The Efficacy of Directed Studies Courses as a Form of Undergraduate Research Experience: A Comparison of Instructor and Student Perspectives on Course Dynamics

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Directed Studies (DS) courses are widely touted for their ability to enhance research skills in undergraduate students – yet little is known about the dynamics, motivations, and perceived outcomes connected to these specific type of undergraduate research experiences. Building on earlier qualitative research, in this paper we report the results of a self-report survey designed to directly compare instructor and student perspectives on DS course dynamics at a small, liberal arts university. Samples of students who completed DS courses and instructors who supervised them completed a survey assessing their motives, perceived outcomes, and barriers encountered in their course work. Parallel wording of items in instructor and student surveys permitted comparison of perceptions of DS course dynamics. Results indicated that there were many similarities in how both groups approached DS courses but that there were also several important differences in motives and perceived outcomes pointing to the need for greater communication between instructors and students about their expectations for the course.

Keywords: directed studies courses, undergraduate research experiences, motivation for learning, students' perceptions, instructors' perceptions

Introduction

Undergraduate research experiences (UREs) generate many positive outcomes for university students (Russell et al. 2007; Wayment and Dickson 2008). In fact, Kuh (2008) describes the URE as a high impact practice because it provides students with active engagement, empirical observation, use of new technologies, and excitement in answering significant questions. UREs include research internships, research assistantships, research-based courses, in-class research assignments, and directed studies courses. This paper emphasizes directed studies (DS) courses, a specific sub-class of UREs, which are defined as 1-2 semester long courses involving one-on-one instruction with a faculty mentor, and with a focus on student-led independent research (Hvenegaard et al. 2013). DS courses are also called *independent/individual studies courses, directed readings courses, final year projects* and *honour's theses*. While their format can vary across academic disciplines, the distinguishing feature of DS courses that differentiates them from other types of UREs is that they are primarily conducted for course credit and do not involve paid or volunteer research experiences such as internships, assistantships, etc. As a course offering, DS courses differ significantly from lecture, lab, and even seminar type courses because they involve frequent and more personalized contact between students and instructors as well as a much stronger emphasis on mentorship practices.

DS courses are offered widely across many academic disciplines, yet despite their popularity, only sporadic research has assessed learning outcomes or examined features of these courses that may promote or hinder beneficial learning outcomes. While there is a paucity of research on experiences of DS courses, considerable research has examined the outcomes of various forms of other UREs. Consequently, a general overview of the motivations, benefits, and challenges as discussed in the literature on UREs in general will be most useful for the purposes of this study. By conducting a comparison of student and instructor perspectives of DS courses, we will be able to identify common understandings shared between student and instructor groups

as well as identify gaps in knowledge that may hinder positive learning outcomes. Ultimately, we can use this kind of information to recommend best practices in DS course delivery in post-secondary institutions by identifying the DS course dynamics that promote beneficial outcomes for instructors and students as well as the challenges that should be addressed or avoided during the design and planning of these types of courses.

Student and Instructor Perceptions of UREs

Most research on the outcomes of UREs focuses on student perceptions alone, with very positive perceptions generally reported by students (Bauer and Bennett 2003). For example, Seymour et al. (2004) found 91% of all statements by students referred to benefits from their UREs. Most of the literature on the benefits of UREs falls into a few broad categories. First, students perceive the URE as advantageous for the development of professional, technical, and research skills such as hypothesis testing, data collection, writing, and presenting data (e.g., Craney et al. 2011; Kardash 2000; Pike 2006). Second, students appreciate opportunities that UREs can provide for personal and intellectual development (e.g., self-regulation skills, Hunter, Laursen, and Seymour 2006; Lopatto 2003; Seymour et al. 2004; Shaw et al. 2013). Landrum and Nelsen (2002) recognized that, in addition to the hard skills and abilities gained by students, these courses developed interpersonal skills. For example, based on a study at four liberal arts colleges, the top three benefits perceived to be gained by undergraduates following their URE were personal and professional gains, skill improvement, and "thinking and working like a scientist" (Seymour et al. 2004). In addition, Slobodzian and Pancsofar (2014) found that final-year education students uniformly reported personal and intellectual development in URE courses and perceptions of role development. Third, UREs help students clarify future decisions and career goals (e.g., admission to and success in graduate school, Hathaway et al. 2002; Lopatto 2007). Many researchers connect the development of research and personal skills to the likelihood of graduate school admission (Craney et al. 2011). Lastly, Ishiyama (2002) examined

students in the humanities or social sciences who completed UREs; these students reported significant gains in their ability to think analytically and logically, to put ideas together, and to *learn on their own* as a result of their UREs.

A few studies examined instructor perceptions of benefits for students participating in UREs (Zydney et al. 2002). In particular, Potter et al. (2009) found that faculty mentors were very positive about their role as mentors. The URE supervisory responsibilities also motivated instructors to do research; only a few mentors reported that such responsibilities hindered their research. Following supervision of a URE, 71% of supervisors either agreed or strongly agreed that they learned from their students, and 56% agreed or strongly agreed that the relationship helped them better relate to their students (Potter et al. 2009). With respect to instructor benefits, key benefits included one-to-one mentorship, academic outcomes (e.g., publishing or presenting), engaging with research topics, and developing relationships (Hvenegaard et al. 2013).

