 25)

Employability Skill Constructs	Importance[a]		Competence[b]		MWDS[c]
	M	*SD*	*M*	*SD*	
1. Motivation	2.77	.38	2.42	.40	.96
2. Oral Communication	2.52	.60	2.21	.50	.78
3. Visioning	2.20	.94	1.86	.78	.75
4. Organization and Time Management	2.53	.43	2.32	.38	.54
5. Creativity, Innovation, and Change	2.43	.63	2.22	.64	.51
6. Problem Solving and Analysis	2.57	.44	2.37	.47	.49
7. Lifelong Learning	2.56	.53	2.37	.53	.48
8. Risk Taking	2.18	.76	2.01	.73	.37
9. Ability to Conceptualize	2.16	.81	2.01	.78	.31
10. Supervision	2.11	.80	1.99	.76	.25
11. Written Communication	2.20	.77	2.10	.64	.22
12. Interpersonal Relations	2.63	.36	2.57	.36	.17
13. Decision Making	2.34	.48	2.20	.45	.03
14. Coordination	2.04	.88	2.10	.83	-.12
15. Managing Conflict	2.18	.69	2.24	.56	-.13
16. Listening	2.58	.55	2.66	.40	-.17

[a]0 = No Importance, 1 = Minor Importance, 2 = Moderate Importance, 3 = Major Importance
[b]0 = No Competence, 1 = Minor Competence, 2 = Moderate Competence, 3 = Major Competence
[c]Mean Weighted Discrepancy Score

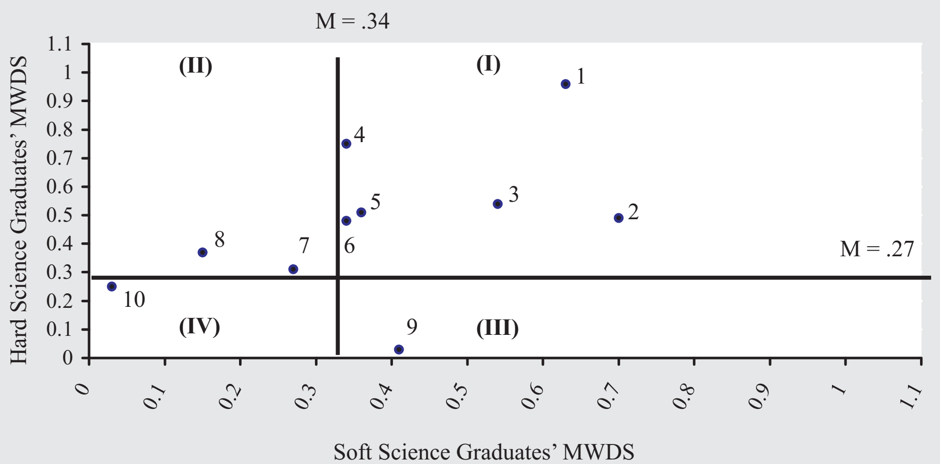

Figure 1. Quadrant Analysis Model of MWDS of Graduates' in Hard and Soft Science Disciplines

Table 5. The Employability Skills of Hard and Soft Science Graduates Represented in the Quadrant Analysis Model According to MWDS

Quadrant	Number	Employability Skill Construct
I	1.	Motivation
	2.	Problem Solving and Analysis
	3.	Organization and Time Management
	4.	Visioning
	5.	Creativity, Innovation, and Change
	6.	Lifelong Learning
II.	7.	Ability to Conceptualize
	8.	Risk Taking
III.	9.	Decision-Making
IV.	10.	Supervision
		Oral Communication*
		Written Communication*
		Managing Conflict*
		Interpersonal Relations*
		Coordination*
		Listening*

Note. * represented the six employability skills that had negative numbers and as such did not register on the quadrant analysis model.

graduates from soft science disciplines (Table 2). Hard science graduates consisted of the following disciplines: agricultural biotechnology (n = 5), animal science (n = 11), forestry (n = 3), individualized agriculture studies (n = 1), landscape architecture (n = 2), natural resources (n = 4), plant and soil sciences (n = 5), and production agriculture (n = 1). Soft science graduates consisted of the following disciplines: agricultural economics (n = 8), public service leadership (n = 8), agricultural education (n = 4), agricultural communications (n = 4), and family studies (n = 1).

