

RESEARCH ARTICLE

A mixed-method investigation of faculty perspectives on the benefits and challenges of engaging in student partnership activities in science

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ABSTRACT

There is a growing interest within higher education to engage with students as partners to reposition students from consumers to producers of knowledge. The purpose of this study was to gather insights into the benefits, barriers/challenges, and best practices for engaging in student-faculty partnership activities for science faculty members. Supervising or working with graduate teaching assistants, working with students on university committees, collaborating with undergraduate or graduate students on a new or existing research project, and co-authoring manuscripts with graduate students were regarded as the most impactful partnership activities. Common benefits of student partnership activities included: collaboration and relationship building, broadening perspectives and gaining feedback, personal satisfaction, and institutional and career-related benefits. Common barriers/challenges reported were interpersonal dynamics and maintaining relationships, student management, and external influences. Best practices consisted of planning and setting expectations, developing students' agency, using open communication, and facilitating peer-to-peer collaboration and peer mentoring.

KEYWORDS

student-faculty partnerships, pedagogical partnerships, collaborative learning, science, faculty partners, faculty perspectives

Students as partners (SaP) is a unique method of working with students that has received increased attention and praise within higher education (Healey et al., 2014, 2016; Matthews et al., 2019). Cook-Sather et al. (2014) define student partnership as “a collaborative, reciprocal process through which all participants have the opportunity to contribute equally, although not necessarily in the same ways, to curricular or pedagogical conceptualization, decision-making,

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implementation, investigation, or analysis” (p. 6–7). Partnerships reorient students as active co-creators of knowledge and allow space for mutually beneficial collaborations and power sharing to develop between students and faculty/staff that are rooted in values of respect and reciprocity (Alhadad et al., 2021; Cook-Sather et al., 2014; Matthews et al., 2018).

Although several ways exist in which students can engage in partnership, Healey et al. (2014) proposed four areas: (a) learning, teaching, and assessment; (b) curriculum design and pedagogic consultancy; (c) subject-based research and inquiry; and (d) scholarship of teaching and learning (SoTL). The partnership roles that students often assume are co-researcher, pedagogical co-designer, consultant, and representative (Bovill et al., 2016).

Despite there being multiple ways of engaging in partnership, students want to be more involved in SaP activities (Matthews et al., 2017) but have reported barriers to engagement (Marquis et al., 2018). When students do have the opportunity to participate, there are benefits for both students and faculty/staff (Matthews et al., 2019). Faculty benefits include the creation of teaching materials (Mercer-Mapstone et al., 2017), building relationships with students (Curran et al., 2017), reframing of teacher-student roles (Maunder et al., 2021), and shifts in perspectives of teaching and learning as collaborative (Cook-Sather et al., 2019). Despite these benefits, studies in non-Western contexts have highlighted cultural context as a potential barrier to partnership (Liang & Matthews, 2021).

Partnerships are often implemented at the institutional level outside of a specific discipline (Hall, 2021; Mercer-Mapstone et al., 2017). Although science, technology, engineering, and math (STEM) fields offer many possibilities for partnership activities, SaP within STEM has been less explored and primarily limited to case studies on single disciplinary perspectives and student-focused benefits (Curtin & Sarju, 2021; Hamerski et al., 2021). Within a science context, undergraduate and graduate students have reported benefits of SaP involvement within social, personal, and career development domains. Barriers reported include difficulties finding opportunities to engage in partnerships, social barriers, power imbalances, difficult working environments, and personal challenges. Students also noted that teaching assistantships and collaborating with faculty on research were particularly impactful (Chittle et al., in-press).

While less often studied (Mercer-Mapstone et al., 2017), faculty/staff have expressed barriers to partnerships such as academic resistance from peers or institutions (Matthews et al., 2019), systemic factors (e.g., program structures that work against partnerships, and lack of time and resources) (Curtis & Anderson, 2021), concern whether initiatives would be successful (Matthews et al., 2019; Mercer-Mapstone et al., 2017), and potential risk to faculty partners’ career progression (Marquis, 2018). Faculty members across a range of academic disciplines (including STEM) have benefited from interacting with student-partners (Begley et al., 2019; Chadha et al., 2023). However, fewer studies have explored both the positive and negative aspects of partnership from the faculty lens within a range of science disciplines and partnership activities.

The purpose of this study was to conduct a faculty-wide investigation of student-faculty partnerships within a Faculty of Science at a mid-sized Canadian university. The study sought to: (a) determine the ways and frequency in which science faculty members formally or informally engage with undergraduate and graduate students in partnership activities, (b) identify the positive outcomes and barriers/challenges associated with these practices, and (c) determine best practices for engaging with students in partnership activities.

METHODS

Research context

The study was conducted at a multidisciplinary Faculty of Science at a mid-sized university in Ontario, Canada. The faculty was composed of eight departments with approximately 60 academic programs. At the time of data collection (fall 2020), there were approximately 120 faculty members and 2,269 undergraduate and 873 graduate students. In the spirit of partnership, our team included five students, a post-doctoral fellow, a faculty member, and the dean at the time. This study is one component of a larger Faculty-wide investigation of student-faculty partnerships.