Of the few studies comparing the perspectives of students and instructors, results suggest that both groups benefit from involvement in these types of courses (Barker 2009). For example, Lei and Chuang (2009) compared the major benefits listed by students (improvement in organizational and management skills needed to succeed at a graduate level, the enhancement of creative thinking, and an increase in logical and analytical skills) with the major benefits reported by supervisors (assistance in research grant writing, manuscript writing, and enjoyment of the experience). In a different study, Kardash (2000) asked students to self-rate their ability to perform 14 skills at the beginning and end of their URE, and asked faculty mentors to rate how well each student was able to perform each skill at the end of the URE. Undergraduate students and their mentors did not differ significantly in their assessment of final skill level. Students reported gains for all 14 skills, but those reported gains were higher for "softer" skills (e.g., oral communication of research results, observing and collecting data, developing a broader

perspective) than research design questions (e.g., identifying research questions, establishing a workable hypothesis, designing a test, and interpreting the experimental results). Finally, a Texas study found that student goals for UREs related to research skills, exploring a field of study, and preparation for graduate study, whereas faculty goals for UREs related to preparing students for careers and graduate school, meeting curricular requirements, exploring new areas, and interacting with students (Mancha and Yoder 2014).

Very few studies have examined the critical factors leading to successful UREs (Mancha and Yoder 2014). In one study, Barker (2009) demonstrated that specific institutional features (i.e., becoming members of an intellectual community or research culture, having a strong and positive relationship with a faculty mentor, and having that mentor scaffold the student throughout the research process, and providing connections and information) can lead to positive student perceptions of the URE and increased success in admission to graduate school. In another study assessing students in final-year UREs for graduate research, Shaw et al. (2013) concluded that such students demonstrated better "research preparedness" than other similar students. Moreover, the key factors critical to success identified by students were student motivation, hard work, mentor relationship, and clear expectations; the key factors for faculty members were hard working students, available resources, and manageable research projects.

A small part of the literature focuses on the real, but surmountable, challenges of UREs. The most commonly noted challenges to faculty members' participation in UREs include the lack of compensation for undertaking such work and the time necessary for such work (Potter et al. 2009). Lei and Chuang (2009) reported other perceived disincentives for faculty, including the need for additional student training before the URE, lack of funding, and limited space for research. One study concluded categorically that "larger institutional issues, such as the inconsistent value accorded to faculty work with undergraduates in faculty retention, tenure, and promotion decisions . . . cannot be ignored" (Jones and Davis 2014, 40). Students reported other

major barriers to a URE, including lack of awareness of URE opportunities, unequal student access, poor timing, lack of publicity, and unequal incentives for faculty (Wayment and Dickson 2008). Other researchers also found that time constraints were a major barrier for students (Hvenegaard et al. 2013; Lei and Chuang 2009).

Perceptions of DS courses

Aside from the more general work on UREs, DS courses, as a separate and popular form of the URE, have not been adequately studied (Healey et al. 2013; Sanders 1984). Of those studies that have considered DS courses, Scott (1973) proposed that universities should offer DS courses to fulfill students' desire for independent learning and provide valuable benefits (e.g., improvement of students' problem-solving skills, self-discipline, self-directed learning, and increased positive interaction with instructors), but should address students' capacity for these courses, ensure the academic rigour of these courses, and acknowledge that instructors may view DS courses as an "extra burden" (5). Similarly, Peterson (1974) found that DS courses required a greater time obligation of mentors per student than other types of undergraduate teaching, that they required more personal interaction time from mentors, and that mentors perceive students to gain more from a DS course than from a typical course. Lamdin and Worby (1976) concluded that DS courses serve several purposes, including fulfilling a mentor's aspiration to work in an academic specialization area, helping students meet program requirements, and enhancing a department's reputation of supporting students, all within the constraints of workload and time. However, Katz et al. (2006) concluded that instructors are inspired to support future researchers and to prepare students for future research opportunities, such as at graduate school (Hvenegaard et al. 2013). Since the publication of this foundational work on DS courses, there has been very little further investigation of their course dynamics. We speculate that this neglect in studying DS courses as a specific form of URE may in part be due to the stronger emphasis in the scholarship of teaching and learning on understanding how to integrate broad-based UREs

across the entire curriculum and spectrum of course offerings within programs (e.g., Elrod, et al., 2010). This focus on understanding UREs at a more general level has come at the expense of studying dynamics of specific subtypes of URE, such as DS courses. By conducting research comparing student and instructor perspectives of DS courses, we are building upon the existing literature by assessing perceptions of previously identified course dynamics and expanding knowledge of this topic by making direct comparisons of stakeholder perspectives to determine if there is overlap or shared perceptions. In addition, by conducting this research we hope to encourage scholars to re-examine more closely the specific design features of the specific types of UREs offered at their institutions. In doing so, they maybe be able to better determine the comparative impact of various URE practices offered at their own institutions while at the same time strengthening the scholarly understanding of what constitutes a high impact URE.

Purpose of the Present Study

Given the limitations of the extant research, it is acknowledged that more study of student and faculty dynamics in URE participation, and particularly DS courses, is necessary (Hvenegaard et al., 2013; Lopatto 2003; Millspaugh and Millenbah 2004). Hence, the purposes of this study were to compare student and instructor perspectives about DS courses (i.e., perceived structure, goals, benefits, and challenges), as one type of URE, and to identify practices associated with beneficial learning and instructional outcomes. This study is important, firstly because it takes many disciplines into account, rather than just one department or program. Second, rather than focusing on a large research-intensive university, where research is largely driven by graduate programs, this study examines DS courses at a small, liberal arts, undergraduate campus, the kind of campus in which collaborative research with students is critical in advancing the research career of instructors with very high teaching loads and enhancing their research productivity (e.g., Koch and Johnson, 2000; Osborn and Karukstis, 2009; Rowlett et al., 2012). Third, this study provides a Canadian example of UREs, which is

missing in most previous research (Vajoczki 2010). Fourth, this study compares the motivations, benefits, and challenges of both students and instructors rather than focusing on only one of these factors. Fifth, this study includes the perspectives of both students and instructors at the same institution and time period, which helps identify potential mismatches between educational aims, actual practice, and outcomes DS courses (McKenzie et al. 1985).

