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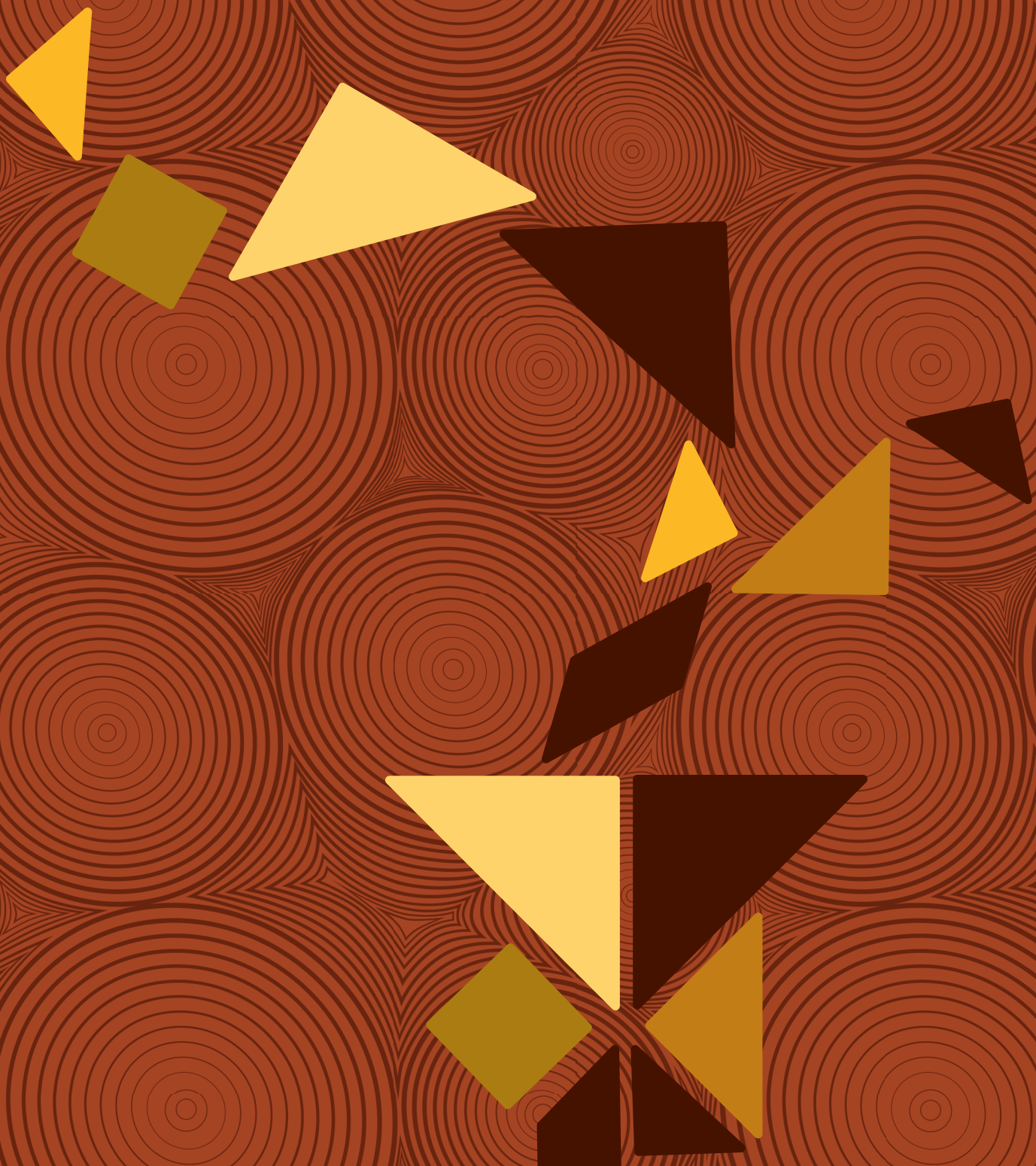

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CONTENTS

With Issue 2 of Volume 45, the 2011 publication of the *Journal of Cooperative Education and Internships* draws to a close. This has been a year of great change and foundation building. We've seen the introduction of a new editorial board that offers a much more international flavor with members from all over the world. We've created a strong partnership between four large organizations, the Australian Collaborative Education Association, the Canadian Association for Cooperative Education, the Cooperative Education and Internship Association and the World Association for Cooperative Education. But the partnerships are just beginning.

While we have worked with EBSCCO in the past to enable libraries to order a subscription to the *Journal*, we are now working with EBSCOhost™ databases. This new partnership will enable the *Journal* to continue to grow in submissions as well as prestige. We will gain new users who were not familiar with our publication who now find articles as results to their keyword searches within the database. *Journal* articles will now receive an even larger global exposure through an expanded presence within two higher education research databases. And according to EBSCO, their publishing partners see significant growth to their web traffic, and, as a result, a boost in subscriptions, membership, and (or) submissions.

We are also extremely pleased that the partnership with CEIA's *Experience Magazine* has turned out so very well. In taking over the *Journal* and discussing where we want to take it from her with various organizations, it became apparent that the field really had two distinct needs. Clearly there is a need to advance scholarship and promote research, which the *Journal of Cooperative Education and Internships* fills. But there is also a need for practitioners to learn about best practices from one another. Rather than creating a hybrid Journal, CEIA commissioned the reintroduction of their former trade journal, *Experience Magazine*. Under the leadership of Michelle Clare, this publication has already established such a strong presence that EBSCO has decided to add it to their holdings. So now whether the reader's need is for a trade journal or a scholarly journal, the higher education research database should allow our field to continue to evolve.

Moving into Volume 46 for 2012, we look forward to your submissions. While the editors and editorial board can shepherd the scholarly process, it is only through the work of the scholars in the field that this *Journal* will become a premier publication.

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Fenn at 40: How Recent Findings Are Changing Our Approach to Grantmaking for Work-Integrated Learning

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Cleveland Foundation

In 1965, Fenn College, a private institution that was home to one of the earliest cooperative education programs in the country, merged with Cleveland State University. The college's remaining assets were used to form the Fenn Educational Foundation, a private foundation dedicated to carrying out the mission of Fenn College and its role in cooperative education. In 1971, the foundation was transformed into the Fenn Educational Fund (Fund) of the Cleveland Foundation. The Cleveland Foundation, the nation's first community foundation with assets of approximately $1.9 billion, holds programmatic and fiduciary responsibility for the Fund. Over the past 40 years, the Fenn Educational Fund has distributed nearly $7.6 million in project-based grants and $1.7 million in scholarships to local institutions and students, respectively.

Throughout its metamorphosis from a private college to an advised fund of the Cleveland Foundation, Fenn has worked to promote the importance of co-op programs and internships to enhance students' academic and career development. Members of the Fund's advisory committee (comprised of representatives from the corporate, education, and nonprofit sectors) believe the region's economic vitality depends, in part, on cooperation between educators and employers. Today, as the sole funding source in the field of cooperative education in the Cleveland area, the Fenn Educational Fund concentrates on using cooperative education to aid in the development of a strong workforce, a key to the economic vitality of Greater Cleveland.

During the last few months of 2008, the Fenn Educational Fund Advisory Committee began to study the effectiveness of Fenn's recent grant making, with a focus on relevance to changing community needs. Janus Small Associates, a local consulting firm, coordinated the study. Preliminary efforts involved an online survey that was sent to career services and fund development departments at Fenn grantee institutions. This survey, which drew a response rate close to 75%, examined career services programs, staffing, and connections and relationships among students, faculty, alumni, and community-based corporations and organizations.

The following findings were of particular interest to the advisory committee:

- Close to half of the career services respondents had been in their current position for less than one year, and three-quarters of respondents had been in the field for five or fewer years.
- While respondents believed in the importance of internships as a key part of career services, almost 60% did not assist internship work sites in developing internships or in writing internship job descriptions.
- Nearly half of the respondents did not have complete (or any) information regarding internship statistics (how many placements, did placements lead to employment, etc.)
- Informal networking with the business community and with college/university alumni in the business community was minimal regarding development of internship opportunities.

The second phase of inquiry examined career services departments and internships connected to local institutions and several strong programs from outside the local area as identified by local practitioners. The focus was on examining best practices in the field, illuminating innovative working relationships between businesses and higher education institutions, and bringing presidents and other senior-level college and university leaders into the discussion.

Following are selected highlights from college/university interviews:

- Very few institutions use alumni as sources of internship positions.
- Institutions with strong programs have support above the career services department and individual division/college level.
- Strong institutions reach out to the business community and work hard to maintain relationships.
- Institutions with strong programs integrate the internship experience into the academic portion of the overall learning experience and often achieve impressive results, with more than 50% of participating interns receiving job offers.
- Most institutions have little or no data on internship results in terms of job placement.

Selected highlights from business/corporation interviews included:

- All the companies have a formal performance evaluation and/or exit interview process (some also require presentations by their interns).
- Most feel that colleges adequately prepare their students for internships.
- The most frequently mentioned ways of recruiting students are through companies' own websites and through individual colleges/divisions/faculty members (other responses included student groups and career services).

- Asked how career services could be more helpful, some respondents urged more direct communication about opportunities they offer (be more responsive and quicker to respond). Half said they do not need help recruiting students.

With this information in hand the advisory committee created funding priorities seeking proposals that bring together multiple institutions and employers and address several of the findings mentioned above. A complete request for proposals can be found online at: **http://www.clevelandfoundation.org/AffiliatedPrograms/FennEducationFund/**

For four decades, the Fenn Educational Fund has worked to promote cooperative education and internship programs at institutions of higher learning in Greater Cleveland. Cooperative education and internships remain an important avenue to strengthen ties between higher education institutions and local employers. As the region's sole funding source devoted to cooperative education and internships, Fenn is uniquely positioned to support this key aspect of the emerging economic development plan.

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Exploring some current issues for Cooperative Education

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Abstract

As cooperative education (co-op) has recently surpassed 100 years, it is worthwhile to reflect on the challenges co-op faced and responded to, as co-op has matured and new challenges developed. Much concern was raised in the past of a lack of accepted theoretical learning framework for learning in co-op, however, there has been advances made since that attempt to capture the complexities of what is co-op. Over the last so many years, diverse range of terms has developed, along with multiple definitions, to loosely describe what may (or perhaps may not) be co-op, possibly a reflection of the diversity of practices of co-op across the disciplines and attempts to be inclusive. Lastly, we would argue that even though co-op often claims to have integration of knowledge between the workplace and educational institutions, the claims are often not well supported, how integration may occur seems to be poorly understood, and here still lays a challenge for the co-op community.

Keywords: Research, work-integrated education, terminologies, integration.

Introduction

As cooperative education has entered the 21st century, it is worthwhile to reflect how the field has developed, grown, and matured. Literature discussing the early formative years of co-op, particularly in the US, are well explored by Sovilla and Varty (2011, and citations within). These authors go on to describe how Herman Schneider in 1906 at the University of Cincinnati launched the first co-op program, no doubt drawing upon earlier work experience models such as apprenticeships, mentorships, etc, to develop his co-op model originally applied to his engineering students. With the aim of bridging the gap between theory and practice, on-campus and off-campus learning, it was well timed with the US industrial expansion. The growth of co-op occurred quickly in the US and, under a variety of names but essentially holding onto the same core values, spread internationally. Today co-op presents itself well established internationally and across a diverse range of disciplines. Of recent years, much advancement in research and drawing together a comprehensive body of literature has occurred, as well as some new challenges not present in the earlier years of co-op. This paper will explore the state of our literature and research, acceptance and inclusivity of co-op, and identify that work is still required in areas such as integration.

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Maturation of the literature

Bartkus and Stull (1997) described the co-op literature as being sketchy, limited, and uncertain, with a focus predominantly on program development and the practice of co-op, essentially confirming views held by Wilson (1988) ten years earlier. However, Bartkus and Higgs (2011), giving an objective overview on research in co-op, noted that the state of the co-op literature is now stronger than when assessed in 2004 (Bartkus & Stull, 2004), with a greater focus on theoretical framework development. It is our assessment also that co-op has matured considerably over the last decade or so, not only in development of its theoretical underpinnings, but also how co-op advances and disseminates new knowl edge. With that advancement has come a growing body of research literature readily available for co-op, the setting up of research centres focussed on advancing co-op (e.g., WACE's Institute for Global and Experiential Education, and institutional level co-op research units and centres).

A sure measure of maturation of co-op is both the quantity and quality of readily available literature, and that the research realm now is substantive enough to allow two central co-op journals serving the co-op community; the J*ournal of Cooperative Education and Internships* (JCEI; **www.ceiainc.org/journal.asp**) and the A*sia-Pacific Journal of Cooperative Education* (APJCE; **www.apjce.org**). Both these journals have an extensive body of freely available, research-informed literature. JCEI began in 1964 and has a long history of literature available. The recent challenges this journal faced has prompted a transition into new structure and becoming an open access journal, and looks to provide a promising future. The APJCE first publication run was in 2000, and now has more than 130 articles with a steadily increasing number per year. APJCE originally began with the intention, as the name suggests, focussing on the Asia-Pacific area, and encouraging developing researchers into publishing. However, the last five years the journal has grown well beyond the Asia-Pacific region and now is a truly international journal.

In addition to the two central co-op journals, several relevant journals with a strong workplace learning focus, exist serving fields on the periphery of the co-op sphere, namely *Journal of Workplace Learning*, *Reflective Practice*, *Journal of Vocational Education and Training*, and *Journal of Vocational Education Research*. Furthermore, increasingly co-op orientated literature is appearing in discipline specific educational journals, for example; Coll and Zegwaard (2006) in *Research in Science and Technological Education*, Eames and Bell (2005) in *Canadian Journal of Science, Mathematics and Technology Education*, Schafer and Castellano (2005) in *Journal of Criminal Justice Education*, Tully, Kropf and Price (1993) in *Journal of Social Work Education*, and Zegwaard and Coll (2011) in *Science Education International*. Bartkus (2007) and Coll and Kalnins (2009) go on to list more than 100 other journals, with examples, containing co-op focussed literature.

Recently several significant publications drawing together established literature and focussing on best practice has become available. For example, the much expanded second edition of the *International Handbook for Cooperative and Work-integrated Education* (Coll & Zegwaard, 2011b), which presents 42 chapters giving a comprehensive overview of the

co-op literature, learning theories, common models of practices in a range of disciplines, and topical issues currently pertinent to co-op. The *Handbook for Research in Cooperative Education and Internships* (Linn, Howard, & Miller, 2004) still serves as a valuable resource to co-op researchers, and recently commissioned reports on modelling best practice by Orrell (2011), Winberg et al. (2011) and by Martin and Hughes (2011a, 2011b, 2011c) and Martin, Rees and Edwards (2011) also make significant contribution to the best practice of co-op. Two national associations have undertaken national scoping studies which shed informative light on current practice (New Zealand: Coll et al., 2009; Australia: Patrick et al., 2009), noting that there is great diversity of practice, however, little in the way of integration nor structures to facilitate reflective learning. Several co-op association (e.g., WACE, NZACE, ACEN) also produce refereed proceedings from their annual conferences. We would argue that conference proceedings should be given greater prominence and accessibility than currently, and with appropriate refereeing and editing will serve as a valuable resource of information of current topical works that may not become journal articles.

Further research in cooperative education

There often is call for further research in co-op and one we would certainly echo. However, we need to recognize that over the last 25 years we have built up this comprehensive body of research-informed literature and advanced our understanding of co-op. The breadth of this is observed in the second edition of the International Handbook, and confirmed by a quick glance at the growth of APJCE, JCEI, and the journals on the periphery of the co-op realm. The amount of literature cited in the chapters of the Handbook, much of which makes citations to research from various sources beyond co-op, is impressive (cf., Baker, Caldicott, & Spowart, 2011; Bartkus & Higgs, 2011; Dressler & Keeling, 2011; Eames & Cates, 2011). Both the commissioned reviews from Bartkus (2007) and Coll and Kalnins (2009) claim that recent research in co-op now has a solid theoretical base. We suggest that the co-op community needs to reflect on these works and develop a greater shared understanding of the state of our research background. A comprehensive shared understanding across the co-op community will avoid revisiting research and discussion around issues where we already have established understanding, and instead move research direction to new areas and to new levels. The 2010 and 2011 conferences held by WACE and ACEN included helpful research roundtables to drive and focus a collaborative research direction. The broad areas we see as important to focus research on are student learning, assessment of student learning, and the nature of the relationships between the co-op partners.

Acceptance and inclusiveness

Increasingly we are seeing educational models include workplace experiences as part of the qualification requirements, an indication of acceptance by academia. The second edition of the Handbook (2011) gives examples from 18 different disciplines that have well established practices of co-op, some of these fields having long established histories such as medicine, engineering, and teaching. Albeit, the issue of academic acceptance will

no doubt be an ongoing issue for some time, international trending suggests strongly that co-op (even if not under the same name) is getting considerable traction. Considering at the same time our substantive body of literature to support our practice, we should stop being defensive about co-op. As increasingly industry are demanding new-comers to be work-ready and have at least a bachelors level qualification, universities are responding by introducing or increasing the work experience components to their degrees. Significant development has taken place particularly in Australia (Patrick & Kay, 2011), where virtually all tertiary educational institutions have co-op (under the term WIL; work-integrated learning) as a significant part of their educational delivery, with some universities attempting to be pure co-op universities.

Perhaps a spin-off from this increasing diversity of disciplines practicing co-op, is the proliferation of terms used to describe, in board terms, what is essentially co-op (see discussion below). With this increasing diversity of practice of incorporating work experience components into a wide range of disciplines, questions can be asked 'what is co-op, and what is not?'. Some staunch stalwarts of co-op may argue for narrow definitions of co-op, however, we would argue that we need to be more inclusive. Narrow definitions of co-op are not helpful, may have contributed to the proliferation of terms, and could even restrict the realm in which co-op research is undertaken. Much valuable and informative work has been, and still is, carried out in the realms just beyond these narrow definitions of co-op.