Study design

A sequential mixed methods approach (Kowalski, 2018) was used, beginning with an anonymous survey shared with all faculty members and followed by semi-structured interviews with additional faculty members recruited purposively. The study received clearance by the authors' research ethics board.

To reduce unclarity around the term "student partnership," survey and interview participants were provided with the definition (based on Cook-Sather et al.'s 2014 work) to encourage them to select and reflect on activities that they considered partnership in nature.

Online survey

A mass email was sent to all faculty members in the Faculty of Science inviting them to participate in an online survey (hosted by Qualtrics XM Platform) related to student-faculty partnerships. Recruitment flyers were also posted on social media sites associated with the Faculty of Science. The survey included demographic questions and participants were asked to select, from a list, all the student-faculty partnership activities they have engaged with. Activities were informed by and adapted from Matthews et al.'s (2017) Student Involvement Questionnaire (SIQ), which aligns with Healey et al.'s (2014) four-category model of partnership areas (Tables 1–4).

Given the variety of partnerships included in the survey, participants were asked to identify their top three most impactful activities and respond to questions on the positive outcomes and barriers/challenges for only these activities. These questions were developed based on the work of Mercer-Mapstone et al. (2017) and Matthews et al. (2019). Questions related to the positive outcomes associated with student-faculty partnerships activities were gathered using a 5-point Likert scale¹ anchored from (1) "decreased greatly" to (5) "increased greatly" (Table 5). For the purpose of presenting findings for these questions, we offer means, standard deviations, and median scores as we recognize there is debate whether Likert scale responses should be treated as continuous variables (see, e.g., Knapp, 1990; Norman, 2010; Sullivan & Artino, 2013; Wu & Leung, 2017), and this practice often differs by discipline.

For challenges/barriers, participants selected from a list of commonly reported challenges (Table 6). Open-ended questions allowed participants to share new ideas. Questions were reviewed by one faculty member and two students external to the research team to ensure clarity and consistency in interpretation. The current study presents a portion of the data collected from the online survey.

Interviews

The interviews were grounded in qualitative description (Sandelowski, 2000, 2010; Sullivan-Bolyai et al., 2005), informed by a relativist ontology and subjectivist epistemology (Bradshaw et al., 2017). Purposeful sampling was used to recruit five faculty members who were actively engaged in student partnership activities to participate in semi-structured interviews. Our intention behind the interviews was to complement and expand upon the survey findings and shed light on the unique voices and experiences of participants, rather than to generalize findings, which is typically not the focus of qualitative work (Creswell, 2013); therefore, our sample size was sufficient for data saturation (Patton, 2002).

Due to pandemic restrictions, interviews occurred online via Microsoft Teams and were audio recorded and transcribed. Interviews began with an introduction to the study, a definition of student partnership, and examples of partnership activities, followed by several open-ended questions and probes. Questions related to type of partnership activities faculty were involved in, perceptions of the benefits and challenges, and practices and approaches utilized by participants which they perceived as helpful when engaging in partnership activities.² Questions were piloted with a faculty member to ensure clarity. To protect identities during data presentation, participants are labeled P1–P5.

Data analysis

Consistent with the methodological approach of this study, we relied on a content analysis (Neuendorf, 2017). The process began with (a) repeated reading of transcripts to become immersed in the data (Elo & Kyngäs, 2008; Tesch, 1990); (b) identifying possible keywords, categories, and ideas in the data (Kondracki et al., 2002); (c) identifying individual meaning units (Graneheim & Lundman, 2003) using open coding (Creswell, 2014); and (d) grouping similar codes under themes. Inductive and deductive methods were used throughout to recognize that researchers are often informed by past theory (Patton, 2002).

Rigor

Criteria specific to qualitative description were chosen to evaluate rigorousness. Coherence was assured by aligning the methodology, data collection, and analysis approach with the philosophical underpinnings of the study (Tracy, 2020). We also present varied quotes to illustrate multivocality (Tracy, 2020). Co-authors also served as critical friends in the data analysis processes, giving voice to their interpretation and offering feedback (Smith & McGannon, 2018). Lastly, we attempted to create an environment where participants felt comfortable speaking freely, thus creating conditions for authenticity (Milne & Oberle, 2005).

SURVEY RESULTS

Student-faculty partnerships

Survey responses were gathered from 25 faculty members. Most participants identified as male (68%), from European origins (52%), or as being positioned in the Department of Chemistry and Biochemistry (40%). Faculty members reported involvement in several partnership activities. Supervising or working with a graduate teaching assistant³ (GTA) (92%), collaborating with a graduate student on a new or existing research project (84%), working with students on a

university committee (80%), collaborating with an undergraduate student on a new or existing research project (80%), co-authoring a manuscript with a graduate student (80%), and supervising or working with a teaching assistant (TA) (72%) were reported as the most common partnership activities (Tables 1-4). The top five most common partnership activities were also reported as the top five most impactful partnerships (Tables 1–4, shaded cells).

