academicJournals

Vol. 5(2), pp. 21 - 28, August, 2013
DOI: 10.5897/IJVTE2013.0131

http://www.academicjournals.org/IJVTE

International Journal of Vocational and Technical Education

Full Length Research Paper

Portability of technical skills across occupations: A case for demolition of disciplinary silos?

Joseph Mukuni* and Bill Price

Career and Technical Education, Department of Teaching and Learning, Virginia Tech, United States.

Accepted 19 August, 2013

Current general practice among teachers is to isolate themselves and their students from colleagues in other disciplines. In career and technical education, it is assumed that beyond soft skills such as time management and problem solving, program areas have little in common that could necessitate interdisciplinary collaboration. This study, which largely comprised analysis of competency lists of nine different occupations, however, discovered that in addition to soft skills, program areas have numerous technical skills such as safety, maintenance of equipment, and technology use which they have in common. When a focus group of teachers was presented with a list of technical skills that were common among different program areas, all the teachers were surprised at the extent of portability of technical skills across occupations. The results of the study inspired the teachers to consider interdisciplinary collaboration.

Key words: Collaborative teaching/learning, portable skills, technical skills, soft skills, career and technical education

INTRODUCTION

As Schulman (1993) and Palmer (1998) and others observed, one characteristic from which the teaching profession needs to be delivered is pedagogical solitude. Unlike in most professions, the trend in teaching is for teachers to work in silos while at the same time legitimately claiming membership to active communities such as subject-based departments, teachers' associations or unions. Typically, a teacher works alone in performing the core functions of the profession, namely lesson planning, lesson delivery, and assessment. Over the last three decades, several authors have called for an end to this silo syndrome (see for instance Schulman, 1993; Khan, 1993; and Quinlan, 1998) because "we might best learn about teaching by working together and sharing our experiences and insights with our peers" (Quinlan, 1993, p.43). This phenomenon of pedagogical solitude is interesting because it seems to contradict the mantra of 'collaborative teaching/learning' which is trending in academia (Efthymios et al., 2009; Pliner et al., 2011; Schneider and Pickett, 2006; Dugan and Letterman, 2008; Letterman and Dugan, 2004).

In the case of career and technical education (CTE), the case for demolishing teachers' silos is even more compelling because of the nature and magnitude of workplace changes and employers' expectation that schools and colleges should turn out graduates who can cope with the technological and social changes in the workplace. One of the key competencies of today's workforce is the ability to work in teams (Gow and McDonald, 2006; Robinson, 2000). The relevance of this competency to the pedagogical solitude discourse needs little emphasis. It is not enough to tell students the virtue of teamwork when teachers themselves work in isolation. This would be akin to the adage 'Do as I say not as I do'. By practicing team teaching and other collaborative approaches to teaching, teachers would be fostering the spirit of teamwork among students through modeling because, as psychologists have pointed out, students learn many of the behaviors that they exhibit by observing and modeling what others around them (teachers included) do (Bandura, 1977).

Another justification for interdisciplinary collaboration in

*Corresponding author. E-mail: mjoseph7@vt.edu.

career and technical education programs is the existence of workplace-related skills that all students are expected to learn regardless of their future occupations. Teachers could work collaboratively in the teaching of such skills, variously called generic skills, transferable skills, portable skills, employability skills, or workplace readiness skills. Examples of these skills are time management, communication skills, team work, problem solving, numeracy skills, and interpersonal skills (Curtis, 2004; International Labor Organization, 2007; Jelas and Azman, 2005; Robinson, 2000). As will be noted from the examples of the skills given above, in the literature, the focus in the discussion of portable skills has tended to be on soft skills, which can be defined as “the interpersonal, human, people or behavioral skills needed to apply technical skills and knowledge in the workplace” (Weber et al., 2009). Not much has been said in the literature about hard or technical skills that are portable.

This article, therefore, contributes to the pedagogical solitude discourse by reporting a study that found that different occupations have a significant number of hard or technical skills they have in common. That finding provides yet another justification for interdisciplinary collaborative teaching in career and technical education programs.