Method

Sample and Data Collection

In 2010 and 2011, two separate samples of students and instructors from a small, undergraduate liberal arts and sciences campus of a large research-intensive university in Western Canada were recruited to complete a survey about their perceptions and experiences with DS courses. During the time frame of this study, there were on average nearly 1000 full-time students enrolled annually. For example, in 2010-11 when data collection commenced, there were 988 full-time students (425 males/563 females).On this campus, there were 19 majors in academic programs spanning the departments of fine arts, humanities, social sciences, and sciences. These majors were taught by 68 full-time faculty members who were eligible to supervise DS courses. Part-time or sessional instructors typically did not teach these courses. DS course completion was not required for students in any of the academic majors and was an elective credit in most majors and programs on campus. Enrolment typically required students to possess a minimum GPA that represented some minimum level of competency or superior academic performance, although the minimum GPA level varied across disciplines (usually from 3.0 to 3.5 on a 4-point scale) and sometimes the only requirement was permission of the supervising instructor. Students were typically expected to initiate the DS course and approach potential supervising instructors. Additionally, instructors were not required to teach DS courses and voluntarily engaged with them above their full-time teaching load. An exhaustive list of all DS course offerings at the institution was developed through a review of the course catalogue by

the research team using the agreed-upon definition described in the introduction of this paper. Once a list of DS courses was compiled, the university registrar's office generated a list of students who had completed the courses. Based on the information generated from academic records, we identified a sample of 211 students who had voluntarily completed DS courses during the previous 5 years.

Most students (who had completed a DS course in the past 5 years) were recruited via social media (i.e., Facebook and email) to complete an online version of the survey, and a few students completed an identical paper version. All current, full-time teaching faculty members were recruited to participate at a large faculty meeting; absent instructors were recruited via intercampus mail with a paper copy. For both groups, a DS course was defined as any university course that involved self-directed, intensive study of a particular topic under the close supervision of a faculty member). While variable among disciplines and instructors, DS courses typically involve literature reviews, data collection, data analyses, written papers, and public oral presentations.

Development of Survey Items

Based on a literature review (of UREs, DS courses, potential predictors of learning outcomes, and relevant pedagogical theories) and qualitative focus group discussions with 8 instructors and 9 students who had recently completed DS courses (Hvenegaard et al. 2013), we created separate pools of survey items for the professor and a student samples. The questionnaires contained demographic questions, checklists (for perceived motivations, structural features, and benefits derived from DS courses), and Likert-type rating scales (ranging from 1 = strongly disagree to 5 = strongly agree) regarding instructional processes, the student-professor relationship, perceived mentorship, supervision, perceived independence, communication, expectations, workload challenges, and perceived learning outcomes (See Supplementary Materials). For most items, we created parallel wordings for student and instructor surveys.

However, because most students had experience with one DS course, while instructors had supervised multiple DS students, some wording of questions varied slightly between participant groups. Specifically, the student surveys asked about the specific experiences with their *most recently completed DS course*, while the instructor survey questions inquired about more generic experiences with DS type courses and the students who completed them. We concluded the survey with open-ended questions about challenges and recommendations regarding DS courses.

Results

Descriptions of DS Courses

Of the 211 students had completed an DS course in in the preceding 5 years, 102 respondents (48.3% response rate) completed the survey. The sample consisted of 75 females, 25 males, and 2 respondents who did not indicate their gender. While this sample shows an over-representation of female respondents given the gender ratio in the wider student population (roughly a 60:40 split of females to males), this response pattern may have emerged because some of the higher enrolment majors in which DS studies are more commonly offered (e.g., psychology) have greater gender imbalance compared to the overall student population. The majority of students (68.6%) had completed only 1 DS course, 24.5% had completed 2 DS courses, and only 5.9% had completed more than 2 DS courses. Most respondents had completed the course in either their third (25.5%) or fourth year of study (65.7%). The average reported weekly meeting time ($M = 1.99$ hours, $SD = 1.65$) was less than the typical 3 hours of classroom time devoted to lecture courses ($t(93) = -5.93, p < .001$). Even though the majority of instructors at this university campus were male, fewer students reported working with a male DS course supervisor (41.2%). Instead, the majority (58.8%) reported that their supervisor was female. In terms of area of study, there was representation of student respondents from every department on campus and nearly every major area of study (See Table 1). Some students also used DS courses to fulfil their minor requirements. Courses focused on topics as varied from the performing arts

and modern languages/humanities to biological and environmental studies. Overall, there was a slight overrepresentation of psychology majors (17.6%) and no representation of students in business management. This overrepresentation of psychology students could be attributed to a programmatic formalization of DS courses as an equivalent of an honours thesis in the psychology program, while business management did not offer DS courses because of their professional program emphasis. Importantly, despite this wide variability in topics of DS courses, most students agreed there was a common course structure to these types of experiences (see Table 2 and *Perceptions of DS Course Structure* below)

Of the 68 full-time teaching faculty eligible to supervise DS courses (48 males and 20 females), 43 (69.4%) completed the instructor version of the survey. The instructor sample consisted of 10 females and 33 males. The median period of teaching full-time was 10 years (range of 1-39 years). Academic rank of DS instructors was spread across the full-time sessional (7.0%), assistant professor (32.6%), associate professor (37.2%) and full professor (18.6%) ranks. Consistent with the actual sizes of departments on the campus, a larger proportion of instructors surveyed reported affiliation with either the departments of science (32.6%) or social sciences (39.5%), compared to the humanities (14.0%) and fine arts (7.0%) departments. Three instructors (7.0%) did not report their departmental affiliations.