Table 1. Percentage of student-faculty partnership activities identified by faculty members: Learning, teaching, and assessment

STUDENT-FACULTY PARTNERSHIP ACTIVITY	^a PERCENTAGE (COUNT)	^b MOST IMPACTFUL PERCENTAGE (COUNT)
Supervising or working with a teaching assistant (TA)	72 (18)	8 (2)
Supervising or working with a graduate teaching assistant (GTA)	92 (23)	36 (9)
Supervising or working with peer assisted learning (PAL) leader(s)	8 (2)	0 (0)
Co-teaching a class with a student	24 (6)	8 (2)
Negotiating assessment criteria (e.g., rubric), choice in assessment topics and questions, deadlines, and grade weightings with students as part of a class	36 (9)	4 (1)
Working with a student lab demonstrator	56 (14)	0 (0)

^aParticipants could select multiple activities. ^bIdentified by participants as one of their top three most impactful partnerships. Shaded cells in Tables 1–4 indicate the five most impactful activities, overall.

Table 2. Percentage of student-faculty partnership activities identified by faculty members: Curriculum design and pedagogic consultancy

STUDENT-FACULTY PARTNERSHIP ACTIVITY	^a PERCENTAGE (COUNT)	^b MOST IMPACTFUL PERCENTAGE (COUNT)
Co-designing course materials with students	48 (12)	0 (0)
Co-designing assessment tasks with students	24 (6)	4 (1)
Working with students on a university committee (e.g., departmental undergraduate curriculum committee, awards committee, etc.)	80 (20)	20 (5)

^aParticipants could select multiple activities. ^bIdentified by participants as one of their top three most impactful partnerships. Shaded cells in Tables 1–4 indicate the five most impactful activities, overall.

Table 3. Percentage of student-faculty partnership activities identified by faculty members: Subject-based research and inquiry and SoTL practice

STUDENT-FACULTY PARTNERSHIP ACTIVITY	^A PERCENTAGE (COUNT)	^B MOST IMPACTFUL PERCENTAGE (COUNT)
Collaborating with an undergraduate student on a new or existing research project	80 (20)	52 (13)
Collaborating with a graduate student on a new or existing research project	84 (21)	56 (14)
Co-authoring a manuscript with an undergraduate student	68 (17)	4 (1)
Co-authoring a manuscript with a graduate student	80 (20)	40 (10)
Working on a grant proposal with a student	60 (15)	12 (3)
Co-presenting with a student at a conference, workshop, seminar, or symposium	60 (15)	12 (3)

^aParticipants could select multiple activities. ^bIdentified by participants as one of their top three most impactful partnerships. Shaded cells in Tables 1–4 indicate the five most impactful activities, overall.

Table 4. Percentage of student-faculty partnership activities identified by faculty members: Other

STUDENT-FACULTY PARTNERSHIP ACTIVITY	^A PERCENTAGE (COUNT)	^B MOST IMPACTFUL PERCENTAGE (COUNT)
Organizing committee member for a research-conference that includes both faculty and student representatives	28 (7)	4 (1)
Internship placement supervisor	40 (10)	8 (2)
Working with students to develop and/or deliver community outreach activities	48 (12)	16 (4)
Service-learning placement supervisor	16 (4)	4 (1)
Supervisor or advisor for a student-led organization	24 (6)	4 (1)

^aParticipants could select multiple activities. ^bIdentified by participants as one of their top three most impactful partnerships. Shaded cells in Tables 1–4 indicate the five most impactful activities, overall.

Positive outcomes

Each participant indicated positive outcomes associated with their top three most impactful partnerships. Responses from faculty were collected regarding 12 areas of outcomes across five partnerships identified as most impactful (Table 5, positive outcomes 1–12). We reported results for outcomes only when there were five or more responses for that outcome. Our interpretation of findings relies on mean scores (as the data for each survey item was approximately normally distributed) allowing for more granular responses to be noted; however, median scores are also provided in Table 5.

Partnerships related to involvement in research (i.e., collaborating with an undergraduate/graduate student on a new or existing research project and co-authoring a manuscript with a graduate student) had the most positive outcomes (slight-to-great increases based on mean scores) and showed consistent increase in outcomes, including research productivity, interest in working with SaP, trust in the student-partner, motivation to involve students in research, quality of relationship, and willingness to engage in future partnership activities (i.e., positive outcomes 1–6). Interestingly, apart from research productivity, all other outcomes were reported as having approximately stayed the same in supervising or working with

a GTA despite the activity commonly being reported by faculty as one of their three most impactful, based on mean scores (Table 1). Finally, working with students on a university committee resulted in an average slight increase in quality of relationship, willingness to engage in future partnerships activities, and understanding of the student experience and students' responsibilities (i.e., positive outcomes 5–7). Notably, two positive outcomes, confidence working with students and motivation to involve students in your teaching (positive outcomes 11–12), stayed relatively the same for all partnership activities.