LITERATURE REVIEW

The workplace of our century has changed and is constantly changing. One of the dynamics of today’s workplace is the indefiniteness of job security (Gow and McDonald, 2006). Whereas in the past it was important to lay emphases on skills enhancing job security, now equally (and perhaps even more) important are skills for mobility from job to job (Mounier, 2001). According to Darling-Hammond (2010), it is estimated that today’s workers will change jobs ten times before reaching the age of 40 and most of those jobs will require knowledge and skills to use technologies that are not yet in existence. Little wonder that employers are putting premium on skills that enhance worker flexibility, which comprise both soft and hard skills (Bell, 1990). Gibb (2003) gave the following classification of soft or generic skills which are portable across jobs:

1. Basic/fundamental skills: such as literacy, using numbers, using technology.
2. People-related skills: such as communication, interpersonal, team work, customer service skills.
3. Conceptual/thinking skills: such as collecting and organizing information, problem-solving, planning and organizing, learning-to-learn skills, thinking innovatively and creatively, systems thinking.
4. Personal skills and attributes: such as being responsible, resourceful, flexible, able to manage one’s own time, having self-esteem.
5. Business skills: such as innovation skills, enterprise skills.
6. Community skills: such as civic or citizenship knowledge and skills.

As a United Nations body charged with the responsibility of promoting labor matters in the world, the International Labor Organization (ILO) (2007) advised member states to equip workers with skills that would help them cope with rapid technological changes and hence contribute to workers’ employability. The ILO classified portable skills into the following types:

1. Soft or Core Skills
a. Social Skills, for example, ability to work in teams.
b. Communication Skills, for example, ability to interpret graphic information
c. Personal Behavioral/Ethical Skills, for example, ability to make sound judgments.
d. Learning Skills, for example, ability to acquire new knowledge.
e. Cognitive/Problem Solving Skills, for example, ability to analyze and solve business or technical problems.
2. Vocational and Technical Skills, for example, ability to apply technical or business competencies in a work setting.

The two classifications of portable skills mentioned above have at least one thing in common. Both, like many other classifications in the literature (for instance, Curtis, 2004), have more to say about portable soft skills than hard technical skills. Probably this is because technical skills are considered to be less portable than soft skills, as ILO (2007, p.3) indicated:

Vocational skills become general as a consequence of standardization of products and processes and diffusion of similar technologies between enterprises. By contrast, skills in applying the basic principles and techniques of a trade are specific to particular industries and their transferability is limited to these boundaries. Furthermore, specific skills and knowledge which are entirely job-related or firm-specific which workers acquire in enterprises specialized in narrow product or service niches, are almost non-transferable.

This paucity of information about technical portable skills was the motivation for this study.

METHODOLOGY

The data for this study was collected from Zambia, a developing African country with which the researchers’ department has ties. Zambia recently revised its vocational and technical education policy to make it more demand-driven. The theme of this study was of special relevance to Zambia because it shed light on the application of portable skills to the development of demand-driven training programs. Furthermore, it was assumed that a study focusing on portable technical skills and the potential for collaborative teaching would have an economic appeal to a developing country where the inadequacy of training resources would be more critical than in a developed country.

This study used a combination of qualitative and quantitative research methodologies. The study design consisted of the following procedures in addition to a review of literature:

1. Selection of occupational competency lists from which to identify portable technical skills: Three occupational clusters were selected (namely construction, mechanical engineering, and electrical engineering). The selection of the three clusters was based on the range of competency lists made available for this study by Zambia's training authority. From each cluster, three occupational areas were selected as follows: (a) *Construction Cluster:* Building (masonry), carpentry and joinery, and painting, Decoration and Graphics (PDG); (b) *Electrical Cluster*: Electrical craft, electronic systems maintenance, and telecommunications repair; and (c) *Mechanical Cluster*: fitting, machining, and metal fabrication.
2. Analysis of competency lists from the selected occupations: The competency lists for the nine selected occupational areas were analyzed to identify portable technical skills within and across each of the selected occupational clusters;
3. Validation of the list of portable skills by instructors: The list of portable technical skills generated from the analysis of competency lists was validated by instructors from a Zambian technical college, who were familiar with the competency lists; and
4. Determination of classroom implications: A focus group discussion using the nominal group technique (NGT) was conducted with instructors to determine the classroom implications of the identified portable technical skills; and
5. Determination of labor market implications of the identified portable technical skills: A focus group discussion using the NGT was conducted with employer representatives in Zambia to determine the labor market implications of the identified portable technical skills. The employers were mainly from the Informal Micro-Enterprise (IME) sector because that is the sector employing the majority of technical and vocational education and training (TVET) graduates in Zambia. According to Haan (2006), the IME sector contributes 78% to total non-agricultural employment in Africa.

