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Investigating the Relationship between Residence Learning Community Participation and Student Academic Outcomes in a Canadian Institution

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Investigating the Relationship between Residence Learning Community Participation and Student Academic Outcomes in a Canadian Institution

Abstract

This study investigated the relationship between residential living scenario and first year grades, second year retention, and 5-year graduation rates of students at a Canadian comprehensive university. We compared the academic outcomes of students living in residence learning communities (RLCs) to those in other living scenarios (traditional residences and off-campus). RLCs have been shown to be positively associated with student academic outcomes in the United States; however, the data to support RLCs in Canada is non-existent. A longitudinal observational study was conducted to analyse the academic outcomes of a complete cohort of students (n=4805) who lived in RLCs (18%) and non-RLCs (82%). Results indicated that RLC students, on average, achieved higher first year averages, 2nd year retention rates, and 5-year graduation rates relative to non-RLC students, thereby contributing to the goals of post-secondary institutions to attract and retain their students through to graduation.

Cette étude examine la relation qui existe entre le scénario où les étudiants vivent en résidence et les notes obtenues en première année d'études, la rétention en deuxième année et l'obtention des diplômes en cinquième année dans une université canadienne polyvalente. Nous avons comparé les résultats académiques d'étudiants qui vivaient dans des communautés d'apprentissage en résidence (CAR) et ceux des étudiants qui vivaient selon d'autres scénarios (résidence traditionnelle et hors campus). Il a été prouvé qu'aux États-Unis, les CAR sont associées favorablement aux résultats académiques des étudiants. Toutefois, les données pour soutenir les CAR au Canada sont inexistantes. Une étude d'observation longitudinale a été menée pour analyser les résultats académiques d'une cohorte complète d'étudiants (n=4805) qui vivaient dans une CAR (18 %) et ceux d'étudiants qui vivaient autrement (82 %). Les résultats ont indiqué qu'en moyenne, les étudiants qui vivaient dans une CAR avaient obtenu de meilleures notes en première année, avaient réalisé un taux de rétention supérieur en deuxième année et un meilleur pourcentage d'obtention de diplômes en cinquième année, par rapport aux étudiants qui ne vivaient pas dans une CAR, ce qui contribue à répondre aux objectifs des établissements d'enseignement post-secondaire d'attirer et de retenir leurs étudiants jusqu'à ce qu'ils obtiennent leur diplôme.

Keywords

learning communities, student performance, residence, first year university, retention

Measures of Academic Success in Post-Secondary Education (PSE)

Student academic success in post-secondary education (PSE) is most commonly measured by the first year to second year retention rate, and the cohort graduation rate (Noel-Levitz, 2008; Taylor et al., 2003). First year to second year retention rate is commonly defined as the percentage of students who remain enrolled from fall of first year to fall of second year at the university, and the cohort graduation rate is commonly defined as the percentage of students within a cohort who graduate from an institution, typically measured in four, five or six years for a bachelor's level program (Noel-Levitz, 2008). The retention of students in North American PSE institutions has been of concern for several decades (Fisher & Engemann, 2009; Gajewski & Mather, 2015). Specifically, only 79.8% and 66.7% of students are retained between the first and second year of their studies in Canada (Finnie & Qui, 2008) and the United States (U.S) (American College Testing Program, 2010), respectively. Further, in 4-year bachelor's programs in Canadian institutions, only 69% of students graduate within five years of beginning their studies (Finnie & Qui, 2008), while in 4-year bachelor's programs in American institutions, 60% of students graduate within six years of beginning their studies (National Center for Education Statistics [NCES], 2016).¹ Factors which can influence a student's retention and graduation rates may include their gender and academic degree of study, such that females are more likely than males to persist and complete a bachelor's degree (NCES, 2012), and students in business, psychology and social science programs are more likely to have higher retention and thus graduation rates, compared to students in science, math and engineering programs (NCES, 2012; President's Council of Advisors on Science and Technology [PCAST], 2012; Windsor et al., 2015).