Use of terminologies

There has been a shift in the use of terms in co-op and WIL, and with the diversification, this shift appears to be ongoing. The terms co-op and WIL are often used interchangeably and some literature appear to ascribed almost synonymous meanings – even though some argue, probably correctly, that they are not truly synonymous. It is somewhat concerning that there is a proliferation of terms – some terms having been around some time; e.g., work-based learning, workplace learning, professional training, industry engaged learning, career and technical education, internships, collaborative education, experiential education, experiential learning (WIL), industry based learning, vocational education and training, fieldwork education, service learning, community-based learning, practicum, and work exchanges. We would argue that there also is little shared agreement of the meaning of these terms. Recently, WACE has begun using the term work-integrated education rather than work-integrated learning, since the term education is more holistic (includes both learning & teaching), an argument we find convincing, even if the acronym is perhaps somewhat unfortunate. The term work-integrated education may present a useful umbrella term, overcoming the challenge of diversity of terms. Groenewald, Drysdale, Chiupka and Johnston (2011) explore the definitions to co-op and present a possible taxonomy of terms, which is still ongoing ambitious work by Drysdale and Johnstone. There should, in addition, be an increased focus on the *defining features* of co-op/WIL (or whatever term one chooses to use). These defining features may include; exposure to a professional and relevant workplace (community of practice), of a duration alongside practitioners (old

timers) long enough for enculturation to occur (the ideal duration being a topic of much need of discussion), where the tasks undertaken are authentic, relevant, meaningful, and purposeful, where students are able to learn the workplace norms, culture, and understand/develop professional identity, and integrating that knowledge into their on-campus learning.

Integration and cooperative education

Integration is talked about as being fundamental to any co-op program (Coll, et al., 2009; Coll & Zegwaard, 2011a; Johnston, 2011), and the term work-integrated learning/education, implies we are automatically talking about such integration as occurring. However, even though integration is identified as being fundamental (Allen & Peach, 2007), there is uncertainty within the co-op community about what is meant by the term, how we achieve this 'integration', or even if we would recognize it when it has been achieved. Therefore, we believe there is much debate (and research) yet to be had about achieving integration, advancing pedagogy, and curricular development.

Of concern is the unsupported notion that having a mere add-on work-experience program, tacked to the side of a degree or other program somehow constitutes co-op or WIL. Many of these programs exist. The assumption made by these programs is that by providing such experience, that learning will automatically occur (therefore assumed to be adding value to student learning experience), however, this is unfounded and not supported by the literature. At best some random learning may occur; however, it is not planned, structured, nor an expected outcome (Coll & Zegwaard, 2011a; Eames & Cates, 2011; Garrick, 1998). The quality of the learning experience is not secured, and perhaps even the emphasis that the placement is a learning experience may not be present.

The slow drift of co-op becoming centralized and service-focused has come at the cost of research active co-op academics (Sovilla & Varty, 2011) who will likely have a better appreciation of structuring a learning experience and be informed by recent developments of understanding of the co-op learning process. However, whatever the structural or administrative role or label for the co-op practitioner, Coll and Eames (2000) argue what actually matters is that such staff see themselves as 'educators', and have familiarity with theories of learning and the learning process/education per se. In a co-op program as we conceptualize it here, they are involved in *education*, not just the administration of a work-based learning program. It is this role then, whatever its label, and wherever it is located within an educational institution, that is crucial. Emphasis needs to be placed on having co-op practitioners informed by literature and research active, and to be accepted as teachers and educators (Eames & Cates, 2011) rather than general (and often part-time) contract staff. A non-academic location for co-op within an educational institution is not conducive to the formulation of academic programs with rigorous curricular, that will result in desirable educational outcomes (Coll & Zegwaard, 2011a; Freeland, 2007).

Conclusion

Co-op has achieved much since the earlier years of Schneider. We must reflect back on the developments over the years, particular the substantive body of literature now readily available, but also recognize that further research is required. We must continue to advocate for resources that enable us to be effective in delivering our programs, to conduct our research, and to advance best practice models. The onus is on co-op practitioners to make these substantive benefits of co-op programs known to all key stakeholders; students, colleagues, and managers in their institutions, and external stakeholders such as officials and governments. We also need to be encouraged that the educational endeavor we call co-op is well-founded in research, effective, and grants positive and transformative life changing experiences for students that partake in our programs.

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The Effect of Cooperative Education on Change in Self-Efficacy among Undergraduate Students: Introducing Work Self-Efficacy

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Abstract

This study examines the effect of cooperative education, controlling for contextual support and demographic characteristics, on three dimensions of self-efficacy change: work, career, and academic. Of the three forms of self-efficacy, work self-efficacy was found to be the one efficacy form impacted by cooperative education. Since self-efficacy is shaped by performance accomplishments, student success in their co-op jobs appears to enhance their confidence in performing a variety of behaviors that are particular to handling the requirements of the workplace. Change in work self-efficacy was also affected by change in students' confidence in their career orientation. This study claims to open up the so-called *black box of co-op* to articulate the practices and behaviors of cooperative education that shape its contribution to the undergraduate experience.

Keywords: Work self-efficacy, cooperative education, internships, contextual support, career self-efficacy, academic self-efficacy, placement quality.

Introduction

The overarching model for the study outlined in this article proposes that retention is shaped by self-efficacy, which, in turn, is based on the impact of students' demographic characteristics, the effect of work experience, in particular cooperative education, and the contextual support provided by one's university as well as by others, such as parents and friends. This

research is supported by a National Science Foundation Research on Gender in Science and Engineering program grant, designed to determine the effect of self-efficacy and other factors on the retention, especially of women, in undergraduate engineering programs. In this paper, we report on the effect of students' first co-op experience, pursued in the second year of college education, on three forms of self-efficacy change, controlling for contextual support and demographic characteristics. The three efficacy forms consist of work, career, and academic self-efficacy, signifying the confidence that students have in their own success within the workplace, within their career, and within the classroom, respectively. Contextual support was measured as the support provided to students in their first two years of college through a number of mechanisms, in particular, financial aid, mentors, advisors, family, friends, teachers, profession, campus life, and living-learning communities.

These data represent the pre-survey of the study, completed in the 2009-2010 academic year, and a post-survey follow-up in the 2010-2011 academic year. Students initially completed a 96-item survey referred to as Survey 1. They then completed a second 102-item survey (Survey 2) approximately one year later. Surveys were completed both in written format and online. Additional data will be gathered in year 3 of the study, corresponding to the students' fourth year in an undergraduate engineering program.

The data pool is from colleges of engineering from four universities — Northeastern University, Rochester Institute of Technology, Virginia Polytechnic Institute and State University, and the University of Wyoming. The first two institutions provide formal cooperative education while the third and fourth do not require it. The total number of respondents at the point of Survey 1 was 1637 students. The combined response rate was 67%. The response rate for Survey 2 (calculated as the number of respondents from Survey 1 who successfully completed the 2nd survey) was 54% and represents 886 students.

The field of cooperative education and internships has relied on the use of the concept of self-efficacy as a promising avenue to link practice-oriented learning processes to learning outcomes.

This paper first presents the background, conceptual framework, and methodology of the study. Next, we describe the results to date regarding the effect of cooperative education, in conjunction with descriptive measures of respondent demographics and contextual support, on self-efficacy change. We then conclude by reviewing the significant findings of the study along with recommendations for the enhancement of particular features of cooperative education.

Background

The field of cooperative education and internships has relied on the use of the concept of self-efficacy as a promising avenue to link practice-oriented learning processes to learning outcomes (Eames, 2004). Self-efficacy is defined as an individual's perceived level of competence or the degree to which she or he feels capable of completing a task. Self-efficacy is a dynamic trait that changes over time and can be influenced by experience. Self-efficacy expectations are considered the primary cognitive determinant of whether or not an indi-

vidual will attempt a given behavior. Bandura (1986) identified four sources of information that shape self-efficacy: (1) performance accomplishments, (2) vicarious experience, (3) verbal persuasion, and (4) physiological and affective states.

Lent and associates (2002) expanded on general self-efficacy theory to develop a Social Cognitive Career Theory (SCCT), a "conceptual framework aimed at understanding the processes through which people develop educational/vocational interests, make career-relevant choices, and achieve performances of varying quality in their educational and occupational pursuits" (p. 62). In addition to highlighting cognitive-person variables, such as self-efficacy, SCCT emphasizes the role of other personal, contextual, and learning variables (e.g., gender, race or ethnicity, ability, social support, external barriers) that can help shape career trajectories, including the means to remediate any disadvantages from being under-represented in particular occupations (Blustein, McWhirter, & Perry, 2005).

SCCT theory has also made an impact on models, attempting to explain the withdrawal of students from undergraduate education, by focusing on cognitive-person variables, especially self-efficacy, that can enable personal agency in students' career endeavors. What is especially important about these variables is that they can be assessed and their conditions altered in order to enhance students' perceived consequences of succeeding in college (Kahn & Nauta, 2001). In particular, consistent with SCCT theory, recent studies have found that enhanced self-efficacy and social support during the collegiate experience can lead to improved adjustment and academic performance, which, in turn, shape overall satisfaction and commitment to remain in school (Chemers, Hu, & Garcia, 2001; Friedlander, Reid, Shupak, & Cribbie, 2007; Meyers, Silliman, Gedde, & Ohland, 2010).

While this study's path model (Figure 1) bears some resemblance to Lent et al.'s (2003) theoretical SCCT model, Lent and colleagues used outcome expectations and interests as additional cognitive-person variables (Lent, Brown, & Hackett, 1994). This study concentrates on support and self-efficacy constructs, especially since the latter are believed to be the most central and pervasive mechanism of personal agency (Bandura, 1989). Subsequent analyses will focus on the effects of these variables on retention.

Other than Lent's work on contextual factors, there has been some modest research on counseling interventions that may lead to increased self-efficacy. In theoretical papers, Betz (1992) and Brown and Lent (1996) discussed ways that counselors could increase the self-efficacy beliefs of their clients, such as by structuring successful performance experiences, finding successful role models, providing techniques for anxiety management, offering encouragement and support, encouraging data gathering that might counteract detrimental self-efficacy beliefs, and helping process efficacy-relevant data. At the secondary school level, a three-day problem-based camp experience was found to increase students' self-efficacy for specific tasks as well as general self-efficacy (Speight & Rosenthal, 1995). At the college level, Hutchison, Follman, Sumpter, and Bodner (2006) more recently reported a relationship between academic and advisory support and female students' academic self-efficacy. Focusing in particular on cooperative education, a pilot study was performed

by the University of Wyoming's and Northeastern University's Colleges of Engineering to discriminate the effect of co-op versus other competing measures on self-efficacy (Raelin, Reisberg, Whitman, & Hamann, 2007). Cooperative education was found to significantly predict change in work self-efficacy, prior academic achievement was found to predict subsequent academic self-efficacy, and academic support was found to significantly enhance all three forms of self-efficacy. Women undergraduates were found to be more confident than their male counterparts in obtaining occupational information and learning from their work experiences.

In a theoretical study Fletcher (1990) provided a first glimpse attempting to explain how cooperative education experience might enhance self-efficacy and help students make the transition from student to practitioner. Specifically, Fletcher suggested that cooperative education increases self-efficacy through performance accomplishments, one source of efficacy information. In this instance, performance accomplishments would be co-op experiences in which students need to use skills, abilities, and coping strategies to perform tasks. Successful experiences can result in a feedback loop where performance accomplishments would lead to increased self-efficacy, which in turn, enhances students' performance, further strengthening their self-efficacy beliefs. The possibility that cooperative education can be a source of efficacy information through performance accomplishments is provocative, given that performance accomplishments are generally viewed as the most potent source of self-efficacy information. That is, of the four sources of efficacy information, performance accomplishments are thought to exert the most influence (Bandura, 1986; Lent et al., 1994). Nevertheless, formal workplace experiences also expose students to successful peer models, mentor figures, and verbal encouragement that can provide self-efficacy information through Bandura's (1986) vicarious experiences and verbal persuasion sources.

Although the co-op field itself has not fully identified what happens during the co-op experience to produce beneficial outcomes — leading some researchers to refer to this as the *black box* of co-op (Ricks, Cutt, Branton, Loken, & Van Gyn, 1993) — there have been a number of outcome studies demonstrating its salutary effects on students' subsequent employment and career. For example, Weinstein (1980) found that co-op students evinced greater certainty about career choice compared to students who did not participate in a co-op experience, and engineering co-op students in particular were found to have a higher level of professional orientation (Blackwell, Bowes, Harvey, Hesketh, & Knight, 2001). Co-op students were also more likely to have first jobs related to their major and overall career plans (Brown, 1984) and were more likely to hold positions with higher levels of responsibility (Brown, 1976; Gore, 1972). They were also shown to more successfully adjust at the outset of their employment (Brown, 1985), were more self-reliant in learning about their organization and work groups, and rated their knowledge of task and role more highly than non-co-ops (Gardner & Koslowski, 1998). Finally, as related to the social cognitive stream of research, co-op experience has been found to increase self-confidence, self-concept, and career identity (Ducat, 1978; Weston, 1986).

It goes without saying that cooperative education and other related formal work experience programs during the undergraduate experience offer students opportunities to try out, learn from, and reflect on ongoing work experience (Raelin, 2008). As a result, these programs help students transition into full-time work more easily, helping them overcome the *reality shock* attributed to first job experiences for uninitiated novices (Elfering, Semmer, Tschan, Kalin, & Bucher, 2007; Wanous, Poland, Premack, & Davis, 1992). In addition, through its enhancement of self-efficacy, cooperative education can also prove beneficial to students in sustaining their ongoing academic performance and their persistence to graduation (Davie & Russell, 1974; Gardner, Nixon, & Motschenbacker, 1992; Lindenmeyer, 1967; Smith, 1965; Somers, 1986). Blair, Millea, and Hammer (2004), in a study of undergraduate engineering majors, concurred that those who completed three semesters of co-op had superior academic performance and they also earned higher starting salaries (though it took them longer to complete their undergraduate program). Of the various dimensions of self-efficacy that are likely to be affected by co-op, it could be work self-efficacy that would be the construct of choice. Work self-efficacy measures a range of behaviors and practices — e.g., exhibiting teamwork, expressing sensitivity, managing politics, handling pressure — attending to students' beliefs in their command of the social requirements necessary for success in the workplace. Since efficacy is a malleable property, there are methods by which student employees may achieve relative success in their jobs as well as learning within the workplace by increasing their confidence in performing many of these work-related behaviors (Raelin, 2007). Further, though they may have limited confidence in performing especially highly technical work at the outset of their placements, be they co-ops or internships, their success in such tasks as solving difficult problems, working on a team, or learning completely new skills can expand their work self-efficacy over time (Coll, Zegwaard, & Lay, 2001).

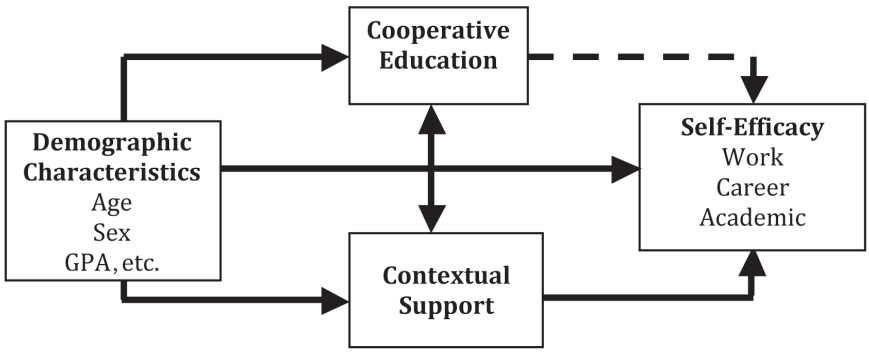
Framework

The conceptual framework for this study is depicted in Figure 1 as a set of paths between four variable clusters. The determination of self-efficacy is based on the impact of students' demographic characteristics, the effect of work experience — in particular cooperative education — and contextual support. In this study, we are especially interested (denoted by the dashed arrow) in the effect of cooperative education on self-efficacy, controlling for demographic characteristics and contextual support. Although the relationship between self-efficacy and its predictors can be bidirectional if prior self-efficacy is taken into account, we are concerned in this study with relationships that are unidirectional.

Thus, the principal research question to be posed in this study is whether cooperative education, by itself, even when controlling for contextual support and demographic characteristics, has an effect on one or more of three forms of self-efficacy: work, academic, and career, and if it does, whether the quality of the co-op placement accounts for self-efficacy enhancement.

Figure 1.

Conceptual Framework of the Study



Data

The data pool represents all sophomores in the colleges of engineering from the four participating universities. Respondents filled out two 20-minute surveys, spaced out over approximately 1 year. While Survey 1 was completed entirely in written form, some 54% of Survey 2 respondents completed their survey online. All surveys were conducted anonymously, although IDs were used to track students for follow-up purposes and to verify some of the descriptive data against the student record. Since IDs were not associated with names on the data file, the data analysis was conducted in total anonymity. Incentives were used to generate higher response rates and entailed both direct gifts for completion (e.g., coupons to on-campus bookstores or coffee shops) and raffles (e.g., VISA gift cards, iPods). As Table 1 reveals, the total number of respondents was 1637 students for Survey 1 and 886 for Survey 2. The response rate at Survey 2 was 54%.

Besides the expected dominance of males in the sample, 79% at Survey 1 and 76% at Survey 2, the initial sample was predominantly Caucasian (79.5%) and middle and upper-middle class (83%) in socioeconomic status. The average SAT score was 1269 (math plus verbal scores), based on the original SAT version with a 1600 maximum score. The average GPA was 3.21 as reported at the end of the freshman year, and 3.07 at the end of the sophomore year for the full sample and 3.12 for those who completed Survey 2. For both surveys, the most popular major was mechanical engineering (at nearly a third of the sample) followed by civil, chemical, and electrical engineering, in that order.

By the time of Survey 2, 39 students had left their university and 110 students had transferred out of engineering. Of those who had left engineering, the most popular new major was science, followed by math and social sciences. The engineering students in the sample are seen as hard-working since some 94% declared that they were working in some capacity. Further, 543 students (65%) participated in a co-op program during their sophomore year, and an additional 118 (13%) undertook an internship, be it in their major or not connected

to their major. Finally, 42% of the sample at Survey 2 reported one year or less of total work experience in their lives, 33% worked between one and three years, and 24% had worked over three years.

Table 1.