The first focus group meeting conducted in this study was with the thirteen instructors who had participated in the validation of portable technical skills. The rationale for holding a nominal group technique session with trainers was to get their views on possible classroom implications of the list of portable technical skills. The second meeting was held with a group of nine participants consisting of: (a) seven representatives of industries that employ graduates from the programs on which this study was based; (b) one instructor identified by the principal from the members of the instructors' focus group participating in this study; and (c) one investigator facilitating the discussion. Selection of employers was based on the following criteria:

1. Must be from the Informal Micro-Enterprise (IME) sector or formal enterprise employing TVET graduates who include those from the nine different occupations comprising the sample of this study; and
2. Must be either a shop floor supervisor or a director.

Each focus group had one session during which participants answered the following questions:

1. (For instructors) In what ways can the list of portable technical skills that have been presented to you be used to enhance the quality of training provided for students at your institution?
2. (For employer representatives) In what ways can the list of portable technical skills that have been presented to you be used to respond to labor demands in your enterprise?

RESULTS

The study discovered 696 portable skills in a sample of 9 different occupations. Examples of the skills, which included the ones listed below, are shown in Table 1, Table 2, and Table 3.

- Safety precautions and procedures
- Brazing
- Welding
- Maintenance of equipment
- Use of drilling machines
- Drawing and sketching
- Care of hand tools
- Use of computers

The extent of portability of skills across occupational boundaries varied within clusters of occupations as well as across clusters as shown in Tables 4 and 5. In the whole sample of occupations, the pair with the highest number of portable skills was fitting/machining, with a total of 504 skills, followed by fitting/metal fabrication, with 459 and then machining/metal fabrication, with 431 portable skills. These pairs belonged to the mechanical engineering cluster, which was the cluster with the highest number of portable skills.

The cluster with the second highest number of portable skills was electrical engineering. In this cluster, the pair with the closest relationship as determined by number of portable skills was electrical system maintenance/ telecommunication repair, with 357 portable skills, followed by electrical craft/telecommunication repair, with 337 portable skills, and then electrical craft/electrical system maintenance, with 319 portable skills.

The cluster with the lowest number of portable skills was construction engineering. In this cluster, the pair with the closest relationship was masonry/carpentry and joinery, with 285 portable skills, followed by masonry/ painting, decorating, and graphics, with 255 portable technical skills, and then carpentry and joinery/ painting, decorating, and graphics, with 238 portable skills.

One major interpretation of these statistics is that workers within the mechanical engineering cluster have the greatest capacity for mobility from one occupation to another within their cluster with not much on-the-job training. With respect to classroom implications, this cluster of occupations offers teachers greater opportunities for collaboration than does any other cluster in the sample.

In the sample, there was also evidence of relationships of occupations across cluster boundaries, as shown in

Table 1. Examples of portable technical skill areas between electrical engineering and mechanical engineering clusters

Pairs of occupational areas	Examples of Portable technical skill areas
Electrical craft with fitting	Engineering drawing using standard views, and both conventional and GD and T dimensioning and tolerance techniques to describe form, orientation, and location accurately; converting orthographic projection in to isometric projection; hot wire welding; word processing; emailing.
Electrical craft with machining	Purposes of dimensioning; differences between dimension line, extension line, leaders etc.; geometric dimensioning and tolerance (GD and T); multi-view and auxiliary view drawings; maintenance of oxy-fuel cutting equipment.
Electrical craft with metal fabrication	Symbols and conventions; producing lines by use of computer; basic operations of C.A.D; commonly used project drawings using Auto-CAD; explain principles of gas welding.
Electronic system maintenance with fitting	Types of cells; electro chemistry; semiconductors and thyristors; semiconductor theory; fractions and percentages; word processing; emailing.
Electronic system maintenance with machining	Nature and sources of electricity; basic laws in electricity (Ohms Law and Kirchhoff's Law); behavior of passive components in AC circuits; welds in various positions.
Electronic system maintenance with metal fabrication	Magnetism and its effects; magnetism and its application to instruments; repairing electrical components; graphs demonstrating reduction of non-linear laws to linear form; graphs with logarithmic scales; maintenance of oxy-fuel cutting equipment.
Telecommunication with fitting	Electrical energy; fuses; lamps; behavior of passive components in ac circuits; values of passive and active components; manual and machine oxy-fuel cutting.
Telecommunication with machining	Magnetism and its effects; magnetism and its application to instruments; repair of electrical components; types of resistors; flat position welding.
Telecommunication with metal fabrication	Riveting; adhesives; electrical connections; brazing; types and uses of joints; calculating angles and sides by using the Pythagoras theorem.

