Higher Education
Quality Council
of Ontario

An agency of the Government of Ontario

Measuring Student Success and Satisfaction in Technology-Enhanced Learning Studio Environments

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Cite this publication in the following format:

Elliott, J., & Colquhoun, R. (2013). *Measuring Student Success and Satisfaction in Technology-Enhanced Learning Studio Environments*. Toronto: Higher Education Quality Council of Ontario.

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Executive Summary

A learning studio is a classroom or specialized learning space that typically features enhanced teaching and learning technologies, comfortable seating, flexible furniture and an open layout. The learning studio concept is gaining popularity in many educational institutions. The increasing use of the learning studios, with the concomitant construction and equipment costs, inevitably raises questions regarding their effectiveness.

This study poses and tests five questions concerning the effectiveness of learning studios when compared to the traditional classroom.

- Do the students better achieve course learning outcomes in a learning studio?
- Do the students experience greater course completion rates in a learning studio?
- Are students more satisfied with the learning experience in a learning studio?
- Are the instructors more satisfied teaching in a learning studio?
- Does the learning studio enable and allow for greater use of technologies or alternative teaching methods than the traditional classroom?

As Lambton College converted a few classrooms into learning studios and the faculty migrated courses from the former to the latter, the opportunity arose to examine the effect of the learning studios. For this study, 11 courses were identified in which a section of the course was taught one year in a classroom and the following year in a learning studio. In the successive deliveries of each of these courses, the instructor, course outline, evaluation scheme and student academic program remained constant, and the student demographics remained relatively steady. With the classroom as the control and the learning studio as the experimental venue, the achievement of the learning outcomes and the completion of the course by the students, and the satisfaction of the students and of the faculty could be compared for the two venues.

The students' final grades were compared for the classroom and studio sections within each course. A statistical test for the difference in means was applied course by course. Multiple linear regressions were also calculated across all of the courses, considering the effect on grades of the learning studios, student age, student gender, and the interaction of age and gender with the learning studios. No strong or statistically significant evidence of a change in grades was found.

In each studio course, student course success – defined as not receiving a failing grade or withdrawing from the course – was compared to the success in the traditional classroom section using a statistical test for the difference in proportions. No strong or statistically significant evidence of a change in student success was found.

It should be noted, however, that the levels of student achievement and success were already quite high in the classroom sections. The pre-existing high level of final grades and course success may have made it too difficult to find observable and statistically significant improvements.

Student satisfaction in the classroom and studio sections of the course was measured using selected relevant items from the standard course feedback survey that is completed near the end of the semester by students across the college. The survey was completed for the classroom section and, a year later, for the studio section in eight of the 11 courses. Student responses to four survey items were considered:

- "The course is well designed and helps me to learn."
- "Overall, I have learned from this course."
- "The professor uses a variety of teaching methods."
- "Overall the professor is effective."

The percentage of "strongly agree" and positive ("strongly agree" plus "agree") responses was considered for each item. In six of the eight courses, at least three of the four items showed an increase in the favourable ("strongly agree" or positive) responses in the learning studio sections compared to the classroom section. In three of the eight courses, there was at least one item in which the increase in the favorable responses was statistically significant. For the second and fourth items ("Overall, I have learned from this course" and "Overall, the professor is effective"), six of the eight courses showed improvements, half of which were statistically significant. Broadly speaking, there was a pattern of increased student satisfaction on the selected survey instrument items from course to studio sections.

Eleven focus groups with over 130 students, as well as ten of the 11 faculty members teaching the courses, were interviewed to elicit comments and perceptions regarding learning and teaching in the studios. The comments from students and instructors were consistent and complimentary, both within and across population groups. The students consistently noted that the learning studios created an environment that was both physically and psychologically comfortable, and almost unanimously identified this as the most important impact of the space on the learning process and outcomes. Students and faculty both noted that the learning studio had a positive impact in encouraging and facilitating group-work and teamwork, and commented positively on the effect of the space in flattening the power hierarchy in the classroom – although it should be noted that this effect was embraced more widely by the students than the faculty.

The comments describing the change in teaching methods and strategies are particularly noteworthy. The students reported that faculty adopted a broad range of active learning strategies in the learning studios. With equal enthusiasm, the faculty described how the learning studios encouraged the adoption and implementation of active learning strategies that had not been possible or had failed in the traditional classrooms. The majority of faculty members did not view either the shift in teaching strategy or the transition to the learning studios as creating greater work for them.