Table 5. Ratings of positive outcomes identified for most impactful partnership activities

POSITIVE OUTCOME	SUPERVISING OR WORKING WITH A GTA (N = 9)	WORKING WITH STUDENTS ON A UNIVERSITY COMMITTEE (N = 5)	COLLABORATING WITH AN UNDERGRADUATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 13)	COLLABORATING WITH A GRADUATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 14)	CO-AUTHORING A MANUSCRIPT WITH A GRADUATE STUDENT (N = 10)
	M(SD) Med	M(SD) Med	M(SD) Med	M(SD) Med	M(SD) Med
1. Research productivity	4.0 (1.6) 5	--	4.2 (0.6) 4	4.6 (0.8) 5	5 (0) 5
2. Interest in working with SaP	3.8 (1.2) 4	3.8 (1.6) 5	4.4 (0.8) 5	4.36(0.8) 5	4.6 (0.8) 5
3. Trust in the student-partner	3.9 (1.3) 4	3.8 (1.5) 4	4.2 (1.0) 5	4.2 (1.0) 4	4.4 (0.7) 5
4. Motivation to involve students in your research	3.6 (1.0) 3.5	--	4.2 (1.0) 5	4.2 (0.9) 4.5	4.1 (0.9) 4
5. Quality of relationship	3.8 (1.2) 4	4 (1.6) 5	4.6 (0.6) 5	4.5 (0.8) 5	4.6 (0.7) 5
6. Willingness to engage in future partnership activities	3.8 (1.0) 4	4.2 (1.0) 5	4.2 (1.0) 5	4.1 (0.8) 4	4.1 (0.8) 5
7. Understanding of the student experience and students' responsibilities	3.7 (1.3) 4	4.0 (1.6) 5	3.9 (1.1) 4	4.2 (0.8) 4	4.2 (0.6) 4
8. Quality educational materials	3.8 (0.9) 4	3.6 (1.0) 4	3.9 (0.9) 4	4 (0.7) 4	3.9 (0.8) 4

POSITIVE OUTCOME	SUPERVISING OR WORKING WITH A GTA (N = 9)	WORKING WITH STUDENTS ON A UNIVERSITY COMMITTEE (N = 5)	COLLABORATING WITH AN UNDERGRADUATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 13)	COLLABORATING WITH A GRADUATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 14)	CO-AUTHORING A MANUSCRIPT WITH A GRADUATE STUDENT (N = 10)
9. Engaging with students in class	3.9 (1.0) 4	--	3.9 (0.9) 4	3.9 (0.9) 4	3.8 (0.7) 4
10. Enjoyment of teaching	3.6 (1.3) 3	--	4 (1.0) 4	3.9 (0.9) 4	3.7 (0.9) 3
11. Confidence working with students	3.0 (1.0) 3	--	3.3 (0.8) 3.5	3.6 (0.5) 4	3.5 (0.5) 3.5
12. Motivation to involve students in your teaching	3.7 (1.1) 3	3.2 (1.0) 3	3.7 (0.7) 4	3.8 (0.9) 3	3.4 (0.7) 3

M = mean. SD = standard deviation. Med = Median. Likert scale: 1 = decreased greatly; 2 = decreased slightly; 3 = stayed the same; 4 = increased slightly; 5 = increased greatly. Shaded cells indicate outcomes with a slight-to-great increase. For individual outcomes 1–12, response rates sometimes varied as not all individuals responded to all questions. As such, we report mean, SD, and medians only when the response rate was 5 or more for that outcome.

Barriers and challenges

Each participant indicated barriers/challenges associated with their top three most impactful partnership activities (Table 6). The five most reported barriers/challenges were: maintaining control of the quality of research conducted, lack of student commitment, balancing support with autonomy, lack of time, and lack of financial support/funding for partnership (i.e., barriers/challenges 1, 6–8, and 14 or shaded cells, “Barrier/Challenge” column). Activities related to research consistently presented barriers/challenges related to maintaining control of the quality of research conducted, lack of student commitment, lack of time, and lack of financial support/funding for partnership (barriers/challenges 1, 6, 8, and 14 in Table 6; shaded cells under “Collaborating with a undergraduate/graduate student on a new or existing research project” and “Co-authoring a manuscript with a graduate student”). Further, balancing support with autonomy was frequently reported as a challenge when collaborating either with an undergraduate (61.5%) or graduate (57.1%) student on a new or existing research project; these two partnership activities had the highest total number of reported barriers/challenges (46 and 58, respectively), which is not surprising given these are the two activities most commonly indicated as impactful by participants. Conversely, the partnership with the least barriers/challenges was working with students on a university committee; however, this may be a function of a smaller number of participant responses related to this activity.

Table 6. Percentage of barriers and challenges identified for more impactful partnership activities