Table 2. Examples of portable technical skill areas between construction and mechanical engineering.

Pairs of Occupational Areas	Examples of portable technical skill areas
Building (masonry) with fitting	Types and uses of marking out tools; types and uses of hand tools; care, storage and maintenance of marking out tools; care, storage and maintenance of hand tools.
Building (masonry) with machining	Care, storage and maintenance of hand tools; safety procedures; marking tools; cutting tools; word processing; emailing.
Building (masonry) with metal fabrication	Types and use of measuring tools; principles of measuring instruments; using measuring instrument; classification of workshop measurement errors.
Carpentry with fitting	Grinding machines; metal rolling machines; use of drilling machines; power saws; turning operations.
Carpentry with machining	Types and uses of hand tools; metal rolling machines; drilling machines; care, storage and maintenance of hand tools; use of drilling machine; word processing; emailing.
Carpentry with metal fabrication	Care, storage and maintenance of marking out tools; drilling machines; types and uses of hand tools; word processing; emailing.
Painting and decorating with fitting	Hand-drawn technical sketches using regular and isometric grid paper; line types from the alphabet of lines for drawing and sketching; Inclined and vertical style hand-lettering.
Painting and decorating with machining	Hand-drawn technical sketches using regular and isometric grid paper; line types from the alphabet of lines for drawing and sketching; inclined and vertical style hand-lettering.
Painting and decorating with metal fabrication	Hand-drawn technical sketches using regular and isometric grid paper; line types from the alphabet of lines for drawing and sketching; inclined and vertical style hand-lettering.

Table 3. Examples of portable technical skill areas between construction and electrical engineering clusters of occupations.

Pairs of occupational areas	Examples of portable technical skill areas
Building (masonry) with electrical craft	First angle; third angle; dimensional drawings; word processing; emailing.
Masonry with electronic system maintenance	Drawing instruments; maintenance of drawing instruments; word processing; emailing; scales for different drawings.
Building (masonry) with telecommunications repair	Simplifying and evaluating expressions using the properties of *logarithms*; exponential equations;
Carpentry with electrical craft	Introduction to cutting machines; grinding machines; metal rolling machines; drilling machines; word processing; emailing.
Carpentry with electronic system maintenance	Multiples and submultiples; S I units; measuring length, angle and weight.
Carpentry with telecommunications repair	Types and uses of joints; mechanical fasteners; riveting; adhesives; word processing; emailing.
Painting and decorating with electrical craft	Stress and strain; Young's Modulus of elasticity; types of stresses and strain.
Painting and decorating with electronic system maintenance	Types and use of measuring tools; principles of measuring instruments; use of measuring instruments.
Painting and decorating with telecommunications repair	Care and storage of measuring instruments; use of measuring instruments; types and uses of marking out tools

Table 4. Distribution of portable technical skills between pairs of occupational areas within clusters of occupational programs

Cluster	Pairs of occupations	Total portable skills between each pair	Average number of portable skills between pairs	Ranking of pairs according to strength of relationship
Mechanical Engineering	Fitting with machining	504	465	1
	Fitting with metal fabrication	459		2
	Machining with metal fabrication	431		3
Electrical Engineering	Electronic system maintenance with telecommunications repair	357	338	4
	Electrical craft with telecommunication repair	337		5
	Electrical craft with electronic systems maintenance	319		6
Construction	Building (masonry) with carpentry and joinery	285	259	7
	Building with painting, decoration, and graphics	255		8
	Carpentry and joinery with painting, decoration, and graphics	238		9

Table 5. For instance, there were 387 portable skills between electrical craft (in electrical engineering cluster) and metal fabrication (in mechanical engineering cluster). This exemplifies the fact that capacity for worker mobility is not limited to transferability within occupational clusters. It also shows that interdisciplinary collaboration by

Table 5. Distribution of Portable Technical Skills across Clusters of Occupations.