The interviews also revealed a number of shortcomings in the facilities. Although a key component of the learning studio model is the infusion of teaching and learning technology into the classroom environment, the majority of students reported that the technologies in the learning studios were not fully or even adequately utilized. The faculty members recognized that their training in the use of the technology was inadequate and that they needed to develop further their facility with it. The constant need to rearrange the furniture and set up the room at the beginning of each class was an irritant to the faculty. The IT infrastructure was not as robust as needed for the smooth and uninterrupted operation of the studio technology. The unexpectedly large number of mobile devices present during some classes had rendered insufficient the number of power outlets and slowed system response times.

Overall, the qualitative results supported and built on the quantitative results, revealing widespread and consistently heightened student satisfaction in the learning studio sections. Furthermore, the faculty unanimously indicated high levels of satisfaction with the learning studios and with their teaching experience in them. For both groups, the expanded use of active learning strategies contributed significantly to this increase in satisfaction.

Although this study failed to find strong or significant evidence of improved student achievement and course completion in the learning studios, it did find statistical evidence and widespread support in student and faculty interviews for a significant increase in the satisfaction levels of the students and faculty as they moved from the traditional classrooms to the learning studios.

The challenge now faced by the college administration is the heightened expectations of students and the increased demand by both faculty and students for access to learning studios.

Introduction

A learning studio is a classroom or specialized learning space that features and facilitates the use of teaching and learning technologies (Perkins, 2005). It is a creative space that is intended to encourage and facilitate cooperative learning strategies in order to engage students and promote learning. For example, Active Learning Classrooms (ALCs) at McGill University are designed to support teaching and learning in an atmosphere conducive to engaging students actively in their own learning. The design draws on the SCALE-UP (Student-Centered Active Learning Environment for Undergraduate Programs) principles and classrooms established at over 40 universities across North America (McGill University Teaching and Learning Spaces Working Group, 2008). Through the layout and technologies, the learning studio encourages and enables the application of alternative teaching and learning strategies, such as active learning. The learning studio typically also features comfortable and flexible furnishings and an open layout.

The learning studio concept is gaining popularity in many educational institutions, including Ivy League schools (Perkins, 2005; Special Report on Campus Architecture, 2006; Feder & Brent, 1994). Several years ago, Lambton College, a small public college in Sarnia, Ontario, undertook its first conversion of a traditional classroom into a learning studio. In the ensuing four years, five studios were completed. The conversion of these classrooms was part of a broader college initiative aimed at improving student achievement, engagement and satisfaction. Separately and in conjunction with the creation of the learning studios, Lambton College promoted, encouraged and supported the adoption of active, cooperative and collaborative learning strategies. A college-wide professional development program was launched to develop and improve faculty skills in the strategies. A professional development award in active learning strategies was instituted. Hybrid courses were initiated and the concept of the flipped classroom, in both hybrid and traditional courses, was promoted. A subset of the active learning training included training in the use of the learning studio, which became a prerequisite for faculty access to a learning studio. Within the first three years, 50% of the full-time faculty had received the training.

The promotion of the new learning strategies and the development of the learning studios were interdependent. Meyers and Jones (1993) described active learning as using problem-solving exercises, informal small groups, simulations, case studies, role-playing and other activities that require students to apply what they are learning. The other methodologies, to varying degrees, also encourage and rely on social interaction, group and student-centred activities. Such classroom activities are facilitated and encouraged by the learning studio environment, as the greater availability of technologies and the greater flexibility in the physical layout of the space are likely to have an impact on the teaching methodologies employed. Dittoe and Porter (2007) noted that learning studios ultimately serve to create flexible spaces to support a flexible pedagogy. It was anticipated by the college that the migration to these new teaching-learning strategies, facilitated by the learning studios, would ultimately lead to the desired enhancement of student achievement and satisfaction.

A learning studio is characterized by technologies, furniture and a room layout different from those of a traditional classroom (Table 1). Compared to the classroom, the learning studio offers the teacher and students a greater choice of available technologies, greater flexibility in the furniture and room arrangements, and ultimately greater choice in how the class is delivered.

Table 1: Features of a Learning Studio and a Classroom

Classroom	Learning Studio
Teacher's podium with computer	Teacher's podium with computer
Internet access	Internet access
Access to course management software	Access to course management software
Static individual furniture	Flexible group furniture
Chalkboard or white board	Multiple, mobile whiteboards
Projector and screen	Multiple projectors and screens
	Document projector
	Smart boards

The adoption of the learning studios by the college as part of its broader initiatives was expected to have a positive impact on learning and teaching. The positive effect was expected directly through the provision of a comfortable environment, particularly for the students. It was also expected that the studios would provide a venue that facilitated and encouraged the adoption or greater use of the new teaching methods and strategies.