In the past 5 years, instructors reported that they had supervised a median number of 3 students (range of 0-8). Only 18.6% reported supervising no students in the past 5 years. When asked how many students they would be willing to supervise in a year, all instructor respondents indicated they would be willing to supervise a median of at least 1 DS student (55.8%), while a smaller proportion reported a willingness to supervise 2 or more DS students (44.2%). Instructors spent a mean of 3.03 hours per week ($SD = 1.31$) on DS course-related tasks (i.e., meetings, readings, preparation, etc.).

Perceptions of DS Course Structure

In order to determine if instructors and students shared similar perceptions of the structure and evaluative components contained in DS courses, we compared the frequencies with which instructors and students endorsed an identical list of possible evaluative course work components that could be included in DS courses. Based on a series of chi-square tests of independence reported in Table 2, it appears students and instructors shared similar perceptions. In general, consistent with definitions of DS courses as research-intensive courses, both students and instructors reported that DS courses focused on writing, analysis of information, as well presentation of this information. Importantly, the only component on which there was a significant level of disagreement was on the inclusion of a participation/engagement mark within their DS course. Students (64.1%) were less likely to indicate that they were being evaluated in terms of their participation or engagement compared to instructors (81.6%).

Perceptions of Motivations

To examine similarities and differences in student and instructor motivations for engaging with a DS course, we compared the frequencies with which each group endorsed a checklist of motivations (Hvenegaard et al. 2013). Motivations were conceived as the *a priori* goals individuals set for the courses. Based on chi-square tests of independence reported in Table 3, both groups were interested in teaching/learning discipline specific research skills, independent project development, working with a specific person, developing work collaboration skills, pursuing scholarly publications, and learning more about a major. Based on levels of agreement, we conclude that DS courses generally involve goals of encouraging independent scholarship in students, fulfilling program requirements, or developing a mentorship relationship. In terms of unique motivations endorsed by instructors and students, instructors were more likely than students to indicate that they were motivated to help students prepare for graduate school, gain research experience, explore a topic in depth, and fulfill program requirements.

Perceptions of Course Benefits

To compare student and instructor perceptions, we compared the frequencies with which each group endorsed a list of benefits they derived from DS courses. Based on chi-square tests of independence reported in Table 4 on each of the listed positive outcomes, both groups reported gaining research experience, gaining learning experiences outside the classroom, experiencing one-on-one instruction, developing a relationship with a mentor, and gaining assistance with decisions to apply to graduate school as beneficial student outcomes. In terms of differences, instructors were more likely than students to report that DS courses prepared students for graduate studies, developed an understanding of the discipline, integrated previous course work, promoted scholarly outputs, and developed students' independent scholarship skills.

The instructor survey also asked respondents about motives that were unique to instructors. Other motives endorsed by instructors included providing hands-on teaching (51.2%), staying current on a research topic of their interest (41.9%), fulfilling their responsibilities as an educator (44.2%), and teaching more about their specific discipline/interest (39.5%). In terms of positive outcomes from teaching DS courses, instructors reported that they were able to pursue a topic of their interest (58.1%), keep up to date with innovations in the field (34.9%), pilot new course material (23.3%), and engage in research collaborations that resulted in a scholarly publication or presentation (23.3%). The only unique outcome we assessed with students was a question about whether completion of their DS course helped in their current career or occupation, to which 64.7% answered this question affirmatively and 19.6% stating the DS course did not help the current career. Some students did not answer this question because they were still currently enrolled in other degree programs and had not entered the workforce yet.

Predictors of DS Course Outcomes

As displayed in Table 5, students reported strong positive endorsement of all key course outcomes. Instructors did not report on perceived improvements in students, but reported strong support for other outcomes such as enjoyment from mentoring, perceptions of learning, and

energy derived from teaching DS courses. Using independent samples t-tests, we determined there were no significant differences between students and instructors in reports of overall enjoyment of the DS experience and enjoyment of the relationship that was developed in the course. However, in terms of self-reported learning, students reported a higher score ($M = 4.54$) than that of instructors ($M = 3.92$, $t(137) = 3.56$, $p = .001$).

In addition to assessing self-reported outcomes, on each of the student and instructor surveys, a pool of 30-35 potential predictors of learning outcomes were used to assess perceived qualities of DS course dynamics (Hvenegaard et al. 2013). Due to the large pool of predictor items and the exploratory nature of this research, we used stepwise multiple regression analysis with forward entry of the most significant predictors ($p < .05$ probability of F to enter) to identify the key predictors of self-reported learning outcomes. As shown in Table 6, the models for student learning outcomes emphasized the importance of engaged, collaborative and self-directed type of learning. For 4 of the 8 outcomes (self-reported amount of learning, improved writing skills, improved presentation skills, and enjoyment of mentoring relationship), the most significant predictor was the perception that the supervisor provided the "right amount" of supervision. Presumably, the more closely the perceived expectations of the student align with the expectations communicated by the instructor, the more likely a student is to report receiving a "right" amount of supervision. The role of communication of expectations between student and supervisor is key. The significance of the time and effort invested in the course by the student also illustrates the active nature of the DS course outcomes. For 7 of the 8 regression models, self-reported effort exerted significant effects on predicted learning outcomes.