Comparison of Clusters	Occupational Areas	Portable Skills between Pairs	Ranking
Electrical with Mechanical Engineering	Electrical Craft with Metal Fabrication	387	1
	Electrical Craft with Machining	359	2
	Electrical Craft with Fitting	367	3
	Telecommunications Repair with Fitting	293	4
	Telecommunications Repair with Machining	296	5
	Electronic Systems Maintenance with Fitting	284	6
	Electronic Systems Maintenance with Machining	277	7
	Telecommunications Repair with Metal Fabrication	292	8
	Electronic Systems Maintenance with Metal Fabrication	277	9
Construction with Mechanical Engineering	Carpentry and Joinery with Metal Fabrication	290	1
	Building (Masonry) with Metal Fabrication	269	2
	Painting, decoration with Fitting	260	3
	Painting, decoration with Metal Fabrication	256	4
	Carpentry and Joinery with Fitting	253	5
	Carpentry and Joinery with Machining	252	6
	Building (Masonry) with Fitting	239	7
	Painting, decoration with Machining	217	8
	Building (Masonry) with Machining	211	9
Construction with Electrical Engineering	Carpentry and Joinery with Electrical Craft	283	1
	Painting, decoration with Electrical Craft	266	2
	Building (Masonry) with Electrical Craft	226	3
	Painting, decoration with Telecommunications Repair	205	4
	Carpentry and Joinery with Telecommunications Repair	201	5
	Building (Masonry) with Telecommunications Repair.	191	6
	Carpentry and Joinery with Electronic Systems Maintenance	183	7
	Painting, decoration with Electronic Systems Maintenance	181	8
	Building (Masonry) with Electronic Systems Maintenance.	176	9
All Clusters	All occupational areas	152	

teachers can be done beyond occupational clusters.

A comparison of Table 4 and Table 5 will show, for instance, that carpentry and joinery (in the construction engineering cluster) had 290 skills in common with metal fabrication (belonging to mechanical engineering) and yet had 285 skills with masonry (belonging to the construction engineering cluster to which carpentry and joinery also belongs). Similarly, electrical craft (in electrical engineering) shared 387 portable skills with metal fabrication (belonging to mechanical engineering) and yet within its own cluster the average number of portable skills between occupational pairs was 338.

Presented with the list of portable skills generated from the sample of this study, a teacher's focus group observed that awareness of the existence of portable technical skills would allow a common approach to delivering these portable skills. They also observed that portable skills could be delivered by one instructor to all the different classes whilst the other teachers concentrated on other duties.

The focus group of employer representatives affirmed the significance of portable technical skills and recommended that training institutions should design and conducts short training programmes focusing on portable technical skills to give graduates the flexibility and adaptability needed in informal sector industries.

Commenting on the results of the focus group discussions, a principal who was on the focus group said: “It has revealed some of the things that we were not aware of, that is, the similarities of the portable skills across the courses. The study provides a platform for effective planning of the delivery of various training modules for all the courses, taking into consideration the portable technical skills.”

DISCUSSION

Looking at the comments collected from the teachers’ focus group discussion, it would appear that the teachers were not aware of the extent of similarities of skills across disciplinary boundaries. If the reason for the silo syndrome among teachers in career and technical education was that teachers thought their task lists did not have much in common beyond soft skills, this study indicated that there were in fact a significant number of portable technical skills. By identifying the 676 portable skills and demonstrating how these skills are distributed among pairs of different occupations, the study showed the need for teachers in career and technical education to seriously consider intra- as well as interdisciplinary collaboration. It was particularly interesting to note that some occupations had more in common with occupations outside their own clusters than with occupations within their clusters. These statistics point towards a need for teachers to familiarize themselves with competency lists of programs other than their own and identify opportunities for collaboration within and across disciplines.