BARRIER/ CHALLENGE	SUPERVISING OR WORKING WITH A GRADUATE STUDENT TEACHING ASSISTANT (N = 9) % (COUNT)	WORKING WITH STUDENTS ON A UNIVERSITY COMMITTEE (N = 5) % (COUNT)	COLLABORAT- ING WITH AN UNDERGRAD- UATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 13) % (COUNT)	COLLABORAT- ING WITH A GRADUATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 14) % (COUNT)	CO- AUTHOR- ING A MANU- SCRIPT WITH A GRADUATE STUDENT (N = 10) % (COUNT)	TOTAL REPORTS PER BARRIER/ CHALLENGE (COUNT)
1. Maintaining control of the quality of research conducted	33.3 (3)	20.0 (1)	46.2 (6)	50.0 (7)	30.0 (3)	(20)
2. Maintaining control of the quality of teaching materials produced	33.3 (3)	20.0 (1)	15.4 (2)	7.1 (1)	0 (0)	(7)
3. Lack of communication with student(s)	22.2 (2)	40.0 (2)	15.4 (2)	21.4 (3)	20.0 (2)	(11)
4. Lack of trust with students	22.2 (2)	40.0 (2)	23.1 (3)	21.4 (3)	10.0 (1)	(11)
5. Lack of interest from students	22.2 (2)	40.0 (2)	0 (0)	14.3 (2)	20.0 (2)	(8)
6. Lack of student commitment	33.3 (3)	0 (0)	38.5 (5)	64.3 (9)	40.0 (4)	(21)
7. Balancing support with autonomy	11.1 (1)	0 (0)	61.5 (8)	57.1 (8)	10.0 (1)	(18)
8. Lack of time	55.6 (5)	40.0 (2)	76.9 (10)	71.4 (10)	40.0 (4)	(31)
9. Course constraints (e.g., course size)	44.4 (4)	20.0 (1)	0 (0)	7.1 (1)	10.0 (1)	(7)
10. Uncertainty of how to begin a student partnership	22.2 (2)	20.0 (1)	7.7 (1)	7.1 (1)	0 (0)	(5)
11. Uncertainty of how to work with students as partners	22.2 (2)	0 (0)	7.7 (1)	7.1 (1)	0 (0)	(4)

BARRIER/ CHALLENGE	SUPERVISING OR WORKING WITH A GRADUATE STUDENT TEACHING ASSISTANT (N = 9) % (COUNT)	WORKING WITH STUDENTS ON A UNIVERSITY COMMITTEE (N = 5) % (COUNT)	COLLABORAT- ING WITH AN UNDERGRAD- UATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 13) % (COUNT)	COLLABORAT- ING WITH A GRADUATE STUDENT ON A NEW OR EXISTING RESEARCH PROJECT (N = 14) % (COUNT)	CO- AUTHOR- ING A MANU- SCRIPT WITH A GRADUATE STUDENT (N = 10) % (COUNT)	TOTAL REPORTS PER BARRIER/ CHALLENGE (COUNT)
12. Limited opportunities to interact with students	22.2 (2)	0 (0)	7.7 (1)	7.1 (1)	0 (0)	(4)
13. Resistance from colleagues to engage in student partnerships	11.1 (1)	0 (0)	15.4 (2)	21.4 (3)	10.0 (1)	(7)
14. Lack of financial support/funding for partnership	33.3 (3)	0 (0)	38.5 (5)	57.1 (8)	30.0 (3)	(19)
15. Total reports per activity	(35)	(12)	(46)	(58)	(22)	

Shaded areas in the barrier column indicate the top five barriers/challenges based on the total number of reports per barrier/challenge.

Interview findings

Five faculty members participated in the semi-structured interviews to provide a deeper investigation into faculty perceptions of the benefits and barriers/challenges when involved in partnerships activities (Table 7). Throughout interviews, faculty expressed their involvement in partnership activities related to course instruction, course design, subject-based research activities, and other activities such as community outreach activities, supporting student-led organizations, committee work, and service-learning and internship supervision.

Table 7. Percentage of student-faculty partnership activities reported by interview participants

CATEGORY OF PARTNERSHIP	ACTIVITY	PERCENTAGE REPORTED BY FACULTY (COUNT)
Learning, teaching, and assessment	Course instruction	80% (4)
Curriculum design and pedagogic consultancy	Course design	60% (3)
Subject-based research and inquiry and SoTL practice	Research projects	80% (4)
Subject-based research and inquiry and SoTL practice	Grant proposals	20% (1)

Subject-based research and inquiry and SoTL practice	Conferences	40% (2)
Other	Working with students to develop and/or deliver community outreach activities	60% (3)
Other	Supervisor or advisor for a student-led organization	40% (2)
Other	Working with students on a university committee	20% (1)
Other	Service-learning placement supervisor	60% (3)
Other	Internship placement supervisor	40% (2)

Table 8 provides a summary of common themes which were interpreted from the data related to the following topics: (a) benefits of working in a partnership (four themes), (b) challenges of working as partners (three themes), and (c) best practices (four themes). The presentation of findings for each question are summarized below.

Table 8. Summary of themes

CATEGORY	THEME	PERCENTAGE REPORTED BY FACULTY (COUNT)
Benefits of working in partnership	Collaboration and relationship-building	100% (5)
Benefits of working in partnership	Broadening perspectives and gaining feedback	100% (5)
Benefits of working in partnership	Personal satisfaction	80% (4)
Benefits of working in partnership	Institutional and career-related	60% (3)
Challenges of working as partners	Interpersonal dynamics and maintaining relationships	80% (4)
Challenges of working as partners	Student management	60% (3)
Challenges of working as partners	External influences	40% (2)
Best practices	Planning and expectations	60% (3)
Best practices	Developing students' agency	80% (4)
Best practices	Open communication	80% (4)
Best practices	Peer-to-peer collaboration and peer mentoring	60% (3)

Benefits of working as partners

The benefits of working in partnership activities were grouped under four main themes: (a) collaboration and relationship-building, (b) broadening perspectives and gaining feedback, (c) personal satisfaction, and (d) institutional and career-related.