The conversion of a traditional classroom into a learning studio is an expensive undertaking and continues to be a significant component of the broader initiative to promote the new teaching strategies. In light of the expense of the learning studios and their role in the broader initiative, it is natural that questions concerning the impact and effectiveness of the learning studio initiative should be raised. This study attempts to determine the effectiveness of the learning studios.

Literature Review

Learning Studio Spaces

Fisher (2010) argues that the limitations of traditional classrooms represent a physically outdated teaching pedagogy that does not match the interconnected virtual world. Students are currently learning collaboratively through a vast array of informal learning spaces and are then forced into outdated traditional lectures where the shift from a "knowledge age" to a "creative age" has not yet occurred (Fisher, 2010). Learning studios present a potential remedy to this disjunction.

Within the literature, there is no consistent terminology or definition to convey the meaning of "learning studio" to the public. Many different terms are utilized, such as "alternative learning classrooms" or "smart classrooms." Perkins (2005) argues that the fundamental concept of a learning studio classroom is to include collaborative student work that is creative and generates conversation. It is not only the definition of a learning studio that is debated within the literature, but also the composition of the space itself. At McGill University in Montreal, ALCs are spaces that are designed to support teaching and learning in an atmosphere conducive to engaging students actively in their own learning. The pioneering SCALE UP project does not offer a general definition but provides a context-specific one with strategies implemented related to the course needs. At

some institutions, changing to a learning studio simply involves altering the physical layout of the traditional classroom to create a comfortable workshop setting or a theatre-in-the-round style classroom that enables students to work easily in small groups around a focal point (Illinois State University, n.d.). According to Taylor (2009), a learning studio is characterized by the following: a combination of moveable furniture and tables that groups students into learning teams; a centrally-located, portable teacher station that does not create a "front" of the classroom; and wireless laptops, computers, projectors, smart boards or other technology that are available to learners for writing or posting ideas. Fitch (2004) suggests that interactivity is a critical part of any form of technology-based learning. Ultimately, the goal of learning studio classrooms is to create flexible spaces to support a flexible pedagogy (Dittoe & Porter, 2007).

A few examples of learning studio/suite utilization within education are worth highlighting. The SCALE UP (Student Centered Activities for Large Enrolment Undergraduate Programs) at North Carolina State University provided some of the first innovative learning studio spaces. These spaces were first implemented in 1997 and were designed to bring active learning pedagogy to large enrolment classes by breaking classes into smaller groups around tables (Beichner, 1999). Ultimately, students engaged in collaborative problem-solving exercises facilitated by a technology-rich environment and by roaming instructors. The Massachusetts Institute of Technology (MIT) has Technology-Enabled Active Learning (TEAL) classrooms, designed to support undergraduate students enrolled in a first-year undergraduate physics course. TEAL classrooms are designed to support student understanding and conceptualization of physics by incorporating technology that enables interactive visualization of the concepts. In these examples, the new studio facility is intended to promote the use of alternative teaching strategies.

Active Learning

Learning studios may have an impact in the classroom by encouraging or facilitating the use of alternative teaching and learning strategies. Taylor (2009) hypothesized that studio learning combined with active learning pedagogy will: 1) enhance the absorption of technical concepts and the critical application of knowledge; 2) lead to gains in problem-solving ability; 3) develop student abilities to represent knowledge in multiple ways; 4) provide students with the resources to develop more in-depth answers; 5) improve student attitude and interest in subject matter; and 6) facilitate extensive interaction and engagement in material. According to Dewing (20010), active learning is an approach for in-depth learning that draws on, creatively synthesizes and integrates numerous learning methods. However, education literature relies more on intuition than common definition when explaining the concept. Chickering and Gamson (1987) suggest that active learning is more than just classroom presentations. In order to be active, learning must engage high-order thinking such as analysis, synthesis and evaluation. Meyers and Jones (1993) defined active learning as learning that allows students to talk and listen, read, write and reflect as they approach course content through problem-solving exercises, informal small groups, simulations, case studies, role playing and other activities that require students to apply what they are learning. Active learning encourages students to be an integral part of the class through discussion, reading, writing and reflection by decreasing their dependence on the passive lecture format (Meyers & Jones, 1993). This discussion appears to have led to a general understanding of active learning as a teaching-learning activity that emphasizes the need for students to do things and think about the things they are doing.