Overall Sample Statistics

School	# Students Completing Survey 1	# Students in Data Pool	Response Rate %	# Students Completing Survey 2	Response Rate %
Northeastern University*	363	422	86	325	90
Rochester Institute of Technology*	315	399	79	174	55
University of Wyoming	128	287	45	94	73
Virginia Polytechnic Institute	831	1353	61	293	35
Totals	**1637**	**2461**	**67**	**886**	**54**

**** Signify the two universities with predominantly co-op engineering colleges.***

Methodology

Measurement. The measures of the principal study variables are as follows. The new work self-efficacy inventory (WS-Ei), developed by Raelin (2010) at Northeastern University, measures a range of behaviors and practices that relate to the non-technical and social skills necessary to achieve success in the workplace. The inventory features seven subscales: problem-solving, sensitivity, communication, teamwork, learning, pressure, and politics. Career self-efficacy was obtained directly from the short-form of the Career Decision-Making Self-Efficacy Scale of Betz, Klein, and Taylor (1996), and academic self-efficacy was derived from the Self-Efficacy for Academic Milestones and the Self-Efficacy for Technical/Scientific Fields surveys (Lent, Brown, & Larkin, 1986). Among the contextual support variables, the majority (friends, family, professional, financial) were derived from familiar support scales in use such as the support subscales of Lent et al. (2001). Two variables were drawn from the college students' mattering literature (Rayle & Chung, 2007; Schlossberg, 1989), purporting that the mattering of one's friends and college were key components of social support. From the retention literature, three other important variables were included: the quality of instruction, the involvement of the student in campus life, and the opportunity to be involved in a living-learning community (Habley & McClanahan, 2004; Nicpon et al., 2006; Tinto, 1999; Ziskin, Hossler, & Kim, 2009). Finally, the support of both an advisor and a mentor (Thom, 2001) was measured deploying the advisorship and mentorship scales from the rapport and apprenticeship subscales of the Advisory Working Alliance Inventory (AWAI) prepared by Schlosser and Gelso (2001). Demographic data were self-reported by the respondents directly on the survey instrument or obtained from their student records.

The first round of analyses established the validity and reliability of these measures. Factor analyses were conducted on the components of each of these established scales using

principal component analysis as the extraction method with eigenvalues set at the Kaiser greater-than-1 rule. The initial solutions for each of the analyses found all the components to load as specified on the first factor. Although not an established scale, a composite social support measure was constructed, based on an exploratory factor analysis, although financial support was found to be a separate construct.

Each of the three self-efficacy scales — work, career, and academic — produced high reliabilities, measured by Cronbach's alpha coefficient of internal consistency:

WS-E: .94
CS-E: .93
AS-E: .91

These scores are above the recommended .70. The advisor, mentor, and social support scales also performed well: advisorship at .95, mentorship at .97, and social support at .74.

One additional scale was created from the Survey 2 data composed of 10 measures used to evaluate the quality of students' co-op experiences. Research by Blackwell et al. (2001) has highlighted the differential learning and employment effects that can ensue from variety in the provision of undergraduate work experience. For example, some co-ops are better at expressly providing students with an opportunity to learn or in enabling them to reflect on what they are learning. The measures used in this study were based on the work of Fogg and Putnam (2004) and Highsmith, Denes, and Pierre (1998) and include such indicators as whether the placement was intellectually challenging and applied the knowledge used in one's field, or whether the student worked as part of a team of professionals. All ten variables loaded on the same factor and achieved a Cronbach's alpha of .87.

The three major self-efficacy scales were found to have a high degree of concurrent validity, measured initially by correlations that are high and significant but not so high as to be equivalent. It was therefore determined that each efficacy measure represents a different facet of self-efficacy.

WS-E and CS-E = .67
AS-E and CS-E = .44
WS-E and AS-E = .32

Convergent validity was also established by significant correlations among discriminating variables. For example, academic advisorship and mentorship, provided as part of programs to support women and underrepresented students, were both significantly correlated with the three efficacy measures. Meanwhile, second and third-year GPA was found to be highly and significantly correlated with academic self-efficacy at both respective time periods. Academic self-efficacy in the second year was also significantly correlated with teaching quality and prior SAT scores.

Statistical analysis. To determine whether cooperative education has an effect on self-efficacy, we performed t-tests of means for two groups: those students who completed a co-op versus those who did not. We performed this analysis to determine for these two groups whether significant change in self-efficacy occurred over the period between the end of the second year and end of the third year. Significance was established based on the more demanding two-tailed test (rather than a one-tailed test) because we are interested in changes from the mean in both directions. We also noted whether any other changes were affected by students' co-op experience.

Thereafter, to determine whether cooperative education had a direct effect on self-efficacy change, independent of the contextual support variables as well as the demographics, a multiple regression was performed for each of the three self-efficacy change measures. The purpose is to determine how much of the variance in each of these dependent variables can be explained at the intermediate phase of the project by the study variables.

Results

Relationship Between Cooperative Education and Self-Efficacy Change. Before computing the relationship between cooperative education and self-efficacy, it is first important to determine if there has been significant change in the three main efficacy scores. Although the difference in self-efficacy between the second and third year was not huge, the scores were significant in each case (see Table 2).

Table 2.

Differences Between Pre and Post-Surveys on Self Efficacy

Self-Efficacy	N	Survey 1 Mean	Survey 2 Mean
Work	886	3.88**	3.93**
Career	882	3.75**	3.81**
Academic	878	3.98**	3.90**

*** Significant at p<.01 using two-tailed paired sample t-test*

It is interesting to note that both work and career self-efficacy increased between the second and third years, whereas the students' confidence in their academic achievement significantly decreased. In a separate analysis, it was discovered that the change in academic self-efficacy was accompanied by a corresponding significant reduction in students' GPA. A significant decrease was also recorded for the change in the contextual support composite scale, with the most significant component being change in *college mattering*, a reflection perhaps of the famous undergraduate convention of the *sophomore slump* (Wilder, 1993).

Turning next to the relationship between co-op and self-efficacy, as can be seen in Table 3, there was a very significant change (p<.01) in co-op students' work self-efficacy upon completion of their co-op experience. Those who participated in co-op indicated a significant

increase in their work self-efficacy, whereas those who did not participate, decreased a little. There were no significant outcomes in the other two self-efficacy change scores between co-ops and non-co-ops.

As could be expected, the overall support co-op students experienced during their time on co-op decreased; in particular, support available from their collegiate advisor. Interestingly, co-op students' GPAs did not decrease as much as non-co-op students' GPAs, a finding consistent with research by Gardner et al. (1992) and Blair et al. (2004). Lastly, co-op students reported a reduction in the quality of instruction; a finding that is not unusual especially among students returning from co-op who begin to question the currency of their teachers' applied engineering experience. This finding may also reflect what Mann (2001) and Auburn (2007), among others, surmised as an alienation resulting from the lack of opportunity of returning students to demonstrate their new knowledge in class due to a teaching style that controls the agenda of learning.

Although the principal focus of this paper is on the impact of cooperative education on self-efficacy, readers of this journal are likely interested in the impact of internships, be they in one's major or not, and whether the findings differ from those attributed to cooperative education. Consequently, we added the 118 internship students in our sample to our original co-op measure and performed the same series of t-tests. Although the overall pattern of the findings did not change substantially, there was one interesting twist. Again, the most pervasive impact of cooperative education and internships was on change in students' work self-efficacy; however, the addition of internships also affected career self-efficacy change. When performing a t-test on interns separately from co-op students, the same effect was produced. Thus, it can be concluded that students on internships are more likely to experience a positive change in their career self-efficacy compared to students choosing neither co-ops nor internships. Besides change in career self-efficacy, there appears to be a likelihood that interns are also more involved in campus life and feel more supported by their university, although these results, given the relatively low number of interns in our sample, can only be considered a trend rather than a statistical finding. It could be a mere artifact of co-ops, in some cases, lasting longer than internships. Nevertheless, they point to a potentially important difference between interns and co-op students, that being the extent of their continuing connection to the university during their internship.

Table 3.

T-Tests for Cooperative Education and Change Scores

	Reported Work Experience	N	Mean	Significance (two-tailed)
Work Self-Efficacy Change	Co-Op	477	.13	.000
	Other	295	-.02	
Career Self-Efficacy Change	Co-Op	477	.09	.326
	Other	295	.05	
Academic Self-Efficacy Change	Co-Op	476	-.04	.750
	Other	294	-.05	
Advisor Support Change	Co-Op	422	-.09	.000
	Other	259	.22	
Support (Composite) Change	Co-Op	472	-.09	.001
	Other	220	.05	
Teaching Quality Change	Co-Op	468	-.05	.016
	Other	215	.14	
GPA Change	Co-Op	543	-.08	.019
	Other	293	-.12	

Relationship Between Cooperative Education and Self-Efficacy Change Controlling for Contextual Support and Demographics. It is important to determine whether any effect of cooperative education on self-efficacy persists when controlling for the contextual support variables, the demographics, and the comparable forms of self-efficacy themselves. In examining the three regression equations, each of which had significant r-squares, the co-op variable only entered one equation with a high ($p.< 01$) level of significance, that being work self-efficacy change. Table 4 displays this regression equation, and as can be plainly seen, participation in cooperative education is the only significant predictor other than a control for career self-efficacy change, which is also highly significant. The conclusion from the regression analysis is that cooperative education has a distinctive impact on the work self-efficacy of its participants. Work self-efficacy change was also impacted by both co-op and non-co-op students' change in confidence in their career orientation. Since it was also found that change in career self-efficacy was influenced by change in work self-efficacy, it appears that each form of self-efficacy has an impact on the other.

Relationship between co-op quality and subsequent self-efficacy. As noted in the description of the data, a set of questions were included to measure the quality of students' co-op experiences, such as their intellectual challenge or their application of subject-matter knowledge. The composite scale composed of the ten co-op quality indicators did not enter the efficacy change regression equations, but separate regressions were run for the post measure of work self-efficacy (as well as the other efficacy measures).

In the regression for work self-efficacy after students' first co-op, three co-op quality dimensions were found to be significant predictors. The most potent predictor was whether the co-op placement made a difference to the unit or organization employing the student. The second was whether the placement allowed the student to be part of a team, and the third was whether the placement applied knowledge in the student's major. It also turns out that this latter co-op quality measure appeared significantly in the two other regression equations. In other words, placements that afford students opportunities to apply knowledge enhance the students' career and academic self-efficacy as well as work self-efficacy. Career self-efficacy was also found to be bolstered by placements that provided students with opportunities for feedback on their performance.

Ancillary findings. There are two clusters of findings not related to self-efficacy that are of interest to report to co-op faculty and administrators, even though the select sub-samples are too low to infer statistical significance. The first is a report of our data on mentorships, limited to those students who sought out a mentor affiliated with a women-in-engineering or multicultural engineering program. For these students, a solid association was found between the perceived support received from one's mentor and six of the ten co-op quality dimensions. Mentors appear to make a difference in assisting students in getting the most out of their co-op experiences.

Secondly, continuing our attention on internships and their distinctiveness, the study differentiated those internships that were connected to the students' majors and those that were not. The same quality of placement questions were also administered to both sets of interns. Although only 16 of the 118 internships were reported as not connected to the major, it was discovered that the mean score for all 10 of the quality measures for these internships were lower than for those internships connected to the major. As would be expected, the difference between these two types of internships varied most dramatically on the measure of the placement's applicability to knowledge in one's major (by over 1 point on a scale from 1-5), but two measures also exceeded a difference of .5, specifically, having a placement with an attentive supervisor and one that involved the intern as part of a team.

Table 4.

Regression for Work Self-Efficacy Change

MODEL SUMMARY

R	R^2	Adjusted R^2	Standard Error of the Estimate
0.555[a]	0.307	0.287	0.431

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	41.963	15	2.798	15.038	0.000
Residual	94.501	508	0.186		
Total	136.464	523			

ENTERED VARIABLES [b]

	Unstandardized Coefficients		Standardized Coefficients		
	B	Standard Error	Beta	t	Sig.
(Constant)	-.246	.701		-.352	.725
Career Self-Efficacy change	.498	.039	.540	12.928	.000
Co-op participation	.123	.044	.112	2.789	.005
Contextual support change	-.047	.041	-.049	-1.133	.258
Advisory support change	-.021	.022	-.038	-.922	.357
Amount of prior work	.009	.013	.028	.703	.483
SAT scores	.089	.000	.020	.518	.605
Financial support change	-.008	.017	-.018	-.479	.632
Academic Self-Efficacy change	.011	.032	.014	.329	.742
Living in learning dorm	.010	.039	.010	.258	.797
Change in GPA	.011	.088	.005	.121	.904

a *Dependent variable is Work Self-Efficacy change.*

b *The demographic variables of age, socioeconomic status, and gender were also entered as controls in this equation, along with the extent of any current work experiences, but were found to be not at all significant.*

Conclusion and Implications

This study has developed one of the key components of a path model that ties cooperative education to students' self-efficacy, controlling for contextual support and students' demographic characteristics. At the third phase of the study, there will be a determination of whether co-op's impact (especially having a second co-op) can contribute to a reversal of the trend, especially among women, to drop out of their engineering concentration. Thus, while demonstrating the impact of co-op on self-efficacy, this article has not shown whether and how self-efficacy may lead to retention in undergraduate education. Further, this analysis has not taken into consideration the impact of time and latency sufficiently to estimate the structural relations between the study variables. Lastly, the co-op effect may be confounded by other latent conditions among the respondents since the comparison group constitutes

universities that do not provide formal cooperative education. A study that can obtain sufficient co-op and non-co-op data from the *same* institution would be recommended to override some of these latent confounding effects.

This study has introduced a form of self-efficacy that has received little attention in the literature, that being work self-efficacy. Work self-efficacy measures a range of behaviors and practices — e.g., exhibiting teamwork, expressing sensitivity, managing politics, handling pressure — attending to students' beliefs in their command of the social requirements necessary for success in the workplace. Since efficacy is shaped by performance accomplishments, it was theorized in this study that student success in their co-op jobs would enhance their confidence in performing a variety of behaviors that are particular to handling the requirements of the workplace.

The results have supported the link between cooperative education (both separate from and including internships) and change in work self-efficacy from the second to the third year. Change in work self-efficacy was also affected by change in student's confidence in their career orientation. However, cooperative education, unlike the recommendation of Weaver-Paquette (1997) and the research of DeLorenzo (2000), did not produce a unique effect on career self-efficacy. A likely explanation for this difference is that work self-efficacy — a new property heretofore unavailable in prior studies — is likely to have accounted for the variance in change in career self-efficacy.

An ongoing effort needs to be made by those responsible for placements that the quality of the experience be an affirmative training ground that not only teaches productive work skills but also productive work habits that may transfer into full employment when the time comes.

In examining the quality of the co-op experience that affects work self-efficacy, it was found that when the placement afforded students a chance to make a difference, to be part of a team, and to apply knowledge from their major, subsequent work self-efficacy was significantly enhanced. This finding is consistent with the practical view (see, e.g., Ryan, Toohey, & Hughes, 1996) that not all work experience programs are of equal value. An ongoing effort needs to be made by those responsible for placements that the quality of the experience be an affirmative training ground that not only teaches productive work skills but also productive work habits that may transfer into full employment when the time comes.

Co-op students were also found to rely less on support provided by their colleges, friends, and parents or as provided by their academic advisors. Although this finding may be initially discomforting, it may also reflect a maturity required of co-op students or interns now having to fend for themselves more independently in the working world. It may also lend insight into findings (see, e.g., Gardner & Koslowski, 1998) that have shown a reduced *reality shock* among co-op students once they have to fully enter the workforce.

Co-op students were also found to value the instruction of their professors less once returning to class after their first co-op experience, a reflection of a possible mismatch between the

expectations of the returning student and the classroom instructor (see, e.g., Auburn, 2007). Some instructors may simply not wish to or may not know how to take sufficient advantage of their students' newfound knowledge and maturity to enhance the classroom experience. In fact, it is conceivable that students fresh from the field may be able to provide an updating of some engineering applications. This would require, however, an explicit attempt by the respective instructor to involve returning students in voicing their new knowledge and contributing to the lessons that have obvious workplace implications. Besides the foregoing rationale for the reduction in co-op students' teaching quality assessment, an alternative explanation is that some co-op-based engineering programs have given special emphasis to dynamic instruction during the freshman year (versus the subsequent years) as a means to enhance first-year retention.

[W]ith the addition of the measure known as work self-efficacy, this study has claimed to open up the black box to show that co-op's eminent contribution to undergraduate studies is based on its enhancement of a special form of self-efficacy that addresses the confidence acquired during co-op in handling the demands and requirements of the workplace.

Finally, throughout much of the history of cooperative education in undergraduate study, there has been affirmation of the value and contribution of cooperative education to students' personal, career, and academic development. However, the actual contributory processes of co-op have been benignly assigned to what has been referred to as the *black box of co-op* because it was thought to be too complex a proposition to determine the complexity of co-op's operational impact. Now, with the addition of the measure known as *work self-efficacy,* this study has claimed to open up the black box to show that co-op's eminent contribution to undergraduate studies is based on its enhancement of a special form of self-efficacy that addresses the confidence acquired during co-op in handling the demands and requirements of the workplace.

With the identification of the components of work self-efficacy, co-op administrative staff and supervisors/preceptors in the field can now focus on the specific meta-competencies associated with this form of efficacy; namely, work learning, problem solving, stress management, role identification, teamwork, sensitivity, and handling politics. In particular, since these competencies are eminently learnable, they can be explained and modeled for students through mentorship and on-the-job demonstration, practice, and feedback. They can be incorporated into their co-op evaluations and raised publicly in any post-co-op reflection meetings held with their co-op advisor. Students should also be given assignments that may enhance these vital work-based skills, and a work culture should be fostered that encourages open dialogue and reflection concerning students' development of their work self-efficacy.

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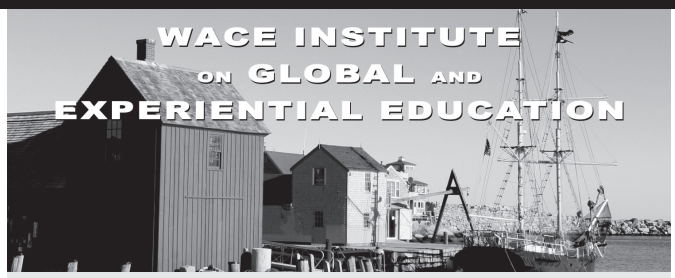

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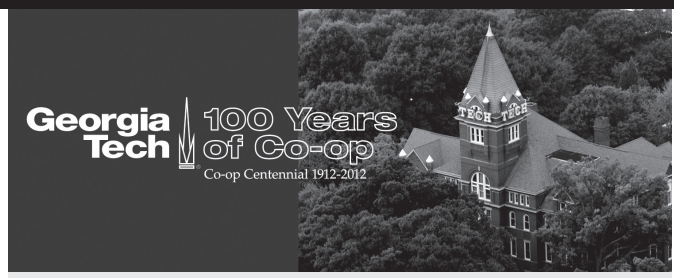

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Professional Placement Educational Processes: Balancing Student-Centred Education and Client-Centred Care During Clinical Education

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Abstract

To date, the literature regarding clinical education strategies that simultaneously meet both the student's and the client's needs is limited. This paper reports on a study that aimed to identify features of clinical education processes that epitomize student-centred education as well as client-centred care. Focusing on physiotherapy pre-professional education, a mixed method approach using quantitative and qualitative methods was used within the analytical and interpretive paradigm of research.