Objective two sought to prioritize, using the Borich needs assessment model, hard and soft science graduates' self-perceived levels regarding the importance of and competence in performing the employability skills. Motivation was deemed the most important employability skill of both hard (M = 2.63; SD = .36) (Table 3) and soft science graduates (M = 2.77; SD = .38) (Table 4). Graduates representing hard science disciplines identified interpersonal relations skills (M = 2.44; SD = .49) (Table 3) as their greatest competency, while graduates representing soft science disciplines identified listening (M = 2.66; SD = .40) (Table 4). When factoring in the three-step Borich needs assessment model, problem solving and analysis (MWDS = .70) was the employability skill with the greatest amount of discrepancy between importance and competence ratings for graduates in hard science disciplines (Table 3). Motivation (MWDS = .96) was the

Table 6. Differences between Hard- and Soft-Science Disciplines' Self-Perceived Competency Scores on the Employability Skills

Experience[a]	*f*	*M*	*SD*	*t*-value	*p*-value	Cohen's *d*
PS & A						
Hard	32	2.27	.43	-.91	.36	-0.22
Soft	25	2.37	.47			
Decision Making						
Hard	32	2.09	.47	-.77	.44	-0.28
Soft	25	2.22	.46			
Org. & Time Mngmt						
Hard	32	2.22	.39	-.88	.39	-0.29
Soft	25	2.33	.38			
Risk Taking						
Hard	32	2.07	.53	.27	.79	0.12
Soft	25	1.99	.74			
Oral Comm						
Hard	32	2.20	.54	-.27	.83	0.02
Soft	25	2.19	.50			
Written Comm						
Hard	32	2.02	.63	-.65	.52	-0.06
Soft	25	2.06	.63			
Listening						
Hard	32	2.43	.45	-2.10	.04*	-0.27
Soft	25	2.65	.40			
Interp Relations						
Hard	32	2.46	.49	-1.07	.29	-0.21
Soft	25	2.55	.36			
Managing Conflict						
Hard	32	2.09	.64	-1.11	.27	-0.20
Soft	25	2.21	.55			
Supervision						
Hard	32	2.11	.64	.68	.50	0.17
Soft	25	1.99	.77			
Coordination						
Hard	32	2.06	.74	-.18	.86	-0.05
Soft	25	2.10	.85			
CI & C						
Hard	32	2.01	.64	-1.39	.17	-0.31
Soft	25	2.21	.64			
Visioning						
Hard	32	1.68	.92	-.97	.34	-0.15
Soft	25	1.81	.76			
Ability to Conceptualize						
Hard	32	2.03	.60	-.07	.94	0.09
Soft	25	1.97	.77			
Lifelong Learning						
Hard	32	2.36	.44	-.23	.82	0.02
Soft	25	2.35	.52			
Motivation						
Hard	32	2.39	.41	-.32	.75	-0.07
Soft	25	2.42	.41			

Note. $^*p < .05$

[a]PS & A = Problem Solving and Analytic; Org. & Time M ngmt = Organization and Time Management; Oral Comm = Oral Communication; Written Comm = Written Communication; Interp Relations = Interpersonal Relations; CI & C = Creativity, Innovation, and Change

employability skill with the greatest amount of discrepancy between importance and competence ratings for graduates in soft science disciplines (Table 4).

Objective three was to identify the employability skills, according to the quadrant analysis model, with the greatest amount of differences between hard and soft science graduates. As such, a 2x2 matrix was used to plot both hard and soft science graduates' MWDS (Figure 1). A grand mean of .27 was realized for all employability skills of hard science graduates, and a grand mean of .34 was realized for all employability skills of soft science graduates. All skills comprising quadrant I corresponded to the greatest need for curricular improvement because they had the largest amount of discrepancy between hard and soft science graduates (Robinson et al., 2007). In all, six skills were in quadrant I, two skills in quadrant II, one skill in quadrant III, and seven skills in quadrant IV (Table 5).