Collaboration and relationship-building

All faculty members indicated collaboration and relationship-building as a benefit; they referred to “creating a culture of inclusion and collaboration” (P2) and stated that “the sum was greater than the parts” (P4). Participants noted that through their student partnerships, they were able to develop meaningful collaborations, and, for P1, this meant an opportunity to engage in research:

I have a research project that I’m a collaborator on now and I work with students on that project. Which has been really interesting for me . . . we always bring students in on those projects. And for me, I don’t think I would really do research without those projects. . . . I’m kind of the opposite of probably most people, where working with students actually leads me to research. (P1)

Broadening perspective and gaining feedback

All faculty reported that partnerships enabled a broadening of perspectives and gaining of valuable feedback. For example, P1 expressed the following: “Because of the nature of the projects, [the] student perspective is essential.” Another participant explained that “it’s unsustainable for me to know anything and everything, but I do believe in investing in a student to be an expert of their thing because it’s good modeling for the careers that they’re going to face.” (P3). P2 emphasized the importance of the student perspective when redesigning courses: “I want to know what [students] think and what they like. . . . I want to hear what parts were not working.” P4 highlighted that

students really came up with wonderful ideas. The way they really knew what would work better for their age group and for their younger age group [of] students. It was much better than what I could have thought of by myself.

Personal satisfaction

Interviewees referred to feeling personally satisfied because of their involvement in partnerships activities. Participants mentioned the satisfaction of witnessing students’ academic journeys: “You get to watch people develop . . . and go off and do wonderful things in the world and contribute to society” (P2). P1 highlighted experiencing personal satisfaction from informal conversations, personal updates, and check-ins with students: “working with students is my favourite part of the job.”

Institutional and career-related

Participants noted partnerships as benefiting both the institution as well as their career development. For example, P3 pointed to the success of a project, which was “so well received . . . [It] led to more opportunities for both the student and myself.” Similarly, P5 shared their success in capturing grant funding, which they attributed to their building of student partnerships arrangements and which led to additional resources to support more partnerships.

Challenges of working as partners

Challenges of working in partnership activities were grouped under three overarching themes: (a) interpersonal dynamics and maintaining relationships, (b) student management, and (c) external influences.

Interpersonal dynamics and maintaining relationships

Multiple participants discussed challenges related to interpersonal dynamics between faculty and students and maintaining that relationship. For example, “the humanity of the individuals comes into it and sometimes you have personality conflicts” (P5). However, participants also pointed to occasions where “it’s taken a bit longer . . . to kind of get that collaboration to be really solid” (P2), as well as cases where a partnership “hasn’t been reciprocal” (P3).

Student management

Interviewees highlighted that timelines and time frames sometimes required adjustment to accommodate student schedules. P4 mentioned the occasional challenge of student work not meeting expectations: “Sometimes you have a student who’s not producing what you expect them to do.” P1 discussed the challenge some faculty face with finding students to collaborate with—ensuring they have the necessary knowledge and skillset, particularly if they are looking for students outside of their department or want to form an interdisciplinary team. This participant recognized that “there is some vulnerability” if faculty do not know the student they will be working with.

External influences

Participants mentioned financial external influences, such as funding, as challenges in engaging in partnership activities with students: “some other people on campus, they find it hard because they don’t have a grant account or they’re not able to accept grants or they’re not allowed to hold grants or whatever to pay students, and they’re not able to get the students” (P4). Other factors included the COVID-19 pandemic making some partnership activities not available or needing to pivot.

Best practices

Best practices of partnership activities were grouped under four overarching themes: (a) planning and expectations, (b) developing students’ agency, (c) open communication, and (d) peer-to-peer collaboration and peer mentoring.

Planning and expectations

Participants referenced planning and setting expectations as best practices. One faculty member indicated they sometimes intentionally select students who are not overloaded and therefore have time for the project. Similarly, another mentioned that they are mindful of busy times of the year for students and use this information when scheduling project activities. Others shared processes they have in place to set standards: “I actually have my internal code of conduct, lab manual, and so students need to read that and sign that, and so there’s a very clear expectation” (P3). P5 also described having internal group processes in place, such as a leadership team and

multi-step hiring process which includes student input to provide agency to students already involved, but also to maintain a cohesive group.

Developing students' agency

Many faculty interviewees stressed the importance of allowing students to have a sense of responsibility in the activity. Ways to develop agency included informing students from the start that “this is your project” (P4), giving them “the ability to make decisions about their projects . . . [and] to have the freedom to explore things” (P2), faculty not micromanaging the project and letting students “lead it as they want to” (P1), and giving students space to “come up with their own ideas” (P1).

Open communication

Most participants suggested open communication as key to successful collaborations. Two participants have an on-campus or virtual open-door policy or stay back after class. Two interviewees also emphasized the importance of providing feedback to students in the form of “generous praise . . . especially at the beginning, when students don’t feel comfortable [and] they don’t know if they’re doing the right thing” (P4). P1 highlighted the importance of students giving feedback “in order to improve the [initiative]”.

Multiple participants spoke to the importance of open communication along with specific ways they foster open conversations and minimize power differentials. For P2 this meant

making myself vulnerable, opening myself up is a way to humanize myself . . . being open about things I struggle with, . . . just acknowledging that in a conversation can have such a huge impact because, we identify with the same things.