Another measure of student academic success in PSE related to retention and graduation rates is the grades students achieve in their courses. Grades are assumed to be related to students' individual academic ability, serving as an incentive for students in allocating their time, effort, and for persisting to program completion (Hu, 2005). Notably, first year grades in particular are often indicative of a student's adjustment to a course of study (Pascarella & Terenzini, 1991), given that the transition to PSE is often difficult for many students (Luna & Gahagan, 2008). In fact, students who choose to withdraw from their studies are most likely to do so between their first and second year of study, with low grades being among the top reasons for doing so (Finnie & Qui, 2008; Grayson & Grayson, 2003; Hoyt & Winn, 2003).

Residence Learning Communities (RLCs)

Due to the long-standing concern about the retention and graduation of students in PSE, initiatives aimed at supporting and engaging first year students have been implemented by many institutions. Specifically, residence learning community (RLC) refers to a grouping of students intentionally living together in a dedicated residence space (Luna & Gahagan, 2008). RLCs serve the primary goal of integrating students' living and academic environments, operating on the widely recognized idea that a significant amount of what students learn is a result of their experiences of daily life (Andrade, 2008; Shapiro & Levine, 1999). Often, students are given the opportunity to select a specific RLC to reside in for their first year living on campus. Options may

¹ The Canadian statistics for first to second year retention rate, and 5-year graduation rate, reported by Finnie and Qui (2008) include CEGEP students in Québec. Finnie and Qui (2008) acknowledge the potential for confounding results by including Québec students in their analysis, but state similar findings even when excluding this student group from their sample.

include academic focused RLCs, associated with a program of study at the institution, and/or social focused RLCs, associated with students' interests beyond academics, such as leadership.

The majority of RLC research comes exclusively from the U.S., which demonstrates a positive benefit of participating in an RLC for first year grades (for males only, Edwards & McKelfresh, 2002; Kanoy & Bruhn, 1996; Knight, 2003; Pasque & Murphy 2005; Purdie II & Rosser, 2011; Stassen, 2003), retention into second year (for specific RLCs only, Knight, 2003; Stassen, 2003), and 4-year graduation rate (Beckett, 2006; Knight, 2003). However, some inconsistencies in the available research have been noted, whereby RLC participation did not improve GPA (Pascarella & Terenzini, 1980; Pike, Schroeder, & Berry, 1997) or retention rate (Edwards & McKelfresh, 2002; Kanoy and Bruhn 1996; Pascarella & Terenzini, 1980; Pike et al. 1997) relative to comparison living scenarios. These inconsistencies may be due to control groups selected, student variables controlled for (e.g., gender, field of study), and the type of programming offered in the RLC (e.g., faculty who live and/or teach in residence compared to no faculty involvement). While a true experimental approach with a treatment and control group in RLC research is impractical given that students are not randomly assigned their living scenario, there are several variables that may be accounted for when measuring the effect of RLCs to strengthen the rigour and validity of the study. Commonly, students' background characteristics such as gender and entering academic ability are controlled for. However, most studies do not investigate or control for students' field of study, and if they did, the control group chosen was not adequate, such that comparison students were not in the same field (Knight, 2003). Kanoy and Bruhn (1996) matched their RLC students to traditional residence students on the basis of predicted GPA, serving as the only study that implemented a matched subset control based on academic ability; however, they did not control for qualitative variables such as field of study. One may argue that the intentions and commitments of students who select to participate in an RLC are different than those who do not. Beckett (2006) posited that one may minimize potential differences in intentions of students by controlling for students' field of study, since students in a similar major or field may have similar academic aspirations. However, only two of the aforementioned studies controlled for students' field of study (Beckett, 2006; Stassen, 2003).

Notably, Canadian and U.S. RLCs are structured quite differently, particularly in regards to participant year of study, course registration requirements, and levels of faculty involvement. For example, Canadian RLCs are primarily exclusive to first year students with limited faculty involvement (Hobbins, Eisenbach, Ritchie, & Jacobs, 2016), and U.S. RLCs are often open to students in multiple years of study, where faculty involvement may be extensive such that they live in the residence (Shapiro & Levine, 1999). Furthermore, Canadian institutions have overall higher retention and graduation rates compared to U.S. institutions (American College Testing Program, 2010; Finnie & Qui, 2008; NCES, 2016). Therefore, data from U.S. RLC studies may not be immediately transferable to the Canadian context.