Research Methodology

For the purposes of this study, the effectiveness of the learning studios is defined in terms of student achievement, student success, student satisfaction and faculty teaching satisfaction. The effectiveness of the learning studios in promoting the use of alternative teaching strategies is also of interest. Five specific questions are addressed.

1. Do the students better achieve the course learning outcomes in a learning studio?
2. Does the proportion of students who successfully complete the course increase in a learning studio?
3. Do the students achieve greater satisfaction with the learning experience in a learning studio?
4. Do the faculty experience greater teaching satisfaction in a learning studio?
5. Did the learning studio lead the teacher to make greater use of technologies or alternative teaching and learning methods?

Student achievement of the learning outcomes is measured using final grades in the course. Successful completion of the course is measured through the proportion of students not failing or withdrawing (with a grade of F or W, respectively) from the course. Student satisfaction is measured by examining student responses to the course evaluation surveys completed at the end of the term. Student and faculty satisfaction are considered using focus groups and individual interviews, respectively. These same individual faculty interviews are used to answer the last research question.

This study considers paired sections for 11 different courses. Although there were more courses that had migrated to the learning studios, these were the courses in which the following criteria were met. Each pair had one section delivered in a traditional classroom and a second delivered a year later in a learning studio. In order to control as many variables as possible, each pair of course sections was taught using the same teacher, the same course outline, learning outcomes and learning objectives, the same course structure, and the same course evaluation structure and evaluation activities. The same student demographics (gender, age, academic program) were also present, with two exceptions.[1] In all courses, the academic experience for the students and teachers in the control (classroom) and experimental (learning studio) sections in each pair was the same except for the setting. Any observed differences in outcomes can likely be attributed to that difference in setting.

Table 2 provides a list of the courses from which the sections were drawn and the number of students in each section. It may be noted that the courses vary widely in discipline and originate from across the college. There was no anticipation, and it was not hypothesized, that any course, program or school would benefit differently from the learning studio experience.

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[1] See Table 3 below. In one course, there was a decrease in the proportion of females in the course from classroom to studio. In another course the median age increased slightly. In both cases, the studio sections were unusually small, seven and 12 respectively, and so susceptible to such fluctuations.

Table 2: Paired-Section Courses and Number of Students in Classroom (C) and Studio (S) Sections

Course			No.	
Code	**Name**	**Program**	**C**	**S**
BSN1713	Introduction to Nursing I	Nursing – BScN	58	60
CYW3012	Therapeutic Activities	Child & Youth Worker	39	35
CYW3023	Group Work	Child & Youth Worker	38	37
DDC2013	Assessments and Life Skills	Developmental Disabilities	25	12
ENG3413	Communications II for Fire Science	Fire Science Technology	26	26
HAT1063	World Cultures and Destinations	Hospitality & Tourism	67	73
HIS1003	History of Western Civilization I	Varied	17	7
MKT3423	Marketing Problems	Business Administration	14	21
NSG4263	Leadership in Professional Practice	Practical Nursing	62	55
PSW1023	Ongoing Health Conditions I	Personal Support Worker	75	81
SRA4303	Strategic Planning of Sports Events	Sports & Recreation Administration	33	24
Total			454	431

Teachers of identified course pairs were not informed of this research study until the end of the second delivery in order to prevent social-desirability bias. At the end of the studio term, the course teachers were approached by the primary researcher to ascertain interest in participating in the research study, and then informed consent was obtained.

For each pair of course sections, data were available at the individual student level. For each student, the researchers had available the final grade on the course, the student's gender and the student's age. The data were complete except for a few missing ages.

The data were analyzed using the Minitab© statistical application. The analysis consists of the following:

- tests for a difference in the mean grade point between the two paired course sections,
- a test for a difference in the mean grade point for the female subset within the pair of courses,
- multiple linear regressions across all of the sections in order to identify an effect from the studios and any influence from or interaction with gender and age,
- a test for a difference in the percentage of successful students within each pair of course sections, and

- tests for a difference in the satisfaction ratings in the paired sections for selected items on a standard student course-evaluation instrument.

For the qualitative component, this study uses purposive sampling, within some availability constraints, to obtain the richest possible source of information to answer the research questions (Morse, 1999). At the completion of the experimental (learning studio) courses, a sample of students from the studio sections and teachers were interviewed in focus groups and individually, respectively. Teachers were informed of the purpose of the research study and asked for class time to interview student participants. Teachers provided in-class