Kolb's (1984) Experiential Learning Cycle was proposed as a model to explore contemporary clinical teaching practices. This model was found to be insufficient to maximise a student's learning from practice because it did not include the voice of third party, the client, in an educative way. A 6-Step framework emerged which extends Kolb's original model by adding two aspects of typical teaching and learning in clinical situations: The seeking of client consent and the post-consultation evaluation of outcomes which includes the clients' perspective of events.

Given that it is widely advocated for entry level health professionals to be client-centred, this emerging educational framework has the potential to significantly impact on the student's development of a client-centred approach to clinical practice.

Keywords: Student-centred teaching, client-centred care, clinical education, clinical teaching

Introduction

Numerous studies have explored clinical education from the perspective of the student, the educator, or the client, either singly or in combination of two of the three parties. However, no single study in the health disciplines has explored clinical education, in-depth, from the perspectives of all three key participants in this experiential learning situation.

One of the key distinguishing features of all experienced-based learning events is that the student typically occupies a central place in all considerations (Andresen, Boud, & Cohen, 1995; Kolb, 1984). However, during in-situ, real time clinical education events the client is the central focus of the teaching and learning. Any reflection-on-practice the student engages in ought to include the client's perspective of the event, for it is likely that in any clinical experience the client might make a pivotal contribution to a student's learning.

A number of theories are relevant in any given experiential learning situation (e.g., Bandura, 1986; Bruner, 1961; Knowles, Elwood & Swanson, 1978; Lave & Wenger, 1991; Vygotsky, 1978; Wenger, 1998) but it is Kolb's Experiential Learning Cycle that synthesises many aspects of these theories and mirrors their intentions and which is widely adopted in clinical education practice. Kolb's conceptual map outlines the cycle of thinking the students might take to transform their practice experiences into professional knowledge. The student first has the experience of the more concrete phase. This is followed by a period of educator-led thinking through their experience, during which they make meaning of their experience. Within the next stage the student typically engages in rethinking and reformulating his or her preconceived ideas before engaging in another learning situation. At all four stages it is expected that the educator will guide the student's thinking and reasoning.

Smith and Irby (1997) explored the application of Experiential Learning Theory to improve medical students' education in the ambulatory care education setting. Smith and Irby advocated that mindfulness of the framework acknowledges the shift in the clinical educator's role from purveyor of information to *facilitator* of learning. In order to assist the educator to make that shift, Smith and Irby suggested the clinical educator needs to: **1)** plan the experience in carefully selected settings, **2)** facilitate reflective observation, **3)** encourage conceptual thinking and inquiry, and **4)** promote feedback and testing of insights.

This research explored the features of an undergraduate physiotherapy program in one university. It combined the perspectives of the three participants involved in physiotherapy clinical education: educators, students, and clients. A full report of the entire study is beyond the capacity of this paper. Hence, the focus here is on reporting how an elaboration of Smith and Irby's ideas and Kolb's model of experiential learning can be adapted in order to include the client's voice and therefore more accurately reflect teaching and learning strategies in real-time, in-situ, health professional clinical education situations.

Methodology

Specifically designed surveys were disseminated to students and clinical educators. The surveys explored, among other topics: the timing and content of student–educator dialogue about client care. Thirty-seven physiotherapy educators responded to the survey, giving an overall response rate of 47%. The total number of student responses was 94. This consisted of 20 third-year students, giving a 100% response rate from that cohort, and 74 fourth-year students, giving a 77% response rate.

After the responses to the surveys had been analysed, observations of clinical education scenarios took place and these were followed by interviews with the clients, educators, and students involved. The areas explored included, but were not limited to, the nature of client-educator-student dialogue during clinic education scenarios, and the clients' views on the scenarios and whether or not the care provided met their needs.

Between August 2006 and March 2008, 12 observations of clinical scenarios were undertaken. These and subsequent interviews were undertaken by the researcher. The duration of each observation was in excess of 30 minutes. They comprised of: seven in private practice; four in public hospital outpatient clinics; and one in a private hospital outpatient clinic. In all, there were 6 clinical educators, all of whom had more than 3 years of experience in clinical education, 15 students, which constituted a mix of third and fourth year students, and 12 conscious and ambulatory clients who all spoke English.

Results and Discussion

The timing and frequency of educator-student discussions about client care. The survey asked students and educators to record how often they met at the designated intervals for discussion about each client's case. The results revealed a general discrepancy between the means scores of the two groups and there was also a discrepancy across the four different clinical settings in which the participants worked. The students in private practice clinics and private hospitals reported that *briefing sessions* were infrequently held; however, the educators' views differed. Educators and students in the community clinic settings agreed that discussion *during consultations* and *de-briefing sessions* occurred irregularly (the students' reports indicated a lesser frequency than their educators). Of more concern was the low mean score in the students' report of the frequency of de-briefing sessions across the board, which was almost the reverse of the educators' report.

The literature reported that the frequent student-educator discussion is highly valued by students (Saarikoski, Leino-Kipi, & Warne, 2002). Other authors advocate for briefing sessions to prepare students for the client–student encounter. Discussions during a consultation are said to allow the educator to monitor client and student progress.

De-briefing sessions provide students with an opportunity to discuss their experiences in order to critically evaluate their thinking and performance (Daelmans et al., 2004; Hart & Rotem, 1994; Hummell, 1997; O'Sullivan, Martin, & Murray, 2000; Raiser, O'Grady, & Lori, 2003; van der Hem-Stokroos, Daeknabs, van der Vleuten, Haarman, & Scherpbier, 2003). De-briefing sessions are the very essence of the Experiential Learning Cycle (Kolb, 1984). Overlooking regular de-briefing sessions has the potential to inhibit students' opportunities to reflect on their practice, to develop the habit of critical reflection and for the educators to guide such reflections.

It cannot be understated that moments of educator-student dialogue, even when brief, are opportunities for students to learn from the acumen of experienced practitioners in their discipline, and for the educator to hear and assess the student's thinking, reasoning and judgements (Ferenchick, Simpson, Blackman, DaRosa, & Dunnington, 1997; Guyatt & Nishikawa, 1993; Heidenreigh, Lye, Simpson, & Lourch, 2000; Kurth, Irigoyen, & Schmidt, 1997; Lipsky, Taylor, & Schnuth, 1999; Neher, Gordon, Meyer, & Stevens, 1992; Raiser et al., 2003; Ramani, 2003; Ramani, Orlander, Strunin, & Barber, 2003; Roth, 1996). Without knowing how the student judges clinical events, the educator is unable to accurately tailor teaching events to meet the student's learning needs.

The topics of educator and student discussions about client care. Both students and educators were asked to indicate how often they discussed a list of given topics related to client care. The topics fell under the broad headings of: assessment, planning, intervention, evaluation and discussion of rationale. It was discovered that there is a clear disparity between what the two groups reported regarding the timing of their discussions about episodes of client care.

An independent *t*-test analysis of the means showed that the differences were statistically significant at the ($p<0.001$) level. Overall, the results revealed a lack of reflection, and a lack of a discussion of the rationale for clinical decision-making.

The topics discussed most often were: the symptomatology, current status of the client, salient features of the case history, strategies for assessment, the findings from diagnosis and assessment, and the rationale for them: the technique/intervention selection and the rationale behind them and the implementation of the intervention.

The topics discussed less often were: the continuum of care and advice given to client for between visits, the student's experience with similar cases, and the criteria to evaluate response to care and the rationale for the chosen criteria.

Table 1. *The issues students and educators discuss.*

Topics of discussion with sub-items	Students' report		Educators' report		
	mean	SD	mean	SD	95% CI
Assessment					
a) The salient features of the case history	3.61	.912	4.54	.650	0.607 - 1.26
b) The symptomatology	3.65	.813	4.59	.644	0.646 - 1.240
c) The current status of the client	3.94	.958	4.54	.558	0.263 - 0.930
d) The diagnosis	3.81	.796	4.51	.692	0.407 - 1.002
e) Strategies for assessment	3.81	.928	4.41	.686	0.262 - 0.931
Planning					
f) The findings from diagnosis/assessment	3.81	.851	4.73	.450	0.628 - 1.214
g) Technique/intervention selection	3.83	.895	4.68	.530	0.532 - 1.156
Intervention					
h) Implementation of the intervention	3.71	.920	4.43	.647	1.383 - 2.960
Evaluation					
i) The criteria for determining the response to treatment	3.44	.878	4.32	.580	0.575 - 1.197
j) The continuum of care and advice given to client for between visits	3.57	.878	4.32	.709	0.429 - 1.074
Discussion of rationale					
k) The rationale for the diagnosis	3.52	.851	4.41	.762	0.564 - 1.203
l) The rationale for the assessment strategy	3.57	.960	4.41	.644	0.498 - 1.179
m) The rationale for the treatment/intervention	3.82	.856	4.51	.607	0.385 - 0.997
n) The rationale for the criteria to evaluate response to care	3.41	.970	4.14	.787	0.368 - 1.080
o) The rationale for the continuum of care/advice for client between visits	3.47	.877	4.03	.897	0.219 - 0.901
p) The rationale for overall treatment plan	3.61	1.024	4.38	.639	0.408 - 1.127
q) What the client contributed to the discussion/care plan	2.89	1.326	3.49	.932	0.126 - 1.075
r) The students experience with similar cases	3.02	.977	3.41	.832	0.020 - 0.746

Both the student survey results and the findings from the observations of real-time clinical education events showed there was a broad-spectrum lack of discussion of the continuum of care and advice given to the client between visits. These findings indicate that the educational event was focussed on the immediate practice with the client and did not take the natural extension of practice into consideration. From this research one can see that this reflects a superficial level of client-centredness, as it does not embrace the whole gamut of practice.

The need to discuss students' experiences of similar cases, for example, as noted by Boendermaker et al., (2002), has the potential to inhibit the development of the student's skills in reflection as well as in critical thinking, clinical reasoning, comparative analysis, and interpretation of the success of treatment outcomes.

A lack of discussion of the criteria for determining response to treatment has the potential to limit the student's skill and knowledge development in understanding treatment outcomes. Also, the student's understanding of the rationale for diagnosis is critical to their integration of theory to practice, which is the overarching aim of clinical education (Australian Physiotherapy Council, 2006; Cooper, Orrell, & Bowden, 2003; Dunn & Saintonge 1997; Fry, Ketteridge, & Marshall, 2005; Higgs & Edwards, 1999; Higgs, Glendenning, Dunsford, & Panter, 1991; Irby, 1986).

Lack of discussion about the advice given to the client for the period between visits and the criteria to evaluate responses to care are also concerning, because it is only during assessment and evaluation that subtle patterns and deviations from normal responses can be detected in the client's condition. Advising what the client is to look for and how they are to manage themselves between consultations is critical to a positive clinical outcome. Without thorough knowledge of assessment options and clear criteria to judge response to care it is difficult for a health practitioner to tailor treatment to the individual client. Further, without clear goals it is difficult to determine if the care-plan needs to be revised. In addition, without clear criteria the student is unable to identify his or her own clinical strengths and weaknesses which may hinder their transition from a student to a professional.

The combination of knowing what are the least topics discussed between the students and their educators and the awareness of the irregular occurrence of de-briefing sessions raises concern of the ability of the educators to develop the metacognition of the students and their self assessment as well as their on the spot analysis of a situation. These skills are critical to developing situational understanding, which is what the educators aspire to.

If educators are aware of what topics the students want to discuss and areas of their work they would like to have feedback on, then their management of clinical education would more precisely reflect their intention, which is to help students develop the necessary skills required of the relevant government authorities and accreditation bodies. These results suggest a lack of observance of the notion of student-centred learning.

It seems that this cohort of clinical educators, like those in the study of physiotherapists by Morris and Stew (2007), "need further guidance when promoting reflection on practice" (p. 419). This is particularly important given that the ability to provide such reflection, according to Boendermaker et al. (2002), is a hallmark of an effective clinical educator.

Observations of scenarios of clinical education. Clinical educators' survey data showed students and educators share a universal understanding of the meaning of client-centred clinical practices. The Observation Audit Tool captured client-student-educator dialogue concerning the clients' understanding of the health care event, their expectations of the treatment outcome, their agreement with the plan, what to do if they were concerned about anything between consultations, how they were feeling, and if they were in any pain. It was found that some of these issues were absent from their verbal exchanges on several occasions. This indicates that the full extent of the opportunity for the educator to role-model client-centred behaviour was not utilized on all occasions.

Harris and Naylor (1992), wrote that the feature of a well planned clinical practicum is evidence that students are encouraged to be client-focused rather than technique-focused. Haidet et al. (2006), and Potter, Gordon, and Hamer (2003) also advocated client-centredness, stating that a client-centred clinical atmosphere, together with encouragement to be client-centred, and the example set by clinical educators, indicates to students that client-centredness is an important issue and the results of the observations flag this as an issue for physiotherapy clinical educators to consider.

The views of the client. Interviews with clients, after the aforementioned observations, revealed that, in the main, they are satisfied that the clinical education events do meet their expectations and their health care needs. Clients have a positive attitude toward participation in physiotherapy clinical education events and they do so with a balanced sense of altruism and self-centeredness. The views of clients ranged from the belief that the student may bring an additional, fresh eye to diagnosis and treatment, to concern over the ability of a student to adequately diagnose or treat real clients.

One concerning outcome of the study is the fact that not all clients gave students genuine feedback. In one observed clinical event, for example, the client gave *non-verbal* clues that he was physically uncomfortable during treatment and did not agree with the treatment plan. This was not detected by the student. These considerations indicate that educators need to be more explicit with clients when they ask for consent to have students involved in their health care. Genuine client feedback to students will undoubtedly maximise learning opportunities, minimise risk to the client and student safety, and ensure clinical education is client-centred. A diminished awareness of the client experience may lead to the student developing an artificial understanding of client behaviours, tolerances and the benefits and effects of some types of clinical procedures and interventions.

When the day-to-day events of actual clinical practice are considered against Kolb's experiential learning framework it becomes clear that, with the addition of two extra steps in the framework, the client's voice can be added to more accurately reflect learning in the clinical context.

The step model. While it was not the intention of this research to design a framework for clinical education, what emerged from the literature (Ferenchick et al., 1997; Guyatt & Nishikawa, 1993; Heidenreigh et al., 2000; Martin, Morris, Moore, Sadlo & Crouch, 2004; Moore, Morris, Crouch & Martin, 2003; Neher et al., 1992; Raiser et al., 2003; Ramani, 2003; Ramani et al., 2003; Roth, 1996; Smith & Irby 1997), together with the findings from this study undertaken by survey and also in real-time, in-situ clinical education is a Six-Step framework for clinical education. This framework accommodates Kolb's (1984) model, extends Smith and Irby's (1997) adaptation, and acknowledges the client as a major contributor to the student's learning. This framework facilitates verbal interactions by the three members of the triad: the client, the educator, and the student.

Any, even brief, dialogue that takes place during client care in the complex milieu of the clinical practicum means that student actions and client safety can be checked and monitored. When there is sufficient time, the extent of the student's knowledge and their rationale for their thoughts and actions can be explored more fully.

When Kolb's (1984) framework is accommodated in such a way, the management of learning events and processes, conceptualised in Figure 1, consist of the following 6 steps:

1) Seeking client's informed consent (ethical principles), **2)** briefing the student, **3)** managing the consultation, **4)** evaluating outcomes, **5)** de-briefing, and **6)** contemplation and research.

Seeking client's informed consent. The client is entitled to know that the person involved in their care is a student (Kapp, 1983, 1984a, 1984b; Kinsman, 2000; Klig, 2003; New South Wales Phisiotherapy[NSW] Registration Board, 2010). Therefore, the inclusion of this step in the Learning from Experience framework establishes the parameters of student involvement. It has the potential to engage the client more fully and enhances the likelihood of *value-adding* to the learning event.

Briefing the student. During student preparation for a client, it is important for the clinical educator and student to discuss what they each know about the case. This involves sharing knowledge of the history and current status of the client and their health care problem. This also involves discussing the student's previous experience with similar cases to scaffold their knowledge. At this point, there can be discussion around potentially sensitive or anxiety provoking issues. The role of the student in this particular episode of care and the activities they will undertake should be clarified.

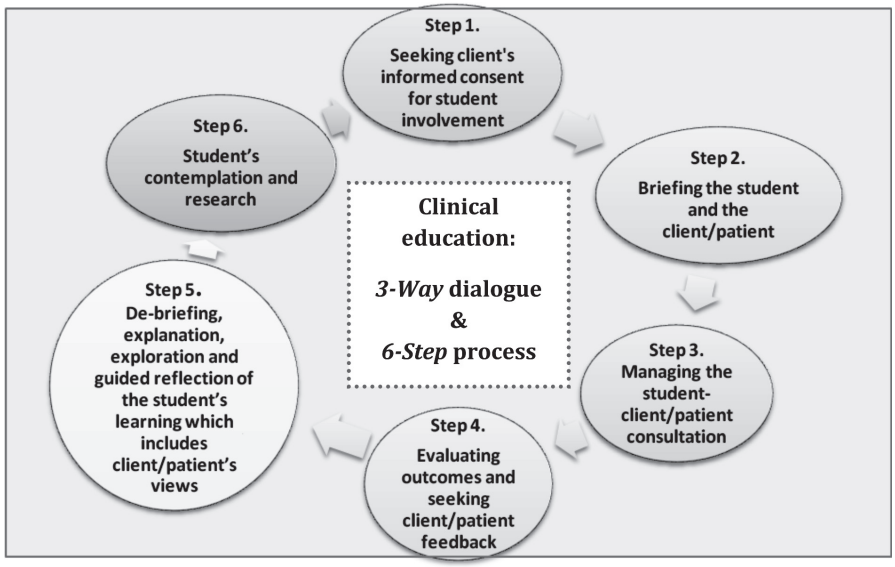
Managing the consultation. This is when the student has the concrete experience (Kolb, 1984) of working with a client. The flow of dialogue in this step is dependent on the model of supervision being used. Dialogue during a consultation offers the educator an opportunity to get an update on the client's and student's needs, partly to assess the appropriateness of the client-student match. A three-way dialogue can ensure that the initial plans for the student's involvement in the case are still appropriate. A purposeful and loosely constructed moment of discussion, prompted by the educator, safeguards the vested interests of all participants in the clinical education triad. Should difficult circumstances arise, the educator and the student can withdraw for private discussions, thus limiting potential anxiety for both the student and the client.