Study Purpose

While 10 of 15 top Canadian comprehensive institutions advertise RLCs on their recruitment websites (Hobbins et al., 2016), no published data exists to show their effectiveness on key student academic outcomes, to our knowledge. Therefore, the purpose of this study is to assess the relationship between RLC participation on several student academic outcomes at a Canadian comprehensive university. We hypothesized that the RLC program at the research site, a program representative of all Canadian comprehensive university programs (Hobbins et al.,

2016), is beneficial to undergraduate student learning. It was predicted that undergraduate students participating in the RLC program would achieve a significantly higher first year average, second year retention rate, and 5-year graduation rate, compared to undergraduate students not participating in the RLC program.



Method

Framework

The present study sought to draw inferences from outcomes derived through non-experimental methodology. Astin (1991, 1993) presented the Input-Environment-Outcome (I-E-O) model to evaluate the impact of environmental experiences on students without manipulating treatment groups. Astin argued that research examining the impact of an educational experience on students will be biased unless student inputs are controlled for. Therefore, this model serves as a guide in assessing academic outcomes while accounting for inputs, after experiencing a specific environment. Specifically, of primary interest to this study, inputs included admissions average, gender, and discipline (broadly defined as Biology, Engineering and Physical Sciences, Veterinarian Studies, Agricultural Studies, Business and Economics, Humanities and Social Sciences, and Arts. These categories coincide with the organisational structure of the university described in this study). The environment of primary interest to this study included living scenario (RLC versus non-RLC). Students who lived in traditional residence and off-campus were classified as “non-RLC” in the dataset because preliminary data analyses revealed that there were no statistical differences between the non-RLC groups. It is important to note that institutions with a higher proportion of off-campus students may wish to keep these students separate for the purposes of data analyses. Outcomes included first year average, retention into second year, and 5-year graduation. Our research study design, guided by the I-E-O model is presented in Table 1.

Table 1

Framework of this Study, based on Astin’s (1991, 1993) Input-Environment-Outcome Model

Control Variables (Input)	Independent Variables (Environment)	Dependent Variables (Outcome)
<ul style="list-style-type: none"> • Admissions average • Gender • Discipline 	 <ul style="list-style-type: none"> • RLC participation, non-RLC participation 	 <ul style="list-style-type: none"> • First year average • Retention into second year (registration in fall 2011) • Graduation in 5 years (summer 2015)

Participants

The full dataset (n=4805; Table 2) was composed of all students in the fall 2010 cohort living in RLCs (n=865) and non-RLCs (n=3940; 2910 were traditional residence and 1030 were off-campus). Initially, all analyses were conducted to first compare RLC students to traditional residence students and to off-campus students as separate groups. However, no significant difference existed between traditional residence and off-campus students; therefore, it was

justifiable to aggregate traditional residence and off-campus students under one category, “non-RLC.” The research protocol was approved by the study site’s Human Research Ethics Board (REB#15MR012). In some cases there were missing data associated with a student profile. These profiles were automatically excluded from the analysis associated with those missing data.

Data Analyses

Descriptive statistics. Descriptive statistics were reported for the variables gender, discipline, and admissions average for all students in all RLCs or non-RLCs. We wanted to determine whether there was a significant relationship between two categorical variables, namely between living scenario and gender, and living scenario and discipline. To do so, we used a Chi-squared test, which is a valid test for differences in distribution across two categories. We also sought to determine if significant differences existed between living scenarios and admissions average. To do this we first conducted a test for normality of the data by thoroughly inspecting the shape of the admission average variable’s distribution using histogram plots as well as interpreting skewness and kurtosis statistics (a standard procedure when parametric tests are going to be used). Given that skewness and kurtosis were well within acceptable values (± 2.58 ; Ghasemi & Zahediasl, 2012) and no significant deviations from normality were present, this was then followed with an unpaired t-test.