A second major theme is the emphasis on student-centred learning. For the course enjoyment outcome, the first predictor emphasized student satisfaction with access to their supervisor (related to mentorship), while the other four predictors emphasized preparation and effort and student choice in pursuing the DS course. With self-reported amount of learning, the

regression model emphasized the importance of providing collaborative learning opportunities (e.g., amount of supervision, learning in discussions, completing work that built on supervisor) and self-directed learning (e.g., putting more effort into DS course, choice in decision making on course content, individual preparation for course, desiring more time to complete course). In terms of specific skills outcomes of perceived improvements in writing, critical thinking, and presentation/communication skills, the models repeated the importance of collaborative and self-directed learning. Role modelling processes on the part of the instructor were also emphasized as important predictors for skill development, graduate school preparation, and student enjoyment of the mentoring relationship.

For four instructor outcomes displayed in Table 7, the models highlighted instructor practices that promote beneficial outcomes for instructors. First, for 3 of the 4 outcomes (enjoyment of supervision, self-reported learning from supervision experiences, and getting energy from supervision), the most significant predictor was self-reported involvement with the DS course process. Second, instructors appear to enjoy the experience of being involved in DS courses if there is greater structure in the course (e.g., clear focus for the research at the start, greater student preparation, and encouraging research that builds on prior work). Finally, self-reported inability to balance workload from other courses with supervision negatively predicted enjoyment levels.

Challenges and Recommendations for Changes

In response to an open-ended question concerning the perceived challenges in DS courses, the most frequent response for students was either a non-response (28.4%) or an explicit "no challenges faced" response (3.9%). For students who provided an answer, the most frequent challenges were time management issues (17.6%), unclear expectations about how to start or carry out the research (10.8%), or difficulty maintaining motivation (3.9%). Students also mentioned specific skill challenges such as difficulty finding research sources (6.9%) or in

writing about their topic (2.9%). Nearly half of instructors did not respond (48.8%) to this question, but for those that did, the most common challenges were time pressures from other work responsibilities (27.9%) and a lack of preparation/motivation on the part of their student mentees (14.0%).

In terms of recommendations for changes to these courses, the majority of students either did not answer the question or explicitly stated they did not have recommendations (58.8%). The main student suggestions for changes focused on the need for better communication about expectations (8.1%), relaxing the grade entrance requirements (4.9%), or the need for raising awareness about the ability of DS courses to prepare students for graduate studies (3.9%). Recommendations by instructors primarily focused on the recognition of DS course work by university administration. Instructors suggested either the provision of explicit remuneration (11.6%) or a teaching credit/course release (4.7%) for supervising DS students.

Discussion

The purposes of this study were to compare student and instructor perspectives about DS courses (i.e., perceived structure, goals, benefits, and challenges) and to identify practices associated with beneficial learning and instructional outcomes. This research helps to better understand the instructional processes in DS courses that facilitate high impact undergraduate research experiences (UREs) and to develop policies or best practices to enhance DS course outcomes for both students and instructors (e.g., Moore et al. 2012).

Consistent with prior studies of UREs, DS courses are viewed very favorably by both instructors and students (e.g., Craney et al. 2011; Hvenegaard et al. 2013; Lopatto, 2007; Seymour et al. 2004; Zydney et al. 2002), particularly in terms of enjoyment and a positive mentoring relationship (Landrum and Nelson 2002). Seymour et al. (2004) found that students appreciated the peer collegiality from working one-on-one with a faculty mentor; this study found that both instructors and students gained from the mentoring relationship. Thiry and

Laursen (2011) suggest that mentoring can occur in one or more areas of professional socialization, intellectual support, and personal support, and that novice students require more assistance than experienced students.

For students, DS courses enhanced several core academic and research skills, and for instructors, DS courses provided opportunities for collaborative research with students and generated energy and enjoyment. For both students and instructors, DS courses involve added, intensive work, but permitted both groups to engage in research and hone their research skills. Finally, the type of learning with DS courses is student-centered and collaborative in nature, fitting related styles of teaching such as discovery learning (Anthony 1973), problem-based learning (Barrows and Tamblyn 1980), inquiry learning (Rutherford 1964), and constructivist learning (Jonassen 1991). All styles share the common qualities of less instructor guidance and more student responsibility for learning.

An important conclusion is that both students and instructors perceive the structure, goals, and beneficial outcomes similarly. This is consistent with other research comparing instructor and student perspectives (e.g., Kardash 2000). Nevertheless, some minor discrepancies point to ways in which DS courses can be improved. For example, students were less aware than instructors that participation contributed to final grades, suggesting a need for improved communication regarding expectations about participation/student engagement in course assessments. It is also important to note that these patterns of similarities and differences were remarkably consistent across all of the academic disciplines surveyed. While prior research has focused on DS courses in specific disciplines or faculties with more narrow teaching or research foci, the patterns of outcomes in the present student were obtained across a variety of disparate disciplines in the liberal arts.