Evaluation of the outcomes — seeking client's views. At this stage the educator can review the outcome of a client-student consultation, such as confirming any advice given by the student and assessing the client's reaction to the intervention and their level of satisfaction. The educator is able to bring client feedback to the attention of the student in Step 5. The literature reports repeatedly that clients have a right to self-determination and are well disposed to participating in clinical education if they feel empowered by a positive partnership with staff and students (McCormack & Corner, 2003; Weir, 2000).

De-briefing: The explanatory, exploratory and guided reflection. At an appropriate time, there is a need to more fully explore students' rationale for clinical decisions, including: diagnosis, short and long term assessment strategies, and treatment/intervention. These extended discussions, at the educator's discretion, can also include the feedback from the client. Further, it is imperative for the student's continued development of reflection on practice that each case is explored for its similarities and differences with other cases.

Contemplation and research. This phase of the learning from experience cycle usually takes place between consultations. Inherently, the student will take something away from each episode of client care and add that to their developing schema in their clinical memory. They will form new concepts to test in new situations (Kolb, 1984). It is expected that students will develop the capacity to identify gaps in their knowledge and skills and either seek advice or undertake research to fill those gaps.

Figure 1. *Clinical Education: A 3-way dialogue and 6-step process*



Conclusion

This study was confined to an investigation of clinical education in the physiotherapy program at one university and the samples of clinical education and healthcare events were idiosyncratic snapshots of practice. It was found that students and educators share a universal understanding of the meaning of client-centred clinical practices.

It was found that clients have a positive attitude toward participation in physiotherapy clinical education events and they do so with a balanced sense of altruism and self-centeredness. Clients are, in the main, happy that the clinical education events meet their expectations and their health care needs. On some occasions clients edit the feedback they offer students with the idea that their genuine thoughts might negatively affect the students learning. If this is not checked in the normal course of management of clinical education, it is possible that students might develop a false sense of how their activities actually affect clients. The student may develop a false sense of their skills and abilities.

One of the new insights from this research included the need to consider the extent to which optimal outcomes for clients and students depends on the preparedness of clinical educators for their educative role through formal programs of professional development which include an assessment of their readiness for their position. There is a need to:

- strengthen the alignment between students learning needs and educators foci of discussion,
- raise awareness of the importance of de-briefing as an opportunity for promoting deeper reflection on learning,
- emphasise student-educator discussions about how the client can contribute to the management of their own care between each therapeutic consultation (Omitting such discussion with students undervalues the requirement for the client to assume particular levels of responsibility for their own care),
- be more explicit about the active nature of the clients' role in the learning event.

The proposed 6-Step framework for clinical education captures the voice of *each* member of the triad more accurately than previous published frameworks, enabling clinical education that is both student and client-centred. This concept for learning from experience may also be applicable to other situations in which higher education students undertake real-time, in-situ professional placement education involving clients, customers, patients, or patrons of any kind.

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An Exploration of Transfer of Learning Opportunities in an Online Co-operative Education Preparatory Curriculum

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Abstract

This study investigated the opportunities for the transfer of learning in a university-level online co-operative education (co-op) preparatory curriculum that is designed to support co-op students' transitions between the classroom and the workplace. An analysis of students' online discussions was undertaken for the primary purpose of determining if the thinking skills exhibited were consistent with what is understood about bridging techniques that support the transfer of learning. A thematic analysis based on a priori codes was used. Key findings with respect to demonstrating support for the transfer of learning are: 1) strong evidence for metacognitive reflection, 2) some evidence for anticipating applications and parallel problem solving, 3) limited evidence for generalizing concepts, and 4) weak evidence for using analogies. The findings have implications for those who design and teach in co-op programs and for further research.

Keywords: Bridging techniques, thinking skills, transfer of learning, co-op.

This study investigated the opportunities for the transfer of learning in a university-level online co-operative education (co-op) preparatory curriculum that is designed to support co-op students' transitions between the classroom and the workplace. Specifically, students' online discussions were analyzed to determine if the thinking skills exhibited were consistent with what is understood to support the transfer of learning.

Context

Co-operative Education programs are the prototypical educational models that are meant to bridge academic learning with workplace learning and to provide structure (administrative and pedagogical) for that learning experience. Co-op programs provide students with the opportunity to realize that academic and workplace skills, knowledge, strategies and abilities are transferable between the two contexts. As such, co-op has the potential to serve as a vehicle that fosters the transfer of learning.

The first author currently works with a university-level online co-op preparatory curriculum which aims to foster the transfer of learning. The curriculum is an outcome of Johnston's (2003) findings that identified co-op students as more successful in securing work and being successful after graduation than non-co-op students if "self-direction, skills acquisition, and transfer" (p. 8) were explicitly practiced. Johnston's (2003) conclusions align with those of Ricks, Cutt, Branton, Loken, and Van Gyn (1993), Schaafsma (1996), and Van Gyn (1996) who all argued that the work experience in itself is insufficient to ensure transfer of learning. The goals of the online preparatory curriculum are multi-fold and aimed at helping "students better interrelate their school and workplace experiences by emphasizing the process of learning and practice that occur in both and by helping students take more control of their learning and work" (Brown, 1998, p. 6). Additionally, since students rarely make the connections between the social context of school and the workplace (Brown, 1998; Johnston, 2007), the online preparatory curriculum understands transfer as complex and difficult, particularly "because so many features of the two contexts are different" (Brown, 1998, p. 7).

The goals of the online preparatory program are achieved through four learning modules, each with related reflection exercises that students are required to respond to via the online discussion forums. Online discussions occur among peers, the course facilitator, and a co-op employer expert (a working professional from industry). The reflection exercises intend to engage students in social interactions and critical thinking as they share personal experiences and reflect on the chosen topics; importantly students are asked to comment on and build on the ideas of their peers. Table 1 shares a sample of two reflection exercises drawn from the curriculum. The discussions leave room for emergent dialogue and exploration of other topics should students choose to venture in new directions, pose thoughts, or question one another. The intent is to get students to participate actively and collectively as they improve their ideas and share experiences around pre-employment preparation, skills transfer, and personal and professional career development. In this way, the curriculum explicitly teaches the thinking skills required for the conceptual transfer of learning.

Table 1. *Sample Reflection Exercises*

Topic: Metacognition Provide an example of a time you reflected about something you did. Describe the situation and what questions you asked yourself about it. What did you learn and how could you use that to your advantage in future situations? Did you generate any generalizable strategies from the situation? *Tip: While reviewing the postings of your peers, develop a personal list of tools/strategies that you may use to promote metacognition.*
Topic: Enhancing Skills Transfer Name two things you would do to help transfer your skills. Think about how you would use this to prepare for an interview for a position that is different from anything you have done before. Hint: Using a metaphor will assist your ability to transfer your learning by seeing the shared generalizable principles between two situations. *Tip: Once you have read the postings in the discussions that exemplify various generalities, you will notice how two systems often look more similar than they did at first.*

Transfer of Learning

The transfer of learning is fundamental to co-operative education in particular and professional development more generally. It has been assumed that thinking skills necessary for the transfer of learning are acquired as part of formal schooling. Yet Pea (1987) argued that the importance is in synthesizing the "abstract treatment of reasoning considered as the support for transfer of learning, otherwise, students may not notice occasions for school-type reasoning outside the school setting" (p. 52). Bransford, Brown, and Cocking (1999) and Lave (1996) also advocated for abstract representations of knowledge in order to promote transfer of learning, as knowledge that is overly contextualized may impair transfer. Studies that support the positive outcomes of abstract instruction are prevalent. Beiderman and Shiffrar (1987) demonstrated that transfer improved considerably if the instruction involved teaching about the abstract principles inherent in a learning situation. In a study by Singley and Anderson (1989), students showed positive transfer of learning with new text editors if the common abstract structures were identified even if the surface structures were largely different. Further studies by the National Research Council (1994) showed benefits for transfer of learning when learners were asked to represent their experiences and learning at abstract levels that transcend the specificity of the context of acquisition. Holyoak (1984) and Novick and Holyoak (1991) demonstrated that abstract representations become integrated into the learner's schema (the learner's guide to thinking) and do not remain in isolated activities. Finally, Gick and Holyoak (1980) showed that in order to foster flexible transfer, learners were instructed in abstract and general principles and this engaged the learner in the *what-if* problem solving, designed to increase the flexibility of understanding.

Marini and Genereux (1995) stated that the transfer of learning research findings in education and training are "replete with reports of failure" (p. 1) suggesting that significant transfer is difficult to achieve. Educators now understand that transfer may not even occur in situations where it would be readily expected. Consequently, it has been argued that in order to enhance the transfer of learning, educators need to explicitly teach for transfer (Bereiter & Scardamalia, 1986; Palincsar & Brown, 1984; Schoenfeld, 1985). Costa and Garmston (2002) also discussed the need for explicit instruction of thinking skills by way of direct and systematic instruction because learners often do not learn *how to think or think critically* merely by being asked to do so. A key outcome from the transfer of learning findings demonstrates that learners' ability to think critically does not automatically result from study in academic disciplines or subjects. As such, understanding the instructional strategies that are capable of supporting transfer is critical to achieving this goal.

Pea (1987) suggested specific instructional strategies that support thinking skills for the transfer of learning based on his synthesis of the relevant research. The instructional strategies included "learning about and practicing knowledge application in multiple contexts of use, constructively participating in bridging instruction across school and non-school problem situations, thinking and self-management skills taught within domains, and synergistic integration of the learning of different subjects" (p. 38).

It has been suggested that instructional strategies related to teaching thinking skills for the transfer of learning are of two formats, namely *hugging* and *bridging* techniques, both originally discussed by Salomon and Perkins (1988). Hugging techniques foster the transfer of learning by "making the learning experience more like the ultimate application" (Fogarty, Perkins, and Barrell, 1992, p. xii). Fogarty et al. (1992) identified five hugging techniques: **1)** setting expectations, **2)** matching experiences, **3)** simulating situations, **4)** modelling application contexts, and **5)** employing problem-based learning. Bridging techniques foster the transfer of learning by making explicit for learners the conceptual connections between what has been learned and a novel application by "mindfully abstracting knowledge and skills from one context and applying them in another" (Fogarty et al., 1992, p. 64). The techniques are complex instructional strategies that involve, "teaching a general principle and then helping students see how it works in multiple situations" (Pea, 1987, p. 51). Feuerstein, Rand, Hoffman, and Miller (1980) used bridging problems to 1) help students draw on their own experiences, 2) increase the potentially infinite number of applications of principles to authentic experiences, 3) generate examples that index the student's level of understanding, and 4) give students the opportunity to apply the principles in diverse contexts. Lave (1996) stated that bridging instruction was a wisdom that prepared the learner for life and learning in context-free terms. These techniques foster the type of thinking skills that support the transfer of learning required in any co-op preparatory curriculum. Table 2 provides the five bridging techniques as defined by Fogarty et al. (1992).

Table 2. *Bridging Techniques Defined*

Anticipating Applications Anticipating applications is defined as thinking about upcoming opportunities to use new ideas in a different context. Furthermore, it involves thinking about adjustments that will make the application relevant, otherwise referred to as scouting for relevant uses. In anticipating applications, diverse applications are targeted rather than assuming spontaneous transfer will occur. Some examples include asking students to predict possible applications remote from the learning context. For example, after students have practiced a thinking skill, the instructions may ask: Where might you use this or adapt it? Let's brainstorm, be creative and list the ideas and discuss them.
Generalizing Concepts Generalizing concepts is defined as asking students to extract the generic ideas out of a situation and encourage the use of generalizable concepts through looking for principles, big picture ideas, or underlying constructs. Some ways of doing this is to ask students to generalize from their experience to produce widely applicable principles, rules, and ideas. An example from Fogarty et al. (1992) asks after studying the discovery of radium, ask, "What big generalizations about scientific discovery does the discovery of radium suggest? Can you support your generalizations by other evidence you know of?"
Using Analogies Using analogies is defined as finding, creating or analyzing analogies as well as comparing and finding similarities between situations using metaphors to make creative connections. Some ways of doing this are to engage students in finding and elaborating an analogy between a topic under study and something distinct from it. An example from Fogarty et al. (1992) asks students to compare and contrast the structure of the human circularity system with the structure of water and waste services in a city. The systematic comparison of unpacking the analogy by elaboration and extending the thinking will force the transfer of learning between different situations.

(Table 2 content continues on next page)

Table 2. (continued) *Bridging Techniques Defined*

Parallel Problem Solving Parallel problem solving is defined as solving problems with similar structures and content in different contexts; further gaining an understanding for the similarities and contrasts between areas. Some ways of doing this are to engage students in solving problems with parallel structures in two different areas in order for them to gain an appreciation for the similarities and contrasts. For example, Fogarty et al. (1992) had students investigate a (non sensitive) problem in their home environment and a study problem in school, using the same problem solving strategy. The instruction helped students to draw out the parallels and differences.
Metacognitive Reflection Metacognitive reflection is defined as thinking about thinking; planning, monitoring and tracking one's progress, and evaluating one's thinking. Also, metacognitive reflection is being able to control one's thinking and subsequent behavior. Metacognition is being aware, strategic, and reflective in the use of thinking about thinking, and through this knowing, the learner will understand how to approach a task and how to approach it better in subsequent performances. Some ways to do this are to prompt and support students in planning, monitoring, and evaluating their own thinking. For example Fogarty et al. (1992) suggested that after a quiz or any thought-demanding activity, students ask themselves, "What went well, what was hard, and how could I handle what was hard better next time?"

Research Questions

The online co-op preparatory curriculum, with which the first author is associated, was designed to foster the transfer of learning. Thus, the primary research question was: ***In what ways do co-op students enrolled in the university-level online co-op preparatory curriculum show evidence for the thinking skills that underpin the five bridging techniques as outlined by Fogarty, Perkins, and Barrell, (1992): 1) anticipating applications, 2) generalizing concepts, 3) using analogies, 4) parallel problem solving, and 5) metacognitive reflection?***

A second and third research question were also investigated based on the first author's interest in the investigation as a co-op instructor and curriculum developer. The second research question investigated the perceptions of the course facilitators who instructed the learning modules and participated in the online discussions that were analyzed for this study. ***In what ways do the course facilitators understand the thinking skills of co-op students and the transfer of learning?***

The input of employers in co-op programs and curriculums is also highly valued and co-op programs strive for a good articulation between workplace values and academic values. Accordingly, this study also investigated how co-op employer experts valued, in the context of the workplace, the thinking skills as exhibited by the students in the online discussion. Although the co-op employer experts are not necessarily specialists in thinking skills for the transfer of learning, it was their personal view that was of interest to this study to add supplemental information that may have relevance for the curriculum. ***How do co-op employer experts value the thinking skills exhibited by students in the online discussions as useful in a workplace context?***

Method

Participants and data collection. Specific to the primary research question, undergraduate university students from across disciplines who had registered during the Summer and Fall 2009 academic year in a session of the online preparatory program (n=45) were invited to participate in the study; 28 (62.2%) voluntarily agreed. Online discussions were the data source used to address the primary research question investigating thinking skills exhibited by students. Ethical procedures in terms of consent to participate and anonymity were strictly adhered to.

To address the second research question, the first author held discussions with the course facilitators; 100% voluntarily agreed. The course facilitators were asked two question:

1. **What is your perspective about the thinking skills that students are using in the online discussions?**
2. **How do the thinking skills support the transfer of learning?**

To address the third research question, co-op employer experts were asked to complete a short activity; four of nine co-op voluntarily agreed. Co-op employer experts are industry professionals or members of the University's co-op alumni who interact online in an advisory capacity with students. The activity they completed began with a written rudimentary exposure to the concept of transfer of learning and the five bridging techniques as instructional strategies that are capable of supporting transfer. Co-op employer experts were then asked to read excerpts taken from the students' online discussions and asked to indicate for each excerpt if the thinking skills demonstrated were useful in a work context.

Data analysis. A qualitative content-analysis approach was used to address the first research question. Verbatim online discussions were imported into the qualitative data analysis software tool called HyperRESEARCH. A priori codes, derived from Fogarty et al.'s (1992) five bridging techniques (see Table 2) were used. A priori coding was used as the method of analysis to serve the purpose of the research and determine whether thinking skills exhibited in the online discussion were consistent with what is understood about bridging techniques. It was immediately obvious that the five main codes did not make possible a detailed enough inspection of the data and therefore, sub-codes for each a priori code were developed. Table 3 lists the a priori main codes and sub-codes.