First Year average. We wanted to identify whether living scenario had an impact on first year average. In order to tease out the effect of living scenario from gender and discipline, we used an Analysis of Covariance (ANCOVA) to control for gender and discipline in each group. An ANCOVA tests for the main effect of a variable (e.g., living scenario) on a continuous dependent variable (e.g., first year average), controlling for the effects of selected other variables (e.g., gender and discipline).

2nd Year retention. To determine whether there was a significant association between retention into second year (measured by registration status in fall 2011 – yes/no) and living scenario between RLCs versus non-RLCs, chi-squared tests were conducted. The groups were split by gender and by discipline, and then analyzed separately because distribution analyses do not allow for control of co-variates.

5-year graduation. To determine whether there was an association between 5-year graduation rates (measured by graduation status in summer 2015 – yes/no) and living scenario between RLCs versus non-RLCs, chi-squared tests were conducted. As was the case for 2nd year retention, the groups were split by gender and by discipline before analyses.

All statistical analyses were calculated using IBM SPSS (version 23) software. When applicable, data are presented as mean \pm standard error (SE). Due to the large sample sizes in our data set, we calculated the effect sizes using Cramer’s V for distribution analyses and Cohen’s d (one way ANOVA) and f (ANCOVA) for scale analyses. Small effects were considered to occur at 0.1 for Cramer’s V and Cohen’s f, and at 0.2 for Cohen’s d (Cohen 1988, p. 25 and 79). Conducting multiple distribution tests increases the chance of erroneously concluding that a significant effect exists (type 1 error). Acknowledging this, we divided the results into ‘weakly significant’ ($0.05 \geq p > 0.001$) and ‘strongly significant’ ($p < 0.001$). All other test results were accepted as significant at $p \leq 0.05$.

Results

Gender

There was no significant difference in the proportion of females to males between RLC and non-RLC students ($\chi^2_1=0.5, p>0.05$) (Table 2).

Discipline

There was a significant relationship between living scenario (RLC, non-RLCs) and discipline. Students enrolled in Biological Sciences, Engineering and Physical Sciences, and Agricultural Sciences accounted for a larger proportion of RLC students compared to their respective proportion in non-RLCs (Table 2). For example, Biological Sciences students accounted for 31% of students in the RLC group, but only 19% of students in the non-RLC group. In comparison, Social Sciences students accounted for only 14% of students in the RLC group, but 24% of students in the non-RLC group.

Admissions Average

RLC students entered university with significantly higher admissions averages compared to non-RLC students (Table 2).

Table 2

Overall Distribution of Students in the 2010 Incoming Cohort.

	RLC	Non-RLC	Total
Overall	865 (18.0%)	3940 (82.0%)	4805
Gender			
Male	360 (41.6%)	1586 (40.3%)	1946 (40.5%)
Female	505 (58.4%)	2354 (59.7%)	2859 (59.5%)
Discipline			
Biological Sciences	271* (31.3%)	768 (19.5%)	1039 (21.6%)
Business and Economics	93 (10.8%)	750* (19.0%)	843 (17.5%)
Arts	136 (15.7%)	770* (19.5%)	906 (18.8%)
Engineering and Physical Sciences	147* (17.0%)	418 (10.6%)	565 (11.7%)
Humanities and Social Sciences	125 (14.5%)	953* (24.2%)	1078 (22.4%)
Agricultural Sciences	93* (10.8%)	281 (7.1%)	374 (7.8%)
$\chi^2= 146, df=5, p<0.001$, Cramer's V = 0.2, *denotes groups that were higher than expected by the model			
Admissions average \pm SE	83.5 \pm 0.2%*	82.1 \pm 0.1%	
$t=-7.22, df=1, 4291, *p<0.001$, Cohen's $d= -0.27$			

First Year Average

RLC students achieved a significantly higher first year average compared to non-RLC students when controlling for gender, and discipline (Table 3).

2nd year Retention

Before controlling for gender and discipline, there was a significant difference in proportion of second year registrants between students living in RLCs versus non-RLCs (Table 3).