P1 explained their request to be addressed with their first name by students: “They just called me [name]. And we have a respectful relationship, so I’m not trying to be anybody’s friend here, but I am trying to make sure that they know they can come talk to me.”

Peer-to-peer collaboration and peer mentoring

Some participants highlighted the involvement of peers as a best practice in creating a comfortable partnership environment. For example, having group meetings with undergraduate students instead of one-on-one meetings where students “would feel really intimidated” (P2) and bringing in graduate student mentors. Similarly, P3 creates opportunities for peer mentorship: “there’s always an undergraduate student that’s matched with, one or maybe more, but at least one master student as well. So, they are working as a team, and . . . there’s a lot of co-leading.”

DISCUSSION

Given that partnership work is context dependent (Cook-Sather et al., 2019), this study contributes to the literature by capturing the unique voices of faculty members engaging in partnership activities from a multidisciplinary Faculty of Science sample and from a variety of SaP activities.

Positive outcomes

Several benefits of engaging in student-faculty partnerships were reported in the survey and interviews by faculty partners. Faculty partners in our study reported that partnerships provided benefits and increased positive outcomes related to collaboration and relationship-building (i.e., partnerships increased both trust in the student partner and quality of relationship) by creating a culture of inclusion and valuing everyone's opinion. This conclusion is supported by Mercer-Mapstone et al. (2017), as well as a study with faculty (from various disciplines including STEM) who benefited from relationship-building with TAs and positioning TAs as co-teachers or colleagues (Begley et al., 2019). A similar type of relationship emerged from our data with a faculty partner speaking to the co-creation of knowledge and co-innovation of solutions with student partners, aligning with roles (e.g., co-researcher, co-designer, consultant) similar to those noted in the literature (Bovill et al., 2016).

Our study also shows that partnerships helped broaden faculty members' perspectives in relation to the activity (e.g., faculty acknowledged the value of students' ideas and disciplinary expertise), similar to a chemical engineering SaP study (Chadha et al., 2023). Our data shows that gaining feedback from students was a positive outcome; importance was placed on having a type of relationship with students that makes students willing to share their perspectives with faculty. In addition, partnerships impacted faculty members' understanding of the student experience and students' responsibilities, as in Mercer-Mapstone et al. (2017).

Activities related to research each resulted in an increase across the following positive outcomes: research productivity, interest in working with SaP, trust in the student partner, motivation to involve students in research, quality of relationship, and willingness to engage in future partnerships. Some of the above activities also increased outcomes in understanding the student experience and their responsibilities, the quality of educational materials, and enjoying teaching aligning with other reported faculty benefits noted in the literature (e.g., Mercer-Mapstone et al., 2017).

Highlighted throughout this research is a theme of personal satisfaction, despite the required time commitment and planning needed to work in partnership activities with students. Faculty referred to job satisfaction, students as a source of inspiration for new activities, pride in observing students develop confidence, enjoying teaching, satisfaction in informally interacting with students, and developing relationships with colleagues. These intrinsic factors may contribute to a broader conversation around faculty motivation, well-being, and job satisfaction as examined through the lens of self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2000), in which relatedness (i.e., meaningful connections with others) is posited to mediate job satisfaction of faculty in higher education (Larson et al., 2019; Smith et al., 2018).

Barriers and challenges

The most common barrier/challenge identified was related to interpersonal dynamics between students and faculty and maintaining their relationship. Contributing issues included a lack of setting expectations, lack of processes, lack of trust with students, lack of interest from students, and the absence of communication with students, with the impact of a lack of communication having already been highlighted by Bovill et al. (2016). Overall, the challenge related to relationships aligns with the conceptualization of SaP as a values-based practice in which respect, trust, and the recognition of each partner's expertise and knowledge are integral (Matthews et al., 2018), revealing that our study's participants perceived partnership as not merely any involvement with students, but rather as a level of collaboration in which faculty actively seek and genuinely appreciate student perspectives and feedback.

Our data indicate that factors related to lack of time and the time-intensiveness of partnerships consistently presented as a barrier/challenge, reinforcing the literature. Marquis (2018) speaks to the extra time needed to develop effective collaborations in partnerships with students; similarly, Johnston and Ryan (2022) refer to the challenge of time management in providing feedback to student partners in an online partnership. However, in one study, time investment was not a challenge faced by faculty partners engaged in service-learning partnerships, possibly due to the extensive structure of the SaP program (Begley et al., 2019). Alongside time constraints, our data indicates lack of financial resources as a barrier/challenge (Curtis & Anderson, 2021).

Our research demonstrates a barrier/challenge connected to student management, with faculty partners surfacing the involvement of finding students with the required skills, adjusting timelines to accommodate student schedules, student work not meeting expectations, maintaining control of the quality of research conducted, lack of student commitment, and balancing student support with student autonomy. The latter three were prominent in activities related to collaborating with undergraduate or graduate students on new or existing research projects. Student management has not been extensively discussed in the literature, particularly in STEM, and deserves consideration in conceptualizing best practices for partnerships.