In making a case for demolition of teachers’ silos through collaboration, it is not assumed that there are no pitfalls along that path. To begin with, there is little empirical evidence confirming correlation between collaborative teaching and students’ academic growth (Corcoran and Silander, 2009). Furthermore, collaboration is known to be associated with a number of problems such as loss of individual autonomy, conflicts arising from un-clarified roles of team members, and negative impact on research because of too much time spent on joint planning (Letterman and Dugan, 2004; Reig, 2009). Collaboration also works against cultural norms in a society that promotes competition rather than cooperation (Rossen et al., 2008). These challenges, along with the fact that teachers’ tendency to work as individuals is a product of the way they were inducted into the profession, seem to justify the silo syndrome. These and many other constraints notwithstanding, there is a strong case for demolition of teachers’ silos in career and technical education. The global workplace for which students are being prepared is characterized by teamwork and small group activities (Cole, 1989; Bailey et al., 2005; Cleary et al., 2006), which, according Misumi (2001) are the driving force behind Japan’s competitive edge in the international market. Misumi reported that since 1969 when small group activities began in Japan, they have produced positive results and have therefore spread like wild fire to many companies.

Through promoting collaborative teaching, teachers will prepare students by modeling for their future role as members of workplace teams. Any pitfalls lying along the path of teacher collaboration are not without solutions. Many authors have suggested some strategies for overcoming the challenges of collaboration (see for instance Rosen et al, 2008; Sneider and Picket, 2004; Quinlan, 1998). The main point is that collaboration has to be well planned and all the possible pitfalls have to be identified at the planning stage, discussed, and resolved before the collaborative activities are implemented.

CONCLUSION

This article has contributed to the pedagogical solitude discourse by arguing that teachers in career and technical education (particularly those in technology programs) teach a considerable number of technical skills that are transferable from occupation to occupation, as exemplified in the study reported in this article. The article has conceded that collaborative teaching comes with challenges that appear to justify the silo syndrome. However, in the case of career and technical education, the rationale for engaging in collaboration within and across occupation boundaries should motivate teachers to identify any possible challenges and devise strategies for overcoming them.

The sample of occupations used in this study was drawn from engineering programs. There is need for similar studies broadening the sample to include programs outside engineering. In the literature, the need for engineers to learn portable soft skills has been discussed (see for instance Florman, 1979; Kumar and Hsiao, 2007; Puiko and Parikh, 2003). However, little has been said about portable technical skills among non-engineers. Given that the workplace is constantly being impacted by technological changes (Manning, 2004), it can be assumed that all workers regardless of whether they are in engineering or business disciplines need some engineering skills enabling them to cope with technological changes affecting their jobs. There is, therefore, need to establish empirical evidence of such skills through a study investigating the nature and significance of portable technical skills in non-engineering occupations. Such a study would contribute to the determination of the full extent of portable technical skills across all CTE program areas, which in turn would have implications on the collaborative teaching discourse.

REFERENCES

Bailey J, Sass M, Swiercz PM, Seal C, Kayes DC (2005). Teaching with and through teams: Student-written, instructor-facilitated case writing and the signatory code. J. Manage. Educ. 29(1): 39-59. Retrieved May 1, 2012, from ABI/INFORM Global. (Document ID: 923585531).

Bandura A (1977). Social learning theory. Englewood Cliff, NJ.: Prentice Hall.

Bell D (1990). Down to business in the classroom. Canadian Business, 63(5): 19. Retrieved from Business Source Complete database.

Cleary M, Flynn R, Thomasson S (2006). Employability skills from framework to practice: An introductory guide for trainers and assessors. Precision Consultancy. Melbourne: Commonwealth of Australia. Retrieved from http://www.training.com.au/documents/employability%20skills_from%20framework%20to%20practices.pdf

Cole RE (1989). Strategies for learning: Small- Group activities in American, Japanese, and Swedish industry. Berkeley: University of California Press.

Corcoran T, Silander M (2009). Instruction in high schools: The evidence and the challenge. Future of Children 19(1):157-183.

Curtis D (2004). The assessment of generic skills. In: Gibb J (Ed.). Generic skills in vocational education and training: Research readings. pp. 136-156. Adelaide: Australian Training Authority.