The final objective sought to compare hard and soft science graduates' on their self-perceived competence to perform the employability skills. To achieve this objective, a series of t-tests was conducted. Specifically, each graduate's self-perceived competence score at performing said employability skills was considered (Table 6). The t-tests revealed no statistical differences in how these graduates perceived their competence at performing 15 of the 16 skills. One statistical difference did occur. Soft science graduates appeared to be more competent in their ability to perform the listening skill as compared to their hard science counterparts. Thus, in the case of listening, the null hypothesis was rejected in favor of the alternative hypothesis. However, "listening" was found to have between a small and medium effect size (-0.27) indicating little practical difference. Additionally, five other employability skills had between small and medium effect sizes – creativity, innovation, and change (-0.31); organization and time management (-0.29); decsion-making (-0.28); problem solving and analysis (-0.22); and interpersonal relations (-0.21). For all other effect sizes, per Cohen's d, the magnitude of the observed effect relationship was small.

Discussion

In this study, graduates from both the hard science (12 of the 16 skills) and soft science disciplines (13 of the 16 skills) were higher on the importance scale than on the competence scale. This finding is consistent with research by Radhakrishna and Bruening (1994) and Robinson et al., (2007) who found that graduates tend to rate the skills higher on importance than on their competence to perform them.

Soft science graduates' self-perceived ratings indicating their level of competency at performing the skills was higher than hard science graduates on

14 of the 16 skills. The two skills hard science graduates rated higher on competence than soft science graduates were risk taking and supervising.

Because learning varies across disciplines (Donald, 1986) and because hard science disciplines are inherently different in their structure than soft science disciplines (Neumann et al., 2002), it was expected that hard and soft science graduates might differ on their self-perceived ability to perform the employability skills. However, this study found that there were no statistical differences in hard and soft science graduates' self-perceived competence in performing said employability skills, with the lone exception being "listening." However, while statistically significant, the finding resulted in a small practical effect.

Although no differences were recognized on the importance and competence levels among the disciplines, when combined using the Borich needs assessment and plotted onto the quadrant analysis matrix, it was determined that six employability skills were in Quadrant I. These skills emphasized the greatest amount of discrepancy between hard and soft science graduates. With the exception of visioning, all remaining skills were consistent with findings in a similar study by Robinson et al., (2007).

Recommendations

Caution should be used when generalizing the findings of this study. Although non-response error was accounted for (Miller and Smith, 1983), it should still be noted that the response rate was lower than ideal. As such, the findings should not be generalized beyond the population of the study.

Although Garton and Chung (1997) stated that MWDS can be used to target areas in need of curricular enhancement and modification, future studies could be productively conducted with these graduates' supervisors to determine employer perceptions of how graduates are performing the employability skills in the workplace. Then, their ratings of graduates should be triangulated with the findings of this study before enhancing, modifying, or altering the UK COA curricula.

The findings of this study could usefully be shared with current UK COA students. Making students aware of the employability skills needed for the workplace may cause students to seek out ways to more fully develop their skill sets by engaging in activities such as internships, leadership organizations, and service learning in an effort to increase self-efficacy (Bandura, 1993).

Finally, it is recommended that faculty assess their curricula and determine ways, when appropriate, to allow students to develop the skills they perceive to have low efficacy (i.e., those represented in Quadrant I) through class assignments. Specifically, it is recommended that methods such as the problem solving approach and problems-based learning be incorporated, when appropriate, in an attempt to improve students' problem solving skills and increase their motivation to learn. Integrating these skills into the curriculum could lead to higher levels of overall student self-efficacy (Bandura, 1977, 1982, and 1993) as it relates to learning and transferring the necessary employability skills to the workplace (Billett, 1996; Billing, 2003; Crebert et al., 2004a; Smith, 2003).

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