Notably, there were few reports of barriers/challenges related to uncertainty of how to begin a student partnership, uncertainty of how to work with students as partners, limited opportunities to interact with students, limited interaction with students, and resistance from colleagues to engage in student partnerships, indicating that some mechanisms (formal or informal), knowledge, opportunities, and acceptance of working with students may already exist. Interestingly, the fact that resistance from colleagues to engage in partnerships was not found to be a barrier differs from other reports (Curran, 2017).

Best practices

Generally, a common set of values (e.g., trust, respect, honesty) inform SaP practices (Healey & Healey, 2019; Liang & Matthews, 2021). Within our context, faculty shared best practices for successful engagement, many of which align with, or complement, those already described in the literature. Practices included a consideration of logistics (e.g., student schedules), but also developing expectations to inform the ways in which individuals interact with one another. Similarly, and consistent with other research (Luo et al., 2019), open and honest conversation was important. In our study, participants conceptualized this as creating comfortable conditions

that make it easier for students to provide feedback to faculty (e.g., praising students, allowing anonymity in feedback from students, keeping an open-door policy, and maintaining a respectful and receptive atmosphere in which feedback from students is appreciated). To faculty, successful communication meant that faculty also share and humanize themselves. Interestingly, although notions of collaboration and communication emerged as salient, ideas of power asymmetry between faculty and students were not expressed despite power dynamics and the shifting thereof being a prominent conversation in student-focused SaP research (e.g., Alhadad et al., 2021). Nonetheless, a best practice suggested by faculty was developing students' agency in partnership activities by allowing students to make decisions and have a sense of ownership; this indirectly speaks to the shifting of power (e.g., Matthews, 2017). Moving forward, we envision STEM faculty-focused recommendations for good practice will explicitly invite faculty to "leave behind the 'traditional' student-staff power dynamics" (Johnston & Ryan, 2022, p. 18).

As a final recommendation, the study's participants highlighted the role of student peer-to-peer collaboration and peer mentorship in creating a comfortable partnership. Peer mentors have been used in formal SaP partnerships (Begley et al., 2019) and in undergraduate peer mentoring programs that capitalize on the SaP framework (Petrescu et al., 2021). Within the context of the study, we envision the development of workshops or resources to help faculty plan and establish peer-to-peer collaborations in partnerships.

Limitations and future directions

This study includes participants' self-reported involvement in student-partnership activities, and it is possible that not all activities identified by participants were explicitly framed in a partnership lens from the onset. Because participants self-enrolled in the survey and were purposefully selected for interviews, this study may have included faculty with a more positive perspective of SaP; it would be worthwhile to interview faculty with limited or no SaP experience. Furthermore, our survey included 25 participants; however, when delimited to responses based on most impactful partnership activities, this led to smaller sub-samples and so results should be interpreted with this in mind. Although we provided an analysis of faculty perspectives regarding their involvement in partnership activities in science, the findings are limited to a small number of members within a specific faculty; therefore, results may not be applicable to other higher education disciplines or institutions given the contextual nature of SaP work. As a future direction, longitudinal research would be beneficial to evaluate partnerships as students progress along their academic pathway, transition into professional roles, or serve as partners to other students.

Implications for higher education

This work offers insights into student and faculty engagement in partnership activities from the perspective of multidisciplinary science faculty members. Collectively our findings, while institutionally specific, can be used to advocate for the adoption of SaP models as an effective way of fostering student-faculty collaboration, but this study also sheds light on common barriers to be mindful of at the outset of embarking on partnership work, complementing prior studies which describe similar challenges (e.g., Cook-Sather et al., 2019). Findings can guide the academic development of contextualized informational workshops and faculty orientations to guide science faculty in participating in partnerships in a manner that mirrors the value-based approach

that grounds partnerships. Many of the barriers noted by participants are common (Cook-Sather et al., 2019) and can be mitigated by best practices. Furthermore, these results highlight the importance of finding ways to recognize and reward students and faculty for working in partnerships (Cook-Sather et al., 2019). Regarding faculty, this may necessitate recognizing partnership work in tenure and promotion criteria, award nominations, stipends to fund partnerships, and allocated time to accommodate partnership work (Bovill et al., 2014). While faculty identified solid practices that they have used to engage with students, there is an abundance of literature available related to starting, sustaining, and extending student partnerships that is worthy of consideration for those hoping to collaborate with students in this way (see Cook-Sather et al., 2019 for an example). Our findings demonstrate that faculty experience positive outcomes from a variety of partnership activities related to teaching, research, and service; therefore, there are multiple points of entry, with varying commitment levels for those looking to explore this way of collaboration. While our findings offer a macro-level review of engagement in various partnership activities, we encourage continued exploration of areas from varied disciplines to understand the contextual nuances that may arise.

NOTES

1. A sample item related to positive outcomes, measured on a Likert scale, included: "Please rate the impact that your student-faculty partnership activity had on your interest in working with students as partners," where participants responded to this question individually for all three of their top three most impactful partnership activities.
2. Sample interview questions included: "How did you foster student voice and agency?" "What type of positive outcomes, whether this be personal, professional (i.e., teaching, research service), did you experience?" "What type of barriers did you experience when working in partnership?"
3. Graduate teaching assistants (GTAs) are full-time graduate students while teaching assistants (TAs) are undergraduate students.

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