Table 3. *Codebook*

Code	*Definition*
Anticipating Applications	
AA1	Demonstrates thinking about upcoming opportunity(s) to use skills, tasks, knowledge, and/or ideas in different general contexts
AA2	Demonstrates thinking about upcoming opportunity(s) to use skills, tasks, knowledge, and/or ideas in different specific contexts
AA3	Demonstrates thinking about how and why skills, tasks, knowledge, and/or ideas are relevant in an upcoming opportunity(s)
AA4	Demonstrates thinking about the adjustments that skills, tasks, knowledge, and/or ideas require in order to make them relevant in an upcoming opportunity
AAF	Facilitator prompts targeted thinking about upcoming opportunity to use skills, tasks, knowledge, and/or ideas
Generalizing Concepts	
GC1	Demonstrates extracting generic idea out of a situation through looking for principles, rules, big picture ideas and/or underlying constructs
GC2	Demonstrates application of generalizable principles, rules, big picture ideas and/or underlying constructs to new context (s)
GCF	Facilitator encourages use of generalizable concepts through looking for principles, rules, big picture ideas and/or underlying constructs
Using Analogies	
UA1	Demonstrates finding, creating, and/or analyzing analogies
UA2	Unpacks the analogy by elaborating on thinking
UA3	Demonstrates using metaphors to compare and find similarities between situations and to make creative connections
UAF	Facilitator prompts creation and/or elaboration on an analogy between differing contexts
Parallel Problem Solving	
PPS1	Demonstrates thinking about similarities between contexts
PPS2	Demonstrates thinking about similarities between contexts and explicitly identifies overlap(s)
PPS3	Demonstrates thinking about contrasts between contexts
PPS4	Demonstrates thinking about contrasts between contexts and explicitly identifies these
PPS5	Demonstrates thinking about how to solve problems with similar structures and content in different contexts
PPSF	Facilitator prompts drawing out of the parallels and differences between contexts
Metacognitive Reflection	
MR1	Demonstrates planning through thinking
MR2	Demonstrates self-monitoring, self-evaluation, and tracking of progress towards goal(s) through thinking
MR3	Demonstrates awareness of and/ or is strategic and reflective (control one's thinking) in thinking about how metacognition may be applied in subsequent performances
MRF	Facilitator prompts and supports planning, monitoring and evaluation of thinking

The first author established intra-coder reliability by doing the coding multiple times and making revisions as necessary. Once the coding scheme was stable, and in order to increase the internal credibility of the coding structure, the first author engaged the second author to code a sample of the data resulting in an inter-rater agreement of 87.2%. Percentage of agreement versus Cohen's kappa was selected for this study based on evidence presented in the literature. Although Cohen's kappa is typically the standard measure of inter-rater reliability for qualitative methods, and thought to be more robust than percentage calculations because it accounts for agreement that may occur by chance, Cohen's kappa has received some criticism for its affinity to take for granted a code's frequency thus resulting in an effect that underestimates the agreement for a code that is commonly used (Mayring, 2000). For these reasons, Cohen's kappa may be viewed as a cautious measure of agreement and was not employed in this study.

The analysis for the second research question involved the compilation of all the notes the primary author had recorded from the discussions with the course facilitators. As with the first research question, a priori codes derived from Fogarty et al.'s (1992) five bridging techniques were used.

The analysis to address the third research question focusing on co-op employer experts is included data in the form of comments and ratings. The comments were also coded using Fogarty et al.'s (1992) a priori main codes and the ratings within each a priori main code were tallied to generate a percentage of agreement among co-op employer experts.

Findings

The findings are summarized in Table 4. The first column of the Table lists the five bridging techniques (the a priori main codes). The next three columns report the findings for the three research questions based on data collected from students, facilitators and co-op employer experts.

Table 4. *The Findings*

A Priori Main Code	*Students*	*Course Facilitator*	*Co-op Employer Expert*
Metacognitive Reflection	Exhibited in 64.83% of total coded excerpts	Facilitators thought that students were able to illustrate evidence of metacognitive reflection showing consistency with findings from the primary data analysis. Course facilitators also cited metacognitive reflection as important for supporting the transfer of learning.	Co-op employer experts found 'evidence for' 66.66% of the total coded thinking skills that underpin the metacognitive reflection bridging technique useful in a work context to help student's transfer their learning.

(Table 4 content continues on next page)

Table 4. (continued) *The Findings*

A Priori Main Code	*Students*	*Course Facilitator*	*Co-op Employer Expert*
Anticipating Applications	Exhibited in 14.66% of total coded excerpts	Facilitators thought that students were able to show some evidence for anticipating applications showing consistency with findings from the primary data analysis.	Co-op employer experts found 'evidence for' 31.25% of the total coded thinking skills that underpin the metacognitive reflection bridging technique useful in a work context to help student's transfer their learning.
Parallel Problem Solving	Exhibited in 11.11% of total coded excerpts	Facilitators thought that students showed some evidence for parallel problem solving in the online discussions.	Co-op employer experts found 'evidence for' 64.0% of the total coded thinking skills that underpin the metacognitive reflection bridging technique useful in a work context to help student's transfer their learning.
Generalizing Concepts	Exhibited in 7.45% of total coded excerpts	Facilitators thought that students showed limited evidence for generalizing concepts as a thinking skill in the online discussions.	Co-op employer experts found 'evidence for' 100 % of the total coded thinking skills that underpin the metacognitive reflection bridging technique useful in a work context to help student's transfer their learning.
Using Analogies	Exhibited in 1.64% of total coded excerpts	Facilitators thought that students were not readily able to show evidence for using analogies as thinking skills and the student's and facilitator's understanding of using analogies was not consistent with what is understood as supporting the transfer of learning.	Co-op employer experts found 'evidence for' 33.33% of the total coded thinking skills that underpin the metacognitive reflection bridging technique useful in a work context to help student's transfer their learning.

Discussion

From the perspective of improving the online co-op preparatory program, it was important and potentially instructive to consider why the variety and frequency of thinking skills were exhibited as they were (see Table 4). Therefore, the discussion will consider the design of the reflective exercises and the perceptions of the course facilitators and co-op employer experts.

Reflection exercises. It is probable that some of the variability that was witnessed in the thinking skills exhibited is attributable to the transfer cueing affordances of the reflection exercises. To verify this, the first author undertook an analysis of the reflection exercises in the online preparatory co-op program in an effort to determine which thinking skills that underpin the five bridging techniques were supported in each reflection

exercise. The result was that some of the reflection exercises afforded more opportunities for some thinking skills over others and this probably resulted in more frequent evidence for that specific thinking skill over the others in that particular reflection exercise. As well, the thinking skills that were the most integrated into the reflective exercises overall also showed up in the data most frequently. In fact, there was a match between the frequency of occurrence of thinking skills that underpin the five bridging techniques in reflective exercises overall (see Table 4) and evidence in the data in the following order (most frequent to least frequent): metacognitive reflection, anticipating applications, parallel problem solving, generalizing concepts, and using analogies.

Therefore, it seems likely that the more affordances a reflection exercise presents to students to elicit thinking skills, the more prevalent the thinking skill will be in the online discussions, making a strong case for the effectiveness of teaching specific thinking skills. This represents a concrete application of the research and advocates for course activities that explicitly prompt the thinking skills required of learners to support the transfer of learning. Curriculum amendments are suggested wherein the reflection exercises afford more equivalent transfer cueing opportunities.

Course facilitator. The course facilitator's ability to encourage the use of the thinking skills is, in the interpretation of the authors, related to the frequency of evidence for that thinking skill. The primary author coded the course facilitators' discussions and the outcome was that course facilitators reported that they:

- encouraged metacognitive reflection which likely contributed to the strong evidence of that thinking skill by the students,
- somewhat equally encouraged anticipating application and parallel problem solving which likely contributed to the approximate equal evidence of those thinking skills by students, and
- very infrequently encouraged generalizing concepts and did not prompt using analogies which likely contributed to the weak evidence of these thinking skills as exhibited by the students. Course facilitators reported that they had limited understanding about the concept of using analogies to foster the transfer of learning.

Therefore, it seems likely that the greater the course facilitator's knowledge about the thinking skill and their value for it, the more likely they will be able to elicit it in students. This represents a concrete application of the research and advocates for strong training of the knowledge required by course facilitators in order to enhance their ability to foster the learners' thinking skills for the transfer of learning. Curriculum amendments are suggested for the training program to ensure that course facilitators are knowledgeable of the requisite instructional strategies.

Co-op employer experts. The co-op employer experts' perceptions of the thinking skills that are useful in a work context to help student's transfer their learning adds supplemental information that potentially deepens the implications for the curriculum. The think-

ing skills exhibited by students that were rated by the co-op employer expert as most to least useful in a work context to help student's transfer their learning were (see Table 4): generalizing concept, metacognitive reflection, parallel problem solving, using analogies, and anticipating applications.

The students however exhibited evidence for the thinking skills in the following order of most to least frequent (refer to Table 4): metacognitive reflection, anticipating applications, parallel problem solving generalizing concept, and using analogies.

In summary, the thinking skills that the co-op employer experts perceived as most useful in a work context to help student's transfer their learning differed from the thinking skills exhibited by the students. As such, based on the perspective of the co-op employer experts, the interpretation made by the authors is that the curriculum may need to provide more affordances for specific thinking skills in order to enhance the alignment of the curriculum with what employers perceive as useful in assisting students with the transition from an academic to workplace context.

Implications For Practice

Using the bridging techniques as a framework to discuss how education for the transfer of learning can be implemented, the following implications for practice are made. The authors' recommendations are to increase affordances in course activities that will amplify opportunities for students to be able to practice and demonstrate the thinking skills. Specifically, opportunities to discuss anticipating applications, parallel problem solving, generalizing concepts, and using analogies need to be explicitly written more often into the course activities. Another application is developing a training program for course facilitators that provides knowledge about instructional strategies that support their role. The training program should aim to enhance their ability to prompt the thinking skills in learners, especially with respect to the use of using analogies, which was evidenced poorly in the online discussions.

The good news is that properly designed course materials can elicit the desired thinking skills that will enhance students' ability to transfer their learning.

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Since 1973, the Canadian Association for Co-operative Education (CAFCE) has supported post-secondary co-operative education in Canada through its national activities and services to its member institutions and individual professionals. CAFCE's mission is to foster and advance post-secondary co-operative education in Canada. This is achieved through a national forum of professional co-op practitioners; by establishing national standards and promoting the value of co-operative education; and by delivering opportunities for learning and sharing of best practices.

There are presently 400+ members from 77 post-secondary institutions, with approximately 80,000 co-operative education students across Canada. CAFCE's strength lies in the commitment and energy of its membership who volunteer from across the country to work in partnership to establish CAFCE as the voice for post-secondary co-operative education in Canada.

CAFCE's independent Accreditation Council ensures that only the highest standards exist for our members. Member institutions are subject to rigorous evaluation before achieving accreditation status. Ongoing education and discussion of topics concerning co-operative education and professional development ensure that membership can maintain and support CAFCE's commitment for excellence.

Members were recently asked to participate in a CAFCE survey and the results showcase the value members place on creating a national community of co-operative education practitioners able to share best practices, communicate research findings and build positive collaborative relationships.

CAFCE membership provides an opportunity for growth as a co-op practitioner and helps ensure that co-op programs stay current with practices and initiatives in co-operative education while strengthening the capacity and voice of the national Association.

Benefits of membership in CAFCE include access to:

- a **rich network of co-op professionals** to share information, insight and best practices.
- **professional development activities** specific to the needs of co-op practitioners including the upcoming CAFCE Whistler Conference in July 2012, the CAFCE AGM in Victoria BC in November 2011, and a new webinar being offered in early 2012.
- a **national database** that will host current and historical statistics to assist you in advocating the benefits of co-operative education to your students, employers, institutions and regions.
- **automatic WACE membership** as an enhanced part of your CAFCE membership.
- **research findings and publications** through the website, CAFCE's Best Practices, and the CEIA Journal.
- **opportunities for accreditation** to ensure consistent, high level standards across colleges and universities in co-operative education and access to the co-op manual which serves as a guide for new program implementation.
- **the presence of a national office** to ensure communication and support is available to all members across the country.

For further information on post-secondary co-operative education programs in Canada, please visit the Canadian Association for Co-operative Education web site at: www.cafce.ca .

Assessment of the Effectiveness of Engineering and Engineering Technology Curricula in the Context of Student Work Performance: A Quantitative Approach

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Abstract

This publication focuses upon a quantitative approach to use co-op student work performance in a statistical process control setting. An assessment instrument originally developed to evaluate student progress provides scores reported in this paper using conventional tables and by plotting out individual measurement results in Mean Standard Deviation Matrixes (MSM) and Delta Mean Standard Deviation Matrixes (ΔMSM). The matrixes are used to give a picture of the level and uniformity of the performance of a student population. The case presented in this paper covers the performance of Civil and Environmental Engineering students. The researchers conclude that the instrument accurately reflects changes with regard to statistical significance and measurement certainty as long as there truly is a change in the measurand which supports the researchers' hypothesis that ***it is possible to generate statistically valid data for curricular development purposes using co-op student work performance data gathered via Assessment Instrument I.***

Introduction

The University of Cincinnati (UC) was awarded a 3 year U.S. Department of Education Fund for the Improvement of Postsecondary Education (FIPSE) grant to be used for the Development of a Corporate Feedback System for Use in Curricular Reform (CFCR). The project is set in an environment having a long tradition of cooperative education.

In 1906, Herman Schneider, the Dean of the Engineering College at the University of Cincinnati, pioneered cooperative education (Park, 1916, 1943). Since then this applied pedagogy, based on the alternation between school and work, has spread to institutions all over the world. By 2007 the University of Cincinnati itself has grown into a high-impact research university offering Cooperative Education in four colleges: the College of Engineering (CoE); the College of Design, Architecture, Art and Planning (DAAP); the College of Business (CoB); and the College of Applied Science (CAS). The Cooperative Education curricula follow an alternating structure as presented in Figure 3.1.

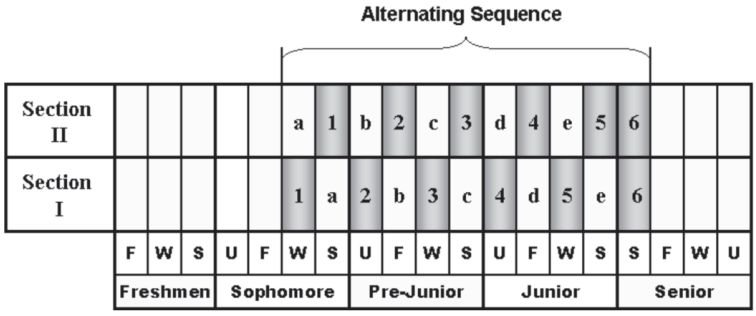


Figure 1. *An overview of the alternating University of Cincinnati co-op curriculum. The abbreviations U, F, W, and S stand for Summer, Fall, Winter and Spring quarters. The work terms are numbered 1, 2, 3, 4, 5, and 6. The school quarters labeled a, b, c, d, e, and f are lectured twice a year and have to be taken in sequence.*

As students enter the co-op program they are divided into two sections; Section I and Section II. When Section I is on work assignment, Section II is in school, and vice versa. The alternating co-op schedule allows the 1,500 employers the university cooperates with to assign students productive and meaningful work assignments. Approximately 4,000 students, enrolled in more than 40 programs, participate in the UC co-op program each year. Employer evaluations provide in excess of 200,000 data points annually. Starting in 2004 this data is directly stored in the Professional Assessment and Learning (PAL) database developed by Division of Professional Practice (PP). PP is a centralized academic unit of the University of Cincinnati responsible for cooperative education. The Division of Professional Practice moved from a paper-based assessment system to the web-based PAL system in 2004. The system was implemented to enhance user friendliness, streamline archiving, and allow flexible production of reports on learning outcomes.

The aim of the CFCR grant is to develop a corporate feedback system for use in curricular reform using supervisors' assessments of the students' work performance during each co-op work term. The project strives to elevate student learning outcomes assessment to a new level by using student co-op work performance data for continuous curriculum improvement. A schematic view of the proposed feedback structure is presented in Figure 2.

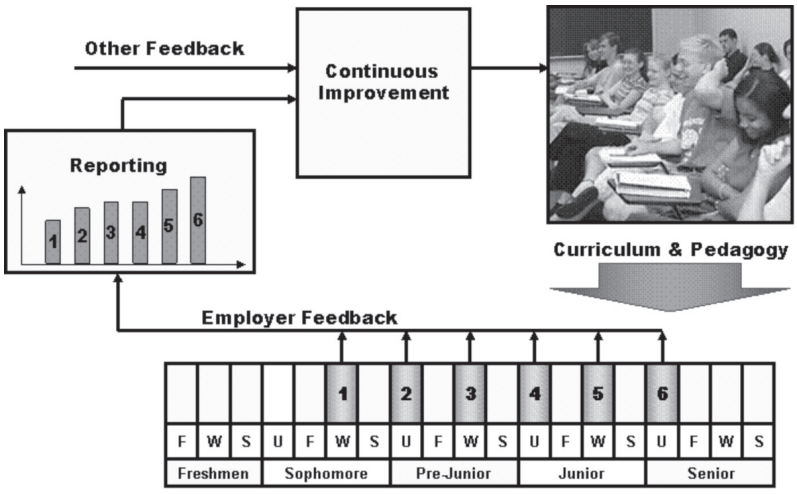


Figure 2. *The corporate feedback loop principle. Employers assess students at the end of each quarter. The assessment data is analyzed and used for continuous improvement of curricula.*

Literature Review

Deming (1943, 1948, 1982, 2000; Deming & Kilian, 1992) is credited with launching continuous improvement as an industrial paradigm. In the second half of the 20th century the philosophy of Deming triggered the realignment of the manufacturing industry from a production oriented to consumer oriented paradigm. By the 1990s the philosophy of continuous improvement had made its way into higher education as a call for outcomes-based education. Competition required educational organizations to develop need-based educational offerings incorporating the philosophy of *pull control* and *continuous improvement* which had demonstrated its strength in relation to *push control* models relying on dominance in production capacity. Accreditation institutions such as Accreditation Board for Engineering and Technology (ABET) soon called for the development of need based curriculum development systems. The need based paradigm was strongly reflected in the ABET learning outcomes criteria launched by the Accreditation Board for Engineering and Technology in their Criteria 2000.

The transformation to an outcomes-based paradigm is also reflected in the revised criteria of a large number of regional accrediting bodies recognized by the Council for Higher Education Accreditation (CHEA) (Council for Higher Education Accreditation, 2006). The movement toward the large scale implementation of outcomes based assessment

results in an interesting development of the institutional research function of institutions engaged in higher education. The generally accepted consensus is to build an inclusive, convincing, energizing and value-adding atmosphere (Carder & Ragan, 2004; Suskie, 2000, 2004) that supports the implementation of assessment. The responsible use of data (Ewell, 2002; Hoey & Nault, 2002) is considered to be an imperative foundation for success in the implementation of continuous improvement systems.

Assessment is typically used for both *summative* and *formative* purposes and should in order to be effective, be *goal oriented, reasonably accurate, used, valued,* and *cost effective* (Suskie, 2004). Achievements need to be compared to goals; measurements need to be verifiable on a repeatable scale; only assessment that is used has any impact on the process; only valued information gets acted upon; and only a cost-effective process can withstand the competition for resources (Cedercreutz, 2007; Suskie, 2004). Good assessment can further be described as *blind, contextual, and direct* (Banta, 2002; Ewell, 2002; Suskie, 2002, 2004, 2006). Blind implies that the assessment is pursued independently from instructional activity. Assessment pursued by a faculty member in charge of the teaching of a specific course does not meet the criteria of being blind. The criterion for being contextual implies that the assessment is pursued in the environment to which the education prepares the student. The requirement that assessment be direct implies that the measurement needs to focus on the actual outcomes of student performance.