When we investigated these proportions of retained students separately by gender, the trend was unchanged (Table 2). Considering this separate analysis for gender and 2nd year retention rate, worth noting is the possible benefit of RLCs to males in particular (Males: 94.2% RLC, 86.3% non-RLC, $p < 0.001$) relative to these values for females (Females: 92.9% RLC, 88.8% non-RLC, $p < 0.01$) (Table 3).

We investigated the proportions of retained students separately by discipline. For Biological Sciences, Engineering and Physical Sciences, and Agricultural Sciences, students in RLCs had higher second year retention rates than non-RLC students (e.g., Biological Sciences: 95.2% RLC, 90.6% non-RLC, $p < 0.05$) (Table 3). There were no significant differences in 2nd year retention rate between RLC and non-RLCs in the other disciplines.

5-year Graduation

Before controlling for gender and discipline, there was a significant difference in proportion of graduates by summer 2015 between students living in RLCs versus non-RLCs (Table 3).

When we investigated these proportions of retained students separately by gender, the trend was unchanged (Table 2). Considering this separate analysis for gender and 5-year graduation rate, worth noting is the benefit of RLCs to males in particular (Males: 69.7% RLC, 58.4% non-RLC, $p < 0.001$) relative to these values for females (Females: 78.4% RLC, 73.3% non-RLC, $p < 0.05$) (Table 3).

We investigated the proportions of retained students separately by discipline. For Biological Sciences and Agricultural Sciences, students in RLCs had higher 5-year graduation rates than non-RLC students (e.g., Biological Sciences: 83.4% RLC, 73% non-RLC, $p < 0.001$) (Table 3). There were no significant differences in 5-year graduation rate between RLC and non-RLCs in the other disciplines.

Table 3

Difference between Living Scenarios Regarding First Year Average, Retention, and 5-year Graduation

Variable	Grouping Variable	RLC	Non-RLC	Statistical Results	
First Year Average (%)	None	71.7	68.5	$t=-8.77, df=1,4689$ $p<0.001$ Cohen's $d=0.3$	
	Female	72.7	69.1	Univariate analysis of variance with both gender and discipline as independent variables:	
	Male	69.3	68.1		
	Biological Sciences	74.3	70.9		
	Business and Economics	70.6	67.4		
	Arts	71.7	68.5	$F=44.3, df=3,4690, p<0.001$ Cohen's $f=0.13$	
	Engineering and Physical Sciences	71.8	70.6		
	Humanities and Social Sciences	71.6	69.4		
	Agricultural Sciences	72.1	68.8		
					$\chi^2, df=1$
2 nd year retention	None	93.4	87.8	22.7**	0.7
	Female	92.9	88.8	7.4*	0.1
	Male	94.2	86.3	17.0**	0.9
	Biological Sciences	95.2	90.6	5.6*	0.1
	Engineering and Physical Sciences	93.4	86.7	4.5*	0.1
	Agricultural Sciences	95.7	89	3.7*	0.1
5 year graduation	None	74.8	67.3	18.4**	0.1
	Female	78.4	73.3	5.6*	0.04
	Male	69.7	58.4	15.6**	0.1
	Biological Sciences	83.4	73	11.7**	0.1
	Agricultural Sciences	81.7	76.5	27.3**	0.1

*Weakly significant differences ($0.05 > p > 0.001$). Full chart including non-significant values and specific p -values available (see the Appendix). **Strongly significant differences ($p < 0.001$).

Discussion

This paper presents the first study to rigorously investigate the impact of RLCs in a Canadian institution. We show that participation in a Canadian RLC program was associated with higher first year grades, second year retention rates, and 5-year graduation rates compared to not participating (students who lived in traditional residence and off-campus), with a potential particular benefit to male students and select disciplines. Calculations of the effect sizes of the analyses support our interpretations of the results in all but one test (see Table 3, 5-year graduation,

variable: female). Though generally the effect sizes demonstrated there to be a small effect of RLC participation on most of the variables, especially when conducting the distribution analyses on separate categories, we found that there was a strong effect of RLC participation on second year retention.