Another conclusion is that perceptions of motivations and the potential for beneficial outcomes connected to DS courses were generally consistent between instructor and student

groups, but that instructors endorsed a broader spectrum of motives and benefits. This finding is consistent with research on instructor perspectives on URE benefits (e.g., Hunter et al. 2006; Mancha and Yoder 2014; Potter et al. 2009). Instructors also were more likely than students to endorse the benefits in providing students greater research experience within their discipline, preparing them for graduate school, and in providing instructors beneficial outcomes like co-authored research publications. Given that instructors had more in-depth experience in supervising multiple DS courses, while students were generally responding to their experience with a single experience, it is likely that instructors could better appreciate the complexity of the motives and benefits associated with DS courses. Instructors and university administrators could better communicate and market the variety of beneficial goals and outcomes to students who are less aware of what can be accomplished in these kinds of courses.

In addition, we identified some key predictors of student and instructor perceived outcomes in DS courses which were similar to critical factors of success identified by Mancha and Yoder (2014). For the student outcomes, common themes emerged related to self-directed learning (e.g., choice/control in the direction the course, preparation, and personal effort), as well as mentorship/communication (e.g., satisfaction with amount of supervision, role modeling, and good access to the supervisor). These results are consistent with Howitt et al.'s (2010) suggestion that the two key factors promote successful research experiences for students are good supervision and doing authentic science. In particular, Pfund et al. (2006) noted the need for good communication as a key feature for effective mentoring.

For instructor outcomes, the key predictors were involvement-related factors and recognition of workload barriers. Taken together, these results imply that beneficial outcomes are most connected to DS courses in which students make decisions about course content and instructors are able to engage with the shared topic of study. As Howitt et al. (2010) conclude, students want to know that they are doing authentic science. Similarly, DS courses produce

student perceptions of beneficial outcomes if they are led by motivated and enthusiastic instructors. At first glance, the finding that instructor enjoyment and learning stems from building student research on the instructor's prior work suggests a tension with students' own self-directed learning motivations. However, these patterns illustrate and reinforce the collaborative nature of DS courses. While students seek to explore ideas and topics that stimulate their own research interests, they still seek input and feedback from their instructor concerning their learning goals. With clearer feedback and definition of research goals on the part of the instructor, the student feels more enjoyment and engagement with their research goals in the DS course, which in turn presumably provides greater enjoyment and learning on the part of the instructor.

Responding to potential challenges, our results reinforced other research in which most students and instructors appear satisfied with their course experiences (e.g., Hvenegaard et al. 2013; Millspaugh and Millenbah 2004; Wayment and Dickson 2008). Of the challenges identified, students generally reported difficulty in balancing their workload and some dissatisfaction with unclear coursework expectations. This is especially true for novice versus experienced undergraduate researchers (Thiry and Laursen, 2011). Instructors also mentioned challenges such as workload, unclear administrative expectations, and a lack of compensation for supervising DS courses. These reported challenges complemented the respondent-based suggestions for changes. Students desired clearer course expectations and more awareness about DS course benefits, while instructors recommended a system of recognizing DS course supervision that addresses workload concerns. These repeated challenges and recommendations suggest that instructors and administrators can improve communications about DS courses and that university administrators should consider how to recognize DS course supervision (which is not presently remunerated). Otherwise, the perception of a heavy workload in an instructor's teaching schedule may lead them to be less motivated to take on the extra burden of supervising

DS courses. Pfund et al. (2006) recommend a mentoring program for undergraduate research mentors that can help align student and supervisor expectations, thus alleviating these concerns about the delivery of the DS courses and improving upon the benefits of IS courses.

Limitations and Future Directions for Research

While the results of this study suggest ways to maximize the impact of UREs offered by DS courses, there were some study limitations. First, the self-reported data must be interpreted cautiously because of potential threats of reporting biases such as socially desirable responding, satisficing, or memory errors (e.g., Tourangeau et al. 2000). However, we took efforts to minimize these concerns by making all surveys anonymous and including question content that encouraged respondents to make deliberative and critical evaluations of their DS experiences. Second, we used primarily self-reported perceptions of behavioral changes in research skills and not more direct behavioral indicators of skill changes (e.g., grade changes). Verbal reports on certain psychological processes have often been criticized for their inaccuracy due to fact that people tend to not consciously monitor their behavior (Nisbett and Wilson 1977).

To address this concern, future research might consider incorporating more direct behavioral indicators of skill changes that occur in students and assessing these skills both before and after completing DS courses. Given the potential for sampling biases with the student respondents, we are cautious about generalizing the findings. The campus on which this survey was conducted was a primarily undergraduate, liberal arts-focused university setting with a smaller student population. One of the primary features of this type of campus is the greater ease with which teaching and mentoring relationships can be established. While it is unclear if these kinds of student-centered mentoring relationships can be established in larger, research intensive university settings, we would argue that the same basic DS course dynamics (i.e., structure, motives, beneficial outcomes, and challenges) are also present at these campuses. Future research might consider investigating DS course dynamics at larger, research intensive

campuses. In addition, while the data from this study represented a relatively large sample of students and instructors who participated in DS courses on a small primarily undergraduate university campus, it is still a comparatively small sample of respondents from a single institution which may limit its generalizability to all post-secondary settings. In order to strengthen our conclusions about the general benefits of DS courses, future research should attempt to conduct similar surveys across a variety of academic programs at multiple post-secondary institutions of varying sizes in order to determine if DS course dynamics demonstrate similar outcomes to the ones obtained in the current study.