The challenge of matching curricular content with industrial needs has been approached on a variety of levels both nationally and internationally. It is well understood that cooperative education, developed by Schneider at the University of Cincinnati in 1906, helps prepare students for professional real word contribution. In 2002 a number of institutions started experimenting with analyzing student real world work performance assessment data in order to understand curricular strengths and weaknesses.

To date the most extensive research in the field of co-op student work performance has been pursued at Georgia Institute of Technology, Iowa State University, and the University of Cincinnati (Cedercreutz, 2007). All three institutions are working on institutionalizing statistical analysis processes of co-op student work performance in their standard assessment procedures. The research pursued at Iowa State University (Hanneman, Mickelson, Pringnitz, & Lehman, 2002) includes an extensive mapping between co-op outcomes and curricular input. The research shows that these curricular maps are very effective when trying to find causalities between curricular structure and student work performance. The experience at Iowa State further shows the value of using web-based software for the collection of a large amount of information. Cooperative education and internships are further seen as a unique contextual environment for the assessment of student performance in a professional setting (Brumm, Hanneman, & Mickelson, 2006).

Research at the Georgia Institute of Technology (Hoey, Marr, & Gardener, 2002) demonstrates a strong, at times almost linear, correlation between work performance and student curricular progression. The research further shows (Hoey & Nault, 2002) the importance of a positive trusting institutional atmosphere when trying to implement employment based curricular improvement.

Research at the University of Cincinnati demonstrates that using cooperative education as a pedagogic strategy gears the curricular content of an educational environment toward meeting industrial needs (Cedercreutz, Cates, Eckart, & Trent, 2002). The research group demonstrates both conceptually (Cedercreutz, Cates, Maltbie, Miller, Uwakweh, 2005) and practically (Cedercreutz & Cates, 2006) that parameter averages and standard deviations of cooperative education assessment data can be used to get an appreciation of which educational processes are stable and which require further improvement.

The field of institutions engaged in engineering education has lacked a generally accepted theoretical framework that could be used for the uncertainty assessment of the quantitative data used for curricular reform. As n-values are typically low and as assessor populations have a distribution in their assessment standards it becomes relatively complicated to demonstrate the importance of measurement significance. The paper at hand demonstrates a methodology for the assessment of measurement significance in the assessment of student work term performance as a function of curricular progression in Civil and Environmental Engineering.

Research Overview

The project builds a feedback loop based on assessment data gathered using three different methodologies, one of which is covered in depth in this paper. Figure 3. gives an overview of how these methodologies (qualitative instruments, quantitative instruments and focus groups) are linked together to form an organic whole.

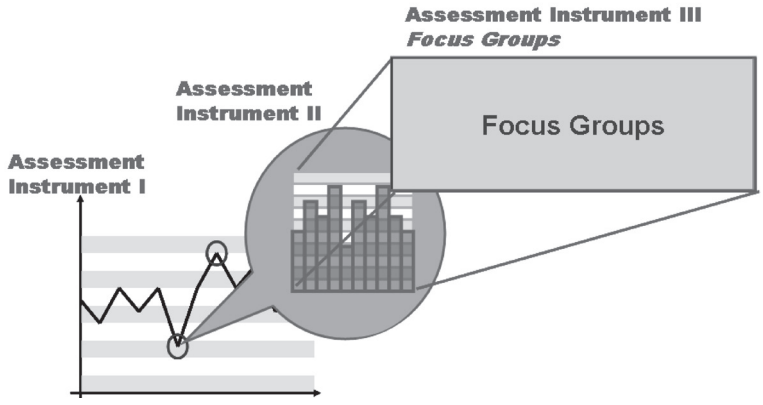


Figure 3. *Levels of assessment in the UC FIPSE Project Developing a Corporate Feedback Loop for Curricular Reform.*

The assessment instruments have characteristics as follows:

— ***Assessment Instrument I*** is the standard instrument used in the three-party assessments by employers to evaluate students. The instrument is well established, and has a long history of application that has resulted in a wealth of longitudinal data.

— ***Assessment Instrument II*** focuses on specific problem areas indicated by Assessment Instrument I. Assessment Instrument II will allow the research team to examine finer details of curricular performance.

— ***Assessment Instrument III*** is specified as a qualitative tool designed to refine and clarify questions raised through Assessment Instruments I and II. The focus group approach will help the research team propose solutions based on underlying needs.

Assessment Instrument

The publication at hand will focus solely upon Assessment Instru¬ment I in a statistical process control setting. The Assessment Instrument is presented in Table 1.

Table 1. *Assessment Instrument I.*

	Category	Question	Code
A	COMMUNI-CATION	Speaks with clarity and confidence	A1
		Writes clearly and concisely	A2
		Makes effective presentations	A3
		Exhibits good listening and questioning skills	A4
B	CONCEP-TUAL AND ALYTICAL ABILITY	Evaluates situations effectively	B1
		Solves problems/makes decisions	B2
		Demonstrates original and creative thinking	B3
		Identifies and suggests new ideas	B4
C	LEARNING/ THEORY AND PRACTICE	Learns new material quickly	C1
		Accesses and applies specialized knowledge	C2
		Applies classroom learning to work situations	C3
D	PROFESSI-ONAL QUALITIES	Assumes responsibility/accountable for actions	D1
		Exhibits self-confidence	D2
		Possesses honesty/integrity/personal ethics	D3
		Shows initiative/is self-motivated	D4
		Demonstrates a positive attitude toward change	D5
E	TEAM WORK	Works effectively with others	E1
		Understands and contributes to the organization's goals	E2
		Demonstrates flexibility/adaptability	E3
		Functions well on multidisciplinary team	E4
F	LEADER-SHIP	Gives direction, guidance and training	F1
		Motivates others to succeed	F2
		Manages conflict effectively	F3
G	TECHNO-LOGY	Uses technology, tools, instruments and information	G1
		Understands complex systems and their interrelationships	G2
		Understands the technology of the discipline	G3
H	DESIGN & EXPERI-MENTAL SKILLS	Displays ability to design a component, system or process	H1
		Demonstrates ability to design and conduct experiments	H2
		Analyzes and interprets data efficiently	H3

Grading Scale; 1=Unsatisfactory;2=Poor; 3=Satisfactory; 4=Good; and 5=Excellent

(Table 1 content continues on next page)

Table 1. (continued) *Assessment Instrument I.*

I	WORK CULTURE	Understands and works within the culture of the group	I1
		Respects diversity	I2
		Recognizes political and social implications of actions	I3
J	ORGANI-ZATION PLANNING	Manages projects and/or other resources effectively	J1
		Sets goals and prioritizes	J2
		Manages several tasks at once	J3
		Allocates time to meet deadlines	J4
K	EVALUA-TION OF WORK HABITS	Professional attitude toward work assigned	K1
		Quality of work produced	K2
		Volume of work produced	K3
		Attendance	K4
		Punctuality	K5

Grading Scale; 1=Unsatisfactory;2=Poor; 3=Satisfactory; 4=Good; and 5=Excellent

Assessment Instrument I was developed during the 1990s by the UC Division Professional Practice Faculty in accordance with the academic governance processes of the unit. The work took into account pedagogic ambitions; the accreditation requirements of regional, national, and professional accrediting bodies; as well as central US Department of Labor publications (Cates & Jones, 1999; Cates & Langford, 2006). The instrument development work explicitly considered the Curriculum 2000 report of the Accreditation Board for Engineering and Technology (Accreditation Board for Engineering and Technology, 1997), the attributes of the Accreditation Council for Cooperative Education (ACCE), the accreditation requirements of the Canadian Association for Cooperative Education (CAFCE) (Conference Board of Canada's Corporate Council on Education, 1992; Canadian Association for Co-operative Education, 1996), and the outcomes-based accreditation requirements of the North Central Accreditation Agency (NCAA) (Handbook of Accreditation, 1997).

Assessment Instrument I was originally developed to evaluate student progress in as many as 45 programs. The instrument measures performance in the context of a specific program, and results are not, due to hermeneutic limitations, necessarily transferable from one employment environment to another. It is easy to understand that a parameter such as *manages projects effectively* has a completely different connotation when being asked in an Aerospace Engineering, Manufacturing Engineering Technology, or an Accounting environment.

Reporting Tools

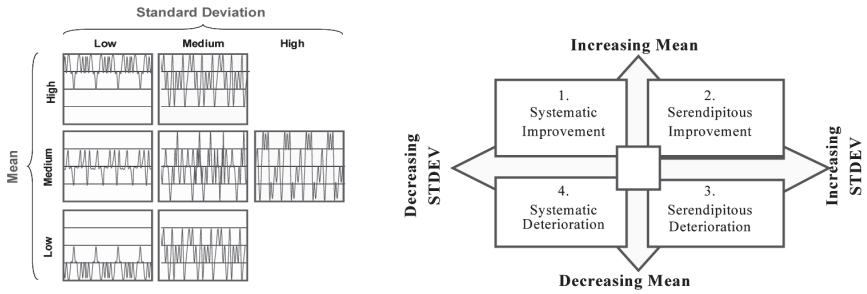
The scores returned using this instrument are reported using conventional tables and by plotting out individual measurement results in Mean Standard Deviation Matrixes (MSM) and Delta Mean Standard Deviation Matrixes (ΔMSM). The reporting instruments are presented in Figure 4. The matrixes are used to give a picture of the level and uniformity of the performance of a student population (Wang, 2005). A low standard deviation of a score implies a low variation in student performance, which suggests a high reliability of

the pedagogic process. Conversely, a high standard deviation of a particular score indicates a high variation in student performance which could indicate that the educational process is unstable. As students are left to their own devices a part of the population succeeds and a part does not. The MSMs and ΔMDMs are visual and simple to read. Scores in the upper left hand corner typically indicate a quality process whereas scores in the lower right hand corner may need to be avoided. The MSMs and ΔMDMs give a good picture of where the educational process is stable and where further improvements should be made (Gitlow & Levine, 2005; Hayler & Nichols, 2005).

Figure 4.

Right, Mean/Standard Deviation Matrix (MSM).

Left, Delta Mean Standard Devia¬tion Matrix (ΔMSM).



Instrument Characteristics

The face value of Assessment Instrument I was judged using a focus group of civil engineering co-op employers and found to have a high degree of relevance by all employers within the focus group. Assessment Instrument I has further been assessed to have a Cronbach (1943, 1946, 1951, 1990, 1998) Alpha of 0.80 or above for all constructs when applied in a civil and environmental engineering environment. The results of the Cronbach alpha analysis is presented in more detail in Table 1.

Table 2. *Cronbach's Coefficient Alpha and corresponding return values for all underlying constructs of Assessment Instrument I, calculated using SPSS 14.0 for Windows.*

Abbrev.	Category	Cron-bach's Alpha	No. of data sets
A1 – A4	Communication	0.81	160
B1 – B4	Conceptual And Analytical Ability	0.90	342
C1 – C3	Learning/Theory And Practice	0.84	320
D1 – D5	Professional Qualities	0.88	367
E1 – E4	Team Work	0.87	325
F1 – F3	Leadership	0.88	150
G1 – G3	Technology	0.81	372
H1 – H3	Design & Experimental Skills	0.88	94
I1 – I3	Work Culture	0.80	335
J1 – J5	Organization Planning	0.94	308
K1 – K5	Evaluation of Work Habits	0.86	383

When subject to a factor analysis the instrument shows that the greatest variation of the instrument can be attributed to *Goal Oriented Professional Contribution which includes manages projects and/or other resources effectively; volume of work pro¬duced; recognizes political/social implications of actions; shows initiative/is self-motivated; professional attitude toward work assigned, and sets goals and prioritizes.*

The parameters, *identifies and suggests new ideas,* and *demonstrates original and creative thinking*, form the major contributors to the factor having the second significance labeled as *Creative Thinking*. This factor has an inverse relationship to the other main factors, which indicates that scoring high in creative thinking has a negative correlation to the other three main factors measured by the instrument. While operating in a Civil and Environmental Engineering context it is no surprise that *understands the technology of the discipline; uses technology, tools, and information;* and *understands complex systems and interrelationships* form a third distinct factor labeled *Technology and Systems Expertise*. *Punctuality* and *Attendance* form the fourth very distinct factor labeled *Punctuality and Attendance*.

Application of Instrument on Civil and Environmental Engineering Case

The case presented in this paper covers the performance of Civil and Environmental engineering Students over Calendar Years 2004 – 2006. The results from two and a half year's worth of co-op data compare a rolling average of co-op quarter three to co-op quarters five and six. Quarters five and six are reported as an aggregate, as approximately half of all

students work back to back double section co-op quarters during quarters five and six. The annual enrollment to the program is stable. The max n value of co-op quarter three is 69 students and quarter five and six is 73 students, reflecting a stable retention rate in the program. The return rate in each section varies between 64% and 69%. The uncertainty aggregation assumes that each assessor participates in the assessment twice over the period of the observation. The results of the observations are presented in Table 3., and Figures 7-9.

The entry, delta, and exit MSM's convey interesting information:

— 17% (7 parameters) show with a statistically significant increase in mean with a confidence level of 95%.

— 20% (8 parameters) show a statistically significant increase in mean and statistically significant decrease in standard deviation with a confidence level of 90%.

— 2% (1 parameter) show a statistically significant in¬crease in mean and statistically significant increase in standard deviation with a confidence level of 90%.

— 22% (9 parameters) show a statistically significant increase in mean with a confidence level of 90%.

— 20% (8 parameters) show a statistically significant decrease in standard deviation with a confidence level of 90%.

— 24% (10 parameters) show a statistically significant increase in mean with a confidence level of 80%.

— 12% (5 parameters) show statistically insignificant changes in mean and standard deviation.

Table 3. *Civil and Environmental Engineering, Co-op Performance Measurement Results*

		Treatment 1=Yes 2 = No	Quarter 3						Quarters 5 & 6						Δ			
																Conf:		90%
			a	s	n	U_{READ}	U_{SYST}	U_{TOT}	a	s	n	U_{READ}	U_{SYST}	U_{TOT}	ΔA	Cons. Treatm.	2-tail	Δs [1] = Decr. [2] = Incr.
A1	*Speaking*	1	**3.96**	0.67	69	0.16	0.09	0.19	**4.39**	0.66	72	0.16	0.09	0.18	**0.43**	95%	(90%)	**-0.01**
A2	*Writing*	1	**3.94**	0.74	62	0.19	0.10	0.21	**4.30**	0.64	61	0.16	0.09	0.19	**0.36**	90%	(79%)	**-0.10**
A3	*Presenting*	1	**3.93**	0.64	30	0.24	0.15	0.28	**4.33**	0.65	33	0.23	0.09	0.25	**0.40**	86%	(71%)	**0.01**
A4	*Listening*	1	**4.20**	0.83	69	0.20	0.09	0.22	**4.60**	0.55	73	0.13	0.09	0.16	**0.40**	93%	(86%)	**-0.29** [1]
B1	*Situation Evaluates*	2	**3.94**	0.73	69	0.17	0.09	0.20	**4.34**	0.65	73	0.15	0.09	0.18	**0.40**	87%		**-0.08**
B2	*Problem Solving*	1	**3.87**	0.79	68	0.19	0.09	0.21	**4.21**	0.74	73	0.17	0.09	0.20	**0.34**	88%	(75%)	**-0.05**
B3	*Creative Thinking*	2	**3.82**	0.76	67	0.18	0.09	0.21	**4.31**	0.78	72	0.18	0.09	0.20	**0.48**	90%		**0.02**
B4	*Idea Generation*	2	**3.75**	0.74	63	0.19	0.10	0.21	**4.34**	0.72	70	0.17	0.09	0.19	**0.60**	96%		**-0.02**
C1	*Learning*	1	**4.32**	0.74	69	0.18	0.09	0.20	**4.56**	0.55	73	0.13	0.09	0.16	**0.24**	83%	(66%)	**-0.19** [1]
C2	*Appl. Spec. Knwldg*	1	**3.94**	0.77	65	0.19	0.09	0.21	**4.39**	0.70	64	0.18	0.09	0.20	**0.45**	94%	(88%)	**-0.06**
C3	*Appl. Classrm Lrnng*	1	**3.81**	0.72	62	0.18	0.10	0.21	**4.28**	0.63	65	0.15	0.09	0.18	**0.47**	95%	(91%)	**-0.10**
D1	*Accountability*	1	**4.37**	0.71	68	0.17	0.09	0.19	**4.62**	0.57	73	0.13	0.09	0.16	**0.25**	84%	(67%)	**-0.14** [1]
D2	*Self Confidence*	2	**4.01**	0.81	69	0.20	0.09	0.22	**4.40**	0.68	73	0.16	0.09	0.18	**0.38**	82%		**-0.13** [1]
D3	*Integrity*	2	**4.56**	0.63	68	0.15	0.09	0.18	**4.68**	0.60	73	0.14	0.09	0.17	**0.13**	39%		**-0.03**
D4	*Self Motivation*	2	**4.13**	0.92	69	0.22	0.09	0.24	**4.52**	0.73	73	0.17	0.09	0.19	**0.39**	79%		**-0.19** [1]
D5	*Positive Attitude*	2	**4.29**	0.67	68	0.16	0.09	0.19	**4.50**	0.67	72	0.16	0.09	0.18	**0.21**	57%		**0.00**
E1	*Works with Others*	1	**4.51**	0.66	69	0.16	0.09	0.18	**4.71**	0.56	73	0.13	0.09	0.16	**0.21**	80%	(60%)	**-0.09**
E2	*Goal orientation*	1	**4.10**	0.78	68	0.19	0.09	0.21	**4.47**	0.60	72	0.14	0.09	0.17	**0.37**	91%	(83%)	**-0.17** [1]
E3	*Flexibility*	1	**4.33**	0.70	69	0.17	0.09	0.19	**4.56**	0.65	73	0.15	0.09	0.17	**0.23**	81%	(62%)	**-0.05**
E4	*Multidiscipl. Team Fct*	1	**4.36**	0.69	58	0.18	0.10	0.21	**4.68**	0.53	71	0.13	0.09	0.15	**0.31**	89%	(77%)	**-0.16** [1]
F1	*Gives Direction*	1	**3.62**	0.64	26	0.26	0.16	0.30	**4.36**	0.64	36	0.22	0.09	0.23	**0.75**	97%	(94%)	**0.00**
F2	*Motivates Others*	2	**3.62**	0.72	37	0.24	0.13	0.27	**4.20**	0.80	35	0.27	0.09	0.29	**0.58**	85%		**0.08**
F3	*Conflict Management*	1	**3.80**	0.76	45	0.23	0.12	0.25	**4.31**	0.69	39	0.22	0.09	0.24	**0.51**	92%	(84%)	**-0.06**
G1	*Use of Technology*	1	**4.24**	0.71	68	0.17	0.09	0.20	**4.47**	0.75	73	0.17	0.09	0.20	**0.23**	80%	(59%)	**0.03**
G2	*Systems Understanding*	1	**3.76**	0.69	62	0.18	0.10	0.20	**4.16**	0.69	67	0.17	0.09	0.19	**0.41**	93%	(85%)	**-0.01**
G3	*Underst. Of Tchnlgy*	1	**3.93**	0.61	68	0.15	0.09	0.17	**4.25**	0.71	71	0.17	0.09	0.19	**0.33**	90%	(79%)	**0.11** [2]
H1	*Comp. Design Ability*	1	**3.64**	0.74	33	0.26	0.14	0.30	**4.26**	0.62	53	0.17	0.09	0.19	**0.63**	96%	(92%)	**-0.12**
H2	*Exprmnt Design Ability*	1	**3.80**	0.71	25	0.29	0.16	0.33	**4.35**	0.59	20	0.27	0.09	0.29	**0.55**	89%	(77%)	**-0.12**
H3	*Data Analysis Ability*	1	**3.97**	0.67	58	0.18	0.10	0.20	**4.31**	0.67	54	0.18	0.09	0.20	**0.35**	89%	(77%)	**-0.01**
I1	*Work Culture Und.*	2	**4.29**	0.75	68	0.18	0.09	0.20	**4.55**	0.60	73	0.14	0.09	0.17	**0.25**	66%		**-0.15** [1]
I2	*Respects Diversity*	2	**4.34**	0.68	68	0.17	0.09	0.19	**4.55**	0.60	71	0.14	0.09	0.17	**0.21**	59%		**-0.08**
I3	*Rec. Political Impl.*	2	**4.25**	0.77	65	0.19	0.09	0.21	**4.47**	0.66	68	0.16	0.09	0.18	**0.22**	57%		**-0.11** [1]
J1	*Project Management*	2	**3.95**	0.83	63	0.21	0.10	0.23	**4.42**	0.65	67	0.16	0.09	0.18	**0.47**	88%		**-0.18** [1]
J2	*Goal Setting*	1	**3.95**	0.73	66	0.18	0.09	0.20	**4.31**	0.63	70	0.15	0.09	0.17	**0.36**	91%	(82%)	**-0.11** [1]
J3	*Task Management*	1	**4.00**	0.81	65	0.20	0.09	0.22	**4.50**	0.65	70	0.16	0.09	0.18	**0.50**	96%	(92%)	**-0.16** [1]
J4	*Time Allocation*	1	**4.07**	0.90	68	0.22	0.09	0.24	**4.48**	0.58	69	0.14	0.09	0.17	**0.40**	92%	(83%)	**-0.32** [1]
K1	*Professional Attitude*	1	**4.38**	0.73	69	0.18	0.09	0.20	**4.62**	0.62	73	0.14	0.09	0.17	**0.24**	82%	(64%)	**-0.11** [1]
K2	*Work Quality*	1	**4.09**	0.78	69	0.19	0.09	0.21	**4.55**	0.55	73	0.13	0.09	0.16	**0.46**	96%	(92%)	**-0.23** [1]
K3	*Work Volume*	1	**4.01**	0.90	69	0.22	0.09	0.23	**4.48**	0.65	73	0.15	0.09	0.18	**0.46**	94%	(88%)	**-0.25** [1]
K4	*Attendance*	2	**4.67**	0.63	69	0.15	0.09	0.18	**4.62**	0.68	73	0.16	0.09	0.18	**-0.05**	16%		**0.05**
K5	*Punctuality*	2	**4.57**	0.74	69	0.18	0.09	0.20	**4.63**	0.74	73	0.17	0.09	0.19	**0.06**	18%		**0.00**
Total:			**4.07**	0.74	61.7	0.19	0.10	0.22	**4.44**	0.65	65.4	0.17	0.09	0.19	**0.37**	-	-	**-0.09**