Consistent with the majority of existing U.S. empirical RLC studies referenced in this paper, this study measured students' academic performance as a cumulative average of first year grades. First year grades are frequently cited as indicators of subsequent academic success and degree completion, with higher grades increasing the probability of timely graduation (Kuh, Kinzie, Buckley, Birdges, & Hayek, 2006; Pascarella & Terenzini, 2005). Additionally, as indicated by the National Survey for Student Engagement (NSSE), grades are positively associated with time spent preparing for class, coming to class prepared, and asking questions in class (Kuh et al., 2006). Therefore, academic engagement and higher grades are correlated, suggesting it is possible that students achieve higher grades in relation to increased student engagement. As was demonstrated in our study, students who lived in an RLC achieved significantly higher first year grades compared to students who did not live in an RLC (traditional residence and off-campus). It is possible that because RLCs are a program implemented to increase student engagement, RLC participation positively contributed to students' academic achievement. Furthermore, although many RLCs provide discipline specific academic support (e.g., study sessions for core courses), it is worth noting that students who participated in a non-academic RLC (themed RLCs, for e.g., International House) also achieved improved first year grades in this study. This suggests that overall engagement in RLCs, regardless of the presence of targeted academic support, contributed to improved first year grades.

Consistent with the majority of RLC literature, retention was measured as students' registration status (yes or no) for the fall semester of their second year of study (fall 2011) in this study. Retention into second year was of particular interest, as opposed to retention into third year for example, because students who discontinue their studies are most likely to do so between their first and second year of study (Grayson & Grayson, 2003; Hoyt & Winn, 2003). Of the six U.S. RLC studies which investigated second year retention rate cited in this paper, only two produced some positive results. However, these six U.S. studies often presented difficulties for interpretation of results given their experimental design in terms of choice of control group. For example, some studies did not control for field of study (Kanoy & Bruhn, 1996; Pasque & Murphy, 2005; Pike et al., 1997), or compared students within one field of study to students in a variety of fields of study (e.g., RLC students in Health Sciences major compared non-RLC students in a variety of majors; Knight, 2003), neglecting to account for potential differences in intentions of students and academic aspirations (Beckett, 2006). Furthermore, one study was not exclusive to first year students only, introducing the possibility of mentorship from upper-year students (Pasque & Murphy, 2005). In neglecting to adequately account for these potential confounding variables, it is possible that the effects of RLC participation in these studies have been skewed, or even muted. We have strengthened our study by including an entire cohort of exclusively first year students, controlling for discipline as a proxy for academic degree, and clearly defining each variable in the study to allow for accurate analyses and interpretations of data, ultimately finding significant results on the outcome of second year retention. It is also worth noting that the 2010 cohort of students at the research site exceeded the provincial average first year to second year retention rate as per the measurements by the Consortium for Student Retention Data Exchange (2014). However, even though first year students in general perform well in terms of retention at the research site, RLC students outperformed non-RLC students on this measure.

Graduation rate is commonly defined as the percentage of an entering class that graduates within 4, 5 or 6 years of beginning their bachelor's degree (Noel-Levitz, 2008). Studies and organizations in PSE vary in the time point chosen to measure graduation. For example, the Common University Data Ontario provides information regarding institutions' graduation rates for a single cohort at 7 year intervals, and the Consortium for Student Retention Data Exchange (2014) does so at six year intervals, whereas some studies have measured this variable at four year intervals (Beckett, 2006; Knight, 2003). Since we investigated the 2010 cohort, and received our dataset in July 2015, the 4- and 5-year graduation measure was obtainable from available information. While there were only two peer-reviewed quantitative U.S.-based studies available that investigated RLC participation and graduation, both studies found that RLC participation was significantly positively associated with graduation in four years, even after controlling for relevant variables. While we measured the 5-year graduation rate, our results are consistent with previous research which supports the finding that there is a positive relationship between RLC participation and graduation.