Conclusions

Despite these limitations, the results of the present study are the first of their kind to directly compare student and instructor perspectives pertaining to the multiple important course dynamics (i.e., perceived motivations, benefits, and challenges) and outcomes of DS courses in a large sample of instructors and students at a primarily undergraduate university institution. These results help confirm that DS courses are a high impact form of URE and help suggest possible ways in which DS courses can be best delivered. Importantly, these patterns of results were consistently reported by both groups of stakeholders representing a broad sampling of individuals from a variety of academic disciplines and are also one of the first studies of its kind undertaken in Canada. The study results support the generation of numerous benefits from DS courses for both undergraduate students and their supervisors. Students report improvements in several key research skills and instructors report benefits for their teaching in other courses and in their ability to engage in research with motivated students. In general, students and instructors share similar beliefs and perceptions about the dynamics of DS courses, but our survey results also indicate key areas where DS courses could be improved. To promote more beneficial outcomes, instructors should address the key student barriers of workload and unclear expectations by providing more consistency in DS courses and more clear communication about

the work being assessed and expected outcomes of the course. Similarly, administrators should address instructor barriers by providing clarity about course and workload expectations and compensation. Finally, the results support the idea that student-centered instructional approaches which offer students greater control over the direction of their research predict higher levels of beneficial outcomes in DS courses. To facilitate this instructional model, university administrators might consider offering formal faculty training in how to mentor effectively in DS courses as well as developing formal guidelines or best practices for how instructors might engage with undergraduate student supervision.

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Table 1

Topics of DS Courses Completed by Student Respondents

Topic of Study	% (n)
Art	2.2 (2)
Biology	5.5 (5)
Classics	2.2 (2)
Computing Science	3.3 (3)
Economics	1.1 (1)
English	8.8 (8)
Environmental Studies	12.1 (11)
German	9.9 (9)
History	3.3 (3)
Interdisciplinary Studies	9.9 (9)
Mathematics	1.1 (1)
Music	5.5 (5)
Religious Studies	2.2 (2)
Philosophy	1.1 (1)
Physics	2.2 (2)
Physical Education	1.1 (1)
Political Studies	6.6 (6)
Psychology	17.6 (16)
Scandinavian Studies	3.3 (3)
Sociology	1.1 (1)

Note: n=91, 9 respondents did not report DS course topic.

Table 2

Perceptions of the Evaluative Components of DS Courses

Evaluative Component	Students % Agreement (n)	Instructors % Agreement (n)	χ^2
Writing	92.2 (95)	92.1 (35)	0.00
Analyzing Information	70.9 (73)	73.7 (28)	0.11
Participation/Engagement	64.1 (66)	81.6 (31)	3.96*
Public Presentation of Research	64.1 (66)	73.7 (28)	1.15
Literature Review	53.4 (55)	57.9 (22)	0.23
Demonstrating Specific Skills	48.5 (50)	39.5 (15)	0.92
Reflective Writing	35.0 (36)	36.8 (14)	0.04
Producing Creative Work	27.2 (28)	28.9 (11)	0.04
Public Presentation of Creative Work	18.4 (19)	13.2 (5)	0.55
Tests/Midterms/Finals	5.8 (6)	5.3 (2)	0.02
Labs	2.9 (3)	2.6 (1)	0.01

* $p < .05.$

Table 3

Perceived Motivations for Completing DS Courses

Goal/Motivation	Students % Agreement (n)	Instructors % Agreement (n)	χ^2
Independent Project Development	65.0 (57)	57.9 (22)	0.61
Work With Specific Professor/Student	54.4 (56)	63.2 (24)	0.87
Explore a Topic in Depth	54.4 (56)	73.7 (28)	4.30*
Gain Research Experience	48.5 (50)	71.1 (27)	5.67*
Fulfill Program Requirement	46.6 (48)	65.8 (25)	4.09*
Preparation for Graduate School	38.5 (40)	67.6 (25)	9.31**
Learn Discipline Specific Skills	30.1 (31)	39.5 (15)	1.10
Learn About Discipline/Major	31.1 (32)	42.1 (16)	1.51
Conduct Field Work	26.2 (27)	15.8 (6)	1.68
Pursue Scholarly Publication	15.5 (16)	18.9 (7)	0.23
Learn/Improve Work Collaboration Skills	8.7 (9)	10.5 (4)	0.11

*$p < .05$. ** $p < .01$.

Table 4

Perceived Beneficial Student Outcomes for DS Courses

	Students	Instructors	
Beneficial Outcome	% Agreement (n)	% Agreement (n)	χ^2
Experienced One on One Instruction	71.8 (74)	81.1(30)	1.22
Pursued Topic of Student Interest	68.9 (70)	86.5 (32)	4.31
Developed a Relationship	66.7 (68)	56.8 (21)	1.16
Gained Research Experience	65.0 (67)	78.4 (29)	2.24
Developed Specific Research Skills	62.1 (64)	78.4 (29)	3.26
Developed Understanding of Discipline	59.2 (61)	86.5 (32)	9.07**
Gained Learning Experience Outside Classroom	53.4 (55)	54.1 (20)	0.01
Developed Independent Scholarship Skills	39.8 (41)	75.7 (28)	14.01**
Prepared Student for Graduate School	35.0 (36)	62.2 (23)	8.27**
Assisted Graduate School Decision	31.1 (31)	32.6 (15)	1.35
Integrated with Previous Course Work	26.2 (27)	54.1 (20)	9.46**
Co-authored Presentation or Publication	16.5 (17)	40.5 (15)	8.91**