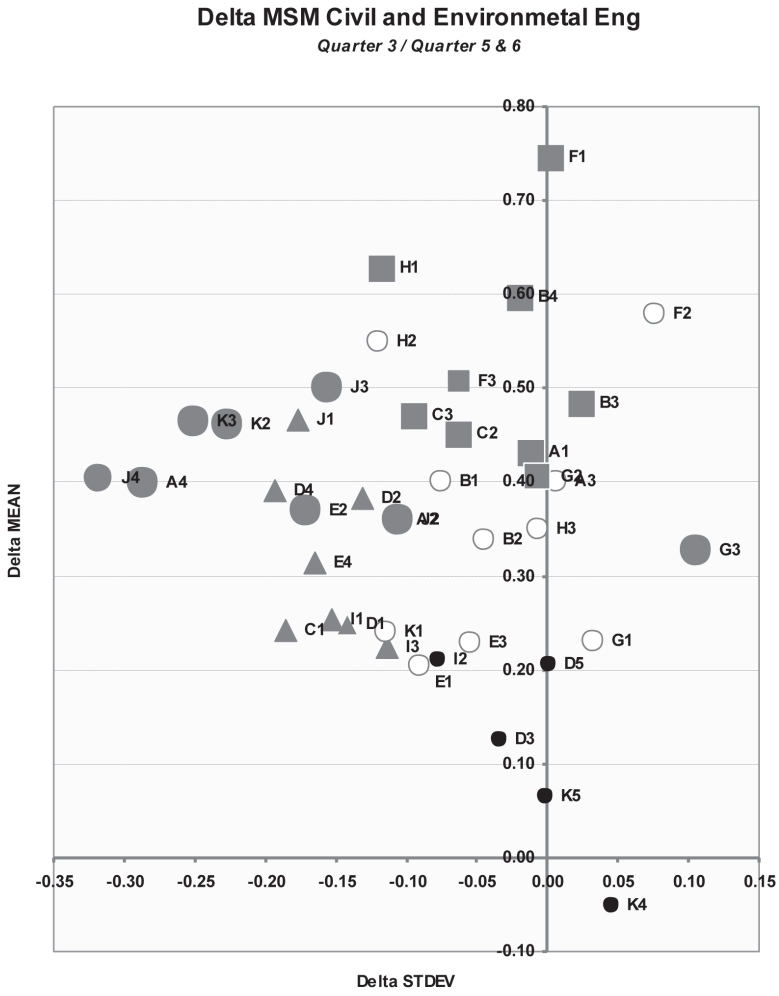


Figure 7. ΔMSM for Case A.

Symbols:

= Δ *A* and Δ *S* significant (conf. 90%)
= Δ *S* significant (conf. 90%)
= Δ *A* significant (conf. 90%)
= Δ *A* significant (conf. 80%) Δ *S* not significant
= Δ *A* and Δ*S* not significant

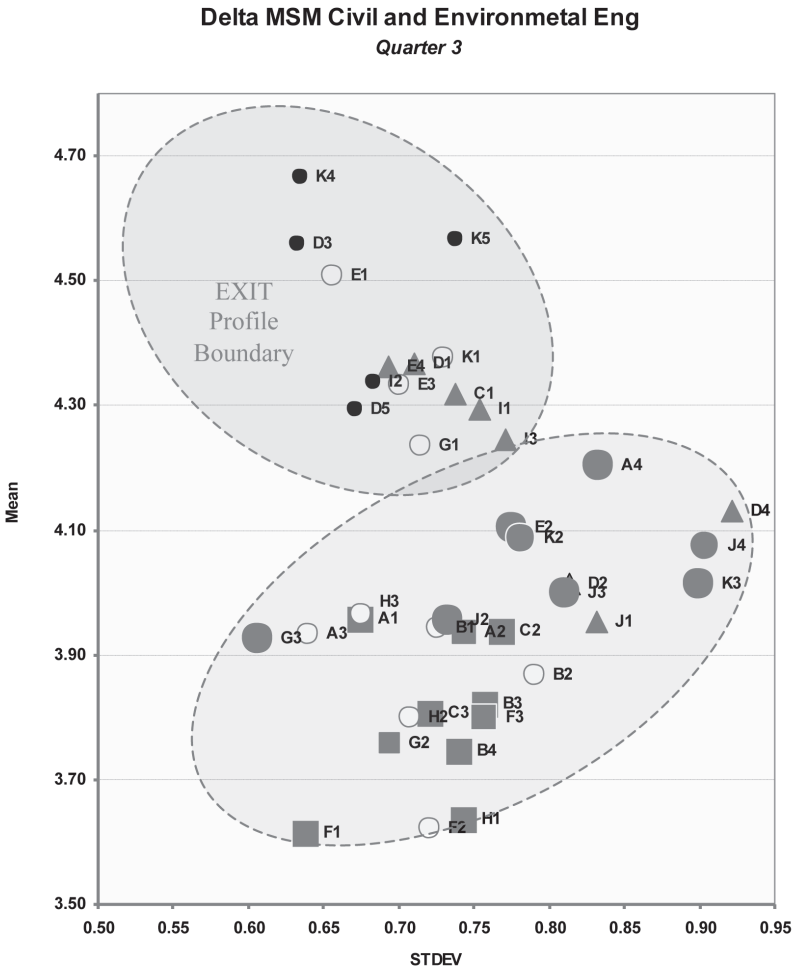


Figure 8. Entry MSM, Case A.

Symbols:

= *Δ A and Δ S significant (conf. 90%)*
= *Δ S significant (conf. 90%)*
= *Δ A significant (conf. 90%)*
= *Δ A significant (conf. 80%) Δ S not significant*
= *Δ A and ΔS not significant*

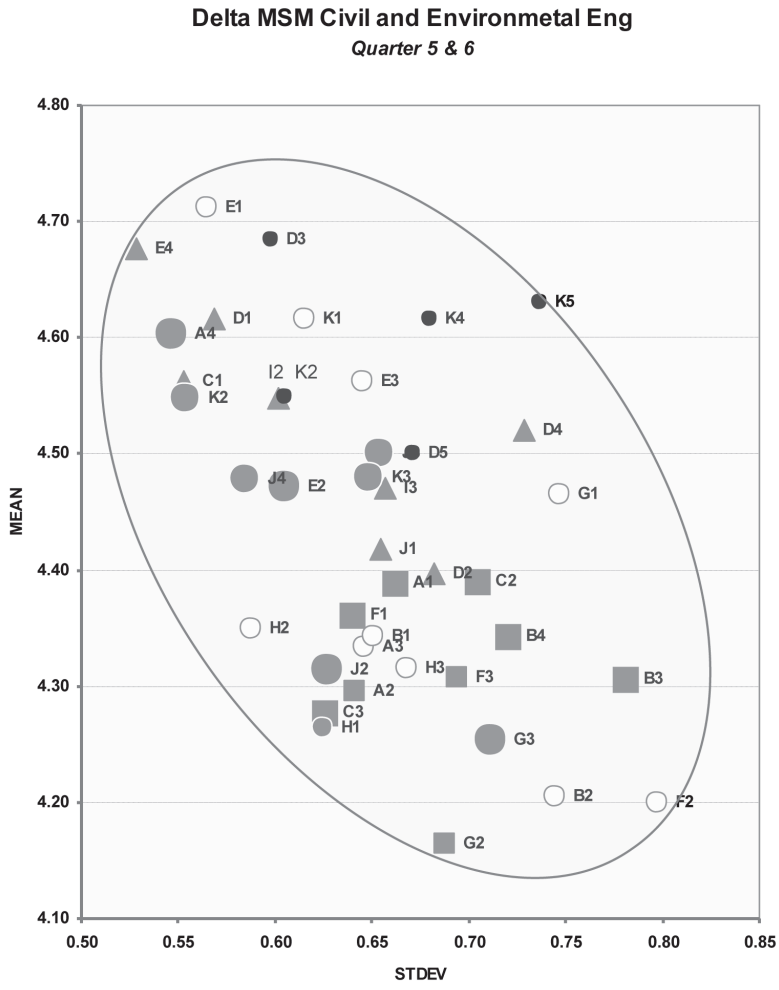


Figure 9. Exit MSM, Case A

Symbols:

= *Δ A and Δ S significant (conf. 90%)*
= *Δ S significant (conf. 90%)*
= *Δ A significant (conf. 90%)*
= *Δ A significant (conf. 80%) Δ S not significant*
= *Δ A and ΔS not significant*

Summary

In summary, 64% of the parameters show changes on a 90% significance level. Another 24% of the parameters show indications of change in mean on an 80% significance level. Analyzing the situation in light of the entry, delta, and exit profiles supports a better understanding of the situation. The exit profile presented in Figure 9 can be easily examined by drawing an ellipse around all of its parameters. This is done in order to maintain a sense of scale when moving from observing one graph to observing another. Plotting the ellipse in scale on the entry profile reveals something important. All parameters that exhibit no statistically significant change can be found at the start within the boundary line of the exit profile. This means that the parameters *Attendance* (K4), *Punctuality* (K5), *Integrity* (D3), *Positive Attitude* (D5), and *Respects Diversity* (I2) initially already exhibit a relatively high professional level. These parameters are simply so high that there is little room for improvement, hence the data cannot demonstrate a statistical significance with respect to improvement. The graph also shows that none of the other parameters that are already in the entry profile exhibit values typical for exit level performance display statistical significance on a 90% confidence level with regard to a change in mean. However, the standard deviation of *Functioning on a multidisciplinary team* (E4), *Accountability* (D1), *Learning* (C1), *Understanding of work culture* (I1), and *Recognition of political implications* (I3) improve with a confidence level of 90% over the duration of the program. The simple and very superficial first glance of the entry and exit profiles seem to indicate that whenever a parameter is already on the level of professional behavior at the start of the program the instrument does not seem to be able to convey any significant change in performance level. The data indicates that one can, however, observe that the entire student cohort performs in a more uniform manner when operating on this initial high level of means. When looking at the data that, in the entry profile, fall outside of the green ellipse, one finds that each parameter is affected to its mean or standard deviation at least with a confidence level of 80%. In fact, 78% of these parameters can be affected with a confidence level of 90%. This implies that the program is remarkably effective in moving parameters with low initial performance levels. When examining the exit MSM one can make another noteworthy observation. The parameters located close to the upper right-hand rim of the plotted ellipse all exhibit low statistical significance with regard to change. The red squares and triangles (parameters with 90% confidence levels) are all clustered close to the left hand rim of the ellipse. The parameters the program is able to affect show a lower standard deviation as compared to those that remain unaffected. This could mean that behavior learned prior to entering the program exhibits more diversity as compared to behavior learned through participation. Further, the ΔMSM in Figure 7. clearly shows that the statistical significance of an observation is in close relationship to the plotted observation's distance to the origin of the coordinate system of the graph. The direction from the origin determines whether the significance gets assigned to the standard deviation, the mean, or both. The graph bears evidence of a strong program. Eighty five percent of the parameters are in the quadrant of increasing mean and decreasing standard deviation. Only one mean decreases (K4, *Attendance*), but in this case the change is

insignificant. The parameter *Understanding of Technology* (G3) is problematic as it indicates a significant increase in the overall mean, but also a significant increase in the standard deviation, which could indicate that a part of the technology gets learned outside of the curriculum, and that personal interests play a role in polarizing the student population.

The researchers conclude that the instrument reflects significant changes with regard to statistical significance and measurement certainty as long as there truly is a change in the measurand. One must bear in mind that a statistically insignificant finding can also be important. In higher education administration it might be equally important to know what the educational process does impact, as compared to what it does not. Case A supports the researchers' hypothesis that *it is possible to generate statistically valid data for curricular development purposes using co-op student work performance data gathered via Assessment Instrument I*. Seven parameters show an increase in means on a 95% confidence level. With an 80% level of confidence, 88% of the parameters show significant changes in either mean or standard deviation. All parameters that at the entry level were outside of the exit level performance envelope, exhibited some level of statistically significant change.

Current Use and Implications for ABET Accreditation

The assessment methodology described in this publication has become a fixture at the University of Cincinnati and is used by the Civil Engineering Program in the School of Advanced Structures to monitor student learning outcomes as part of their continuous improvement program. On an annual basis the Division of Professional Practice, in cooperation with the Center for Cooperative Education Research and Innovation, publishes data on longitudinal learning outcomes. This data contrasts major specific employer evaluations of entry and exit performance of co-op students. The data featured in these reports became a feature in the recent EAC/ABET accreditation site visit conducted in the fall of 2011. Co-op employer evaluations were used to demonstrate the effectiveness of student's educational experiences to prepare them for professional demands. The system developed through the FIPSE grant and described in this article was featured in the ABET self-study as a "significant program improvement action" conducted between 2004 and 2011. The self-study further described how the data has been used to make curricular changes designed to enhance student learning. This is a clear indication of how important this data is for programs that strive to enhance their educational processes.

The Civil Engineering program student outcomes assessment process includes the monitoring of co-op employer satisfaction with student performance as a key component. Through the use of this data, the School of Advanced Structures clearly demonstrates its desire to be responsive to the industry it serves, which not only adheres to accreditation requirements, but more importantly enables the faculty to systematically respond to industrial demand on more than anecdotal evidence. Data from the graduating classes of 2008, 2009, 2010, and 2011 were included in the ABET self-study and showed that student

scores improved in all categories and that the entrance versus exit scores are consistent from year to year. The student outcomes required by ABET are assessed throughout the students' co-op work experiences and form a strong foundation for continuous improvement in relation to learning outcomes. As this assessment methodology matures in its use, the implications for future research are only beginning to unfold. With this tool in hand, the Civil Engineering Program in the School of Advanced Structures will be able to monitor the impact of curricular changes on specific student learning outcomes. A strong new research partnership may unfold between the Division of Professional Practice, the UC Center for Cooperative Education Research and Innovation, and the School of Advanced Structures focusing on the advancement of student outcomes.

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Research reports should contain the following:

- Statement of the Problem
- Introduction, review of relevant literature, context for inquiry
- Description and justification for methodology employed
- Description of research finding
- Discussion of the finds, implications for practitioners
- Conclusion and suggestions for further research

Theory/practice manuscripts should contain the following:

- Statement of the topic or issue to be discussed
- Reference to relevant literature
- Discussion to include development of argument/examples of practice
- Implications for practitioners
- Conclusion and next steps

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