It is possible that RLCs successfully facilitated students' transitions to university as measured by these three academic outcomes through the structured programming offered to participants (Hobbins et al., 2016), effectively increasing engagement and interactions with peers. While the content of structured programming may differ between RLCs, the overarching purpose remains, such that RLCs offer a select group of like-minded individuals consistent and frequent opportunities to engage and interact with peers in a productive way, which is likely over and above the day to day socializing that occurs in traditional residence or on a university campus. Furthermore, RLC students have increased exposure to academic support resources within their community, such as upper year peer mentors who lead study sessions on common core courses within the RLC. These academic resources are offered to RLC students in addition to resources which are available to all students, such as those offered through campus libraries (e.g., supported learning groups). It is therefore possible that the improved performance on these three outcome measures in this study are in part attributable to the increased exposure RLC students have to academic resources.

Literature consistently cites that females outperform males in PSE in terms of grades (Finnie & Martinello, 2010), persistence to, and completion of, a bachelor's degree in 5 years, even after controlling for relevant variables (Conger & Long, 2010; NCES, 2012). Females are also reported to be advantaged relative to males in skills such as organization, peer interaction, and seeking help from others (Conger & Long, 2010; Jacob, 2002). After considering the academic and non-academic skill set of females compared to males, it is perhaps not surprising that an environment such as an RLC appears to be particularly beneficial in supporting male students relatively disadvantaged in these areas. Future research may consider specifically investigating which elements of the RLC may be of benefit to males in particular.

A further surprising result from this study was the apparent benefit of RLCs specifically to science students in terms of retention (for the Biological Sciences, Engineering and Physical Sciences, and Agricultural Sciences), and graduation (for the Biological Sciences and Agricultural Sciences). We initially controlled for discipline as a proxy for academic degree, since students within the same discipline are likely to be working towards the same degree (e.g., Bachelor of Science, Bachelor of Arts). Each university degree has specific course requirements for first year students. Some courses may have lower grade averages than others, suggesting that there is a higher level of difficulty associated with the course. Given that grades are a predictor of retention and graduation (Kuh et al., 2006; Pascarella & Terenzini, 2005), it is possible that certain degrees

are associated with more difficult course requirements and subsequently lower grades, and thus retention and graduation rates. In particular, students in science, math and engineering have been reported to have lower retention and graduation rates compared to students in business, psychology and other social sciences (Beckett, 2006). Approximately 27% of students in science disciplines discontinue studies after their first year, attributed to overwhelming curriculum demands, feelings of poor morale due to the competitive culture of the discipline, and loss of confidence due to low grades (Dagley, Georgiopoulos, Reece, & Young, 2015; PCAST, 2012). It is possible that the sense of community, in addition to the academic and social support created by the RLC for science students, is over and above what is experienced in traditional residence and elsewhere on campus for non-RLC science students, ultimately producing what appears to be a particular benefit of RLCs to science students. Future research may consider specifically investigating which elements of the RLC may be of benefit to science students in particular.

Limitations

There are several factors which may have impacted the outcomes of this study. Most notably, this study relied on quantitative data from institutional records only. Given that RLCs originated to support student engagement and interactions with peers, and thus support students in their academics, this study could benefit from a complementary qualitative piece which assesses areas of student engagement. For example, the NSSE broadly measures the amount of time and effort students put into their academic studies, and evaluates the resources and opportunities for student learning offered by an institution. Data regarding students' experiences as an RLC participant, perhaps through a survey, may also help to extend this research. For example, it would be beneficial to know particulars about which resources students make use of within the RLC (e.g., study sessions or faculty events), within residence (e.g., academic drop-in centres), and throughout the wider campus (e.g., supported learning group study sessions in the library). Other information that may be valuable to collect could include students' reported ratings of faculty and peer interactions within their RLC, and how these interactions may have contributed to their educational experience. Such data may allow us to better evaluate which components of RLCs are contributing to students' academic success.

As noted throughout this paper, of concern to RLC research is the inability to set up a true experimental design, introducing the potential for self-selection bias associated with students selecting to participate in RLC programs. While a true experimental approach is often impractical in RLC research, this study attempted to identify and control for differences between student populations in each living scenario. It is possible that RLC students are particularly motivated and committed to their studies, such that they are inherently more likely to be successful academically than non-RLC students. Therefore, the results of this study may be confounded by unmeasured variables, particularly those qualitative in nature, such as student motivation. In addition, we were not able to account for students who, after their first year of study, changed their declared major so dramatically that it placed them in another one of our broad discipline categories.