Darling-Hammond L (2010). The flat world and education: How America's commitment to equity will determine our future. New York: Teachers College, Columbia University Press.

Dugan K, Letterman M (2008). Student appraisals of collaborative teaching. College Teaching, 56(1):11-15.

Efthymios V, Ioanna P, Iosif F (2009). A Study on perceptions of Open University students about the use of effectiveness of collaborative teaching methods during the tutorial group meetings. Rev. Eur. Stud. 1(2):22-33.

Florman SC (1997). Non-technical studies for engineers: The challenge of relevance. Eur. J. Eng. Educ. 22(3):249.

Gibb J (2003). What impact is implementing a quality system having on the vocational education and training classroom? Leabrook, Australia: National Center for Vocational Education Research (NCVER).

Gow K, McDonald P (2000): Attributes required of graduates for the future workplace, J. Vocat. Educ. Train. 52(3):373-396.

Haan HC (2006). Training for work in the informal sector: New evidence from the Eastern and Southern Africa. Turin: International Center of the ILO.

International Labor Organization. (2007). Portability of skills. Committee on Employment and Social Policy, GB.298/ESP/3. 298th Session. Retrieved from http://www.ilo.org/public/libdoc/ilo/GB/298/GB.298_ESP_3_engl.pdf

Jelas Z, Azman N (2005). Generic skills provision in higher education. Int. J. Learn. 12(5):199-210. Retrieved from http://search.ebscohost.com.

Khan S (1993). Better teaching through better evaluation: A guide for faculty and institutions. To Improve the Academy. Paper 282.http://digitalcommons.unl.edu/podimproveacad/282.

Kumar S, Hsiao JK (2007). Engineers learn soft skills hard way: Planting a seed of leadership in engineering classes. Leadersh. Manage. Eng. 7(1):18-23.

Letterman MR, Dugan KB (2004). Team teaching a cross-disciplinary honors course. College Teach. 52(2):76-79.

Manning A (2004). We can work it out: The impact of technological change on the demand for low-skill workers. Scottish J. Political Econ. 51:5

Misumi J (1990). The Japanese meaning of work and small group activities in Japanese industrial organizations. Int. J. Psychol. 25: 819-832.

Mounier A (2001). The three logics of skills in French literature. Sydney: NSW Board of Vocational Education and Training. Retrieved from http://www.bvet.nsw.gov.au/pdf/threelogics.pdf.

Mukuni J (2012). Portability of technical skills across occupations. Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Career and Technical Education. Blacksburg, VA.: Virginia Tech.

Palmer PJ (1998). The courage to teach: Exploring the inner landscape of a teacher's life. San Francisco: Jossey-Bass Publishers.

Pliner SM, Iuzzini J, Banks CA (2011). Using an intersectional approach to deepen collaborative teaching. New Directions for Teach.ing Learn.ing. (125): 43-51. doi:10.1002/tl.432.

Puiko SH, Parikh S (2003). Teaching 'soft' skills to engineers. Int.ernational J.ournal of Electrical Eng.ineering Educ.ation, 40(4): 243-496.

Quinlan KM (1993). Promoting faculty learning about collaborative teaching. College Teach.ing. 46(2):43-47.

Reig SA (2009). Teaching pre-service teachers to collaboratively plan for student learning. Southeastern Teacher Educ. J. 2 (3): 87-100.

Robinson JP (2000). What are employability skills? Alabama Cooperative Extension Syst. 1(3): 1-3. Retrieved from http://www.dillonatech.com/logon/employability-skills.pdf

Rossen EK, Bartlett R, Herrick , CA (2008). Interdisciplinary collaboration: The need to revisit. Issues in Mental Health Nursing. 29:387-396

Schneider R, Pickett M (2006). Bridging Engineering and Science Teaching: A Collaborative Effort to Design Instruction for College Students. Sch.ool Sci.ence Math.ematics, 106(6): 259-266.

Schulman L (1993). Teaching as community property. Princeton, NJ: Carnegie Foundation for the Advancement of Teaching.

Weber MR, Finley DA, Crawford A, Rivera D (2009). An exploratory study identifying soft skill competencies in entry-level managers. Tour. Hospitality Res. 9(4): 353-361. doi:10.1057/thr.2009.22.