**$p< .01$.

Table 5

Self-Reported DS Course Outcomes

Student Item	*M*	*SD*
I enjoyed my directed studies course.	4.56	0.94
I learned a lot from my directed studies course.	4.54	0.94
I enjoyed the relationship I developed with my directed studies supervisor.	4.40	0.88
My critical thinking skills were strengthened by my directed studies course.	4.30	0.83
I learned things in my directed studies course that could have only been learned in that type of course.	4.23	1.00
My writing improved as a result of undertaking my directed studies course.	4.10	1.01
My DS course gave me additional skills necessary for post-graduate studies or career.	3.99	0.95
I have better presentation and communication skills because of my DS course.	3.83	1.03
Instructor Item	*M*	*SD*
For the most part, I have enjoyed supervising directed studies courses.	4.37	0.71
I enjoy the relationships I develop with my directed studies students.	4.29	0.57
I have learned a lot from supervising directed studies courses.	3.92	0.85
I get energy from teaching directed studies courses.	3.74	0.92

Table 6

Summary of Stepwise Multiple Regressions of Student Outcomes on DS Course Qualities

Dependent Variable: Enjoyment of DS Course

Step	Variable Entered	ΔR^2	β	t
1	Satisfied with Access to Supervisor	.62	.79	12.56
2	Provided Freedom to Explore Ideas	.07	.30	4.48
3	Well Prepared for DS Course	.03	.24	3.12
4	Put More Time and Effort Into Course Than Other Courses	.02	.17	2.78
5	Supervisor Was My First Choice	.01	.16	1.64

Dependent Variable: Learned a Lot in DS Course

Step	Variable Entered	ΔR^2	β	t
1	Supervisor Provided Right Amount of Supervision	.53	.73	10.26
2	Learned a Lot from Discussions with Supervisor	.09	.35	4.54
3	Put More Time and Effort Into Course than Other Courses	.06	.28	4.02
4	Enjoyed Being Able to Make Decisions About Course Content	.03	.28	3.13
5	Completed Work That Built on Other Work of Supervisor	.02	-.17	-2.80
6	Supervisor Acted As Role Model	.01	-.16	-2.12
7	Well Prepared for DS Course	.01	.18	2.25
8	Wish Had More Time to Complete DS Course	.01	.11	2.06

Dependent Variable: Improved Writing

Step	Variable Entered	ΔR^2	β	t
1	Supervisor Provided Right Amount of Supervision	.37	.61	7.42
2	Put More Time and Effort Into Course Than Other Courses	.11	.39	4.50
3	Well Prepared for DS Course	.04	.28	2.68
4	Wish Had More Time to Complete DS Course	.03	.19	2.64

Dependent Variable: Improved Critical Thinking

Step	Variable Entered	ΔR^2	β	t
1	Learned a Lot from Discussions With Supervisor	.36	.60	7.16
2	Put More Time and Effort Into Course Than Other Courses	.08	.31	3.72
3	Students Should Have Discussions With Supervisors Before Enrolling	.05	.25	3.11
4	Reflecting on Issues About Course Topic Was A Major Learning Outcome	.02	.19	2.05

Dependent Variable: Improved Presentation/Communication Skills

Step	Variable Entered	ΔR^2	β	t
1	Supervisor Provided Right Amount of Supervision	.28	.53	6.08
2	Put More Time and Effort Into Course Than Other Courses	.08	.30	3.49
3	Well Prepared for DS Course	.04	-.21	-2.55
4	Wish Had More Time to Complete DS Course	.03	.17	2.01

Dependent Variable: Additional Skills for Graduate School

Step	Variable Entered	ΔR^2	β	t
1	Supervisor Acted as a Role Model	.29	.53	6.09
2	Students Should be Required to Have Minimum GPA	.11	.33	4.01
3	Provided Examples of How to Complete Course Work	.04	.22	2.55

Dependent Variable: Learned Things That Could Only be Learned in DS Course

Step	Variable Entered	ΔR^2	β	t
1	Supervisor Acted as Role Model	.21	.46	4.93
2	Put More Time and Effort into DS Course than Other Courses	.08	.30	3.14
3	Should Have At Least 3rd year Standing	.04	.20	2.29

Dependent Variable: Enjoyment of Relationship With Supervisor

Step	Variable Entered	ΔR^2	β	t
1	Supervisor Provided Right Amount of Supervision	.52	.72	10.03
2	Supervisor Acted as Role Model	.10	.35	4.92
3	Supervisor Provided Considerable Freedom to Explore Ideas	.02	.19	2.42

Table 7

Summary of Stepwise Multiple Regressions of Instructor Outcomes on DS Course Qualities

	Dependent Variable: Enjoyment of Supervision			
Step	Variable Entered	ΔR^2	β	t
1	Typically Highly Involved as Supervisor	.28	.52	3.59
2	Have Difficulty Balancing Workload with Other Courses	.09	-.31	-2.22
3	Get Students to Complete Work that Builds On My Prior Work	.08	.29	2.14

	Dependent Variable: Learned a Lot From Supervising			
Step	Variable Entered	ΔR^2	β	t
1	Typically Highly Involved as Supervisor	.33	.58	4.12
2	Get Students to Complete Work that Builds On My Prior Work	.13	.37	2.89

	Dependent Variable: Enjoyment of Relationships with Supervised Students			
Step	Variable Entered	ΔR^2	β	t
1	Provide Students With A Clear Focus At Start of Term	.40	.63	4.73
2	Important to Have Had Prior Courses With Student	.08	.28	2.18

	Dependent Variable: Get Energy From Teaching DS Courses			
	Variable Entered	ΔR^2	β	t
1	Typically Highly Involved as Supervisor	.32	.56	3.96