Finally, this study was conducted at a single institution. In investigating a group of students at a single institution, it is possible that these students are unique in their academic abilities compared to other institutions, and benefit from RLC participation in a way that is not observed at other institutions. However, the 2010 cohort at the research site had an average admission average of 80.9%, which is approximately equal to the average admission average of the nine Canadian comprehensive universities used to establish that the research site is a representative site for RLC

investigation (Hobbins et al., 2016). Therefore, while the results of this study may not be immediately transferable to other institutions, we have attempted to improve the generalizability of results in conducting this study at a Canadian institution that admits students of similar academic ability, and offers RLC programs similar to those at comparable institutions (Hobbins et al., 2016).

Implications

This study contributes to the current North American literature by examining the relationship between RLC participation on first year grades, retention, and graduation, while accounting for the effects of admissions average, gender, and discipline. Most notably, this study represents the first quantitative study investigating the impact of RLCs in the Canadian context. The results of this study are consistent with data in the U.S. context that participation in an RLC is positively associated with first year grades, second year retention, and graduation rates compared to other living scenarios. Given that this is the first published quantitative RLC study in the Canadian context, it is important that further studies be conducted to support RLC programs. The research design and methodology implemented in our study, for example, collection of specific data from institutional records and collaboration with Student Housing Services, may be of use for other institutions that wish to replicate our study to rigorously assess their RLC programs. Furthermore, the results of this study may inform other Canadian institutions considering implementing or expanding RLCs. Having established that the research site's RLCs are beneficial in supporting students academically in their first year studies, other institutions may wish to consider the specific RLC programming at the research site which they may adopt and implement to achieve similar successful student outcomes.

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Appendix

Expanded Results for 2nd year Retention and 5 year Graduation

Table A1

Difference between Living Scenarios regarding First-year Average, Retention and 5-year Graduation when Controlling for Relevant Variables for all Students in the 2010 Cohort

Variable	Grouping variable	RLC	Non-RLC	Statistical results	
First year Average	None	71.7	68.5	Univariate analysis of variance with both gender and discipline and independent variables: $F=44.3, df=3,4690,$ $p<0.001$	
	Female	72.7	69.1		
	Male	69.3	68.1		
	Biological Sciences	74.3	70.9		
	Business	70.6	67.4		
	Arts	71.7	68.5		
	Engineering and Physical Sciences	71.8	70.6		
	Social Sciences	71.6	69.4		
	Agricultural Sciences	72.1	68.8		
				$X^2, df=1$	p^* (two-tailed)
2 nd year retention	None	93.4	87.8	22.7	<0.001
	Female	92.9	88.8	7.4	<i>0.007</i>
	Male	94.2	86.3	17.0	<0.001
	Biological Sciences	95.2	90.6	5.6	<i>0.02</i>
	Business	94.2	88.9	2.7	0.10
	Arts	89.7	84.7	2.4	0.13
	Math and Physical Sciences	93.4	86.7	4.5	<i>0.03</i>
	Social Sciences	91.2	87.1	1.7	0.20
	Agricultural Sciences	95.7	89	3.7	<i>0.05</i>
5 year graduation	None	74.8	67.3	18.4	<0.001
	Female	78.4	73.3	5.6	<i>0.02</i>
	Male	69.7	58.4	15.6	<0.001
	Biological Sciences	83.4	73	11.7	<0.001
	Business	69.9	65.5	0.8	0.38
	Arts	63.2	61.6	0.1	0.71
	Engineering and Physical Sciences	67.2	59.1	2.8	0.10
	Social Sciences	76.0	69.6	2.2	0.14
	Agricultural Sciences	81.7	76.5	27.3	<0.001

Strongly significant differences ($p<0.001$) are in bold. Weakly significant differences ($0.05>p>0.001$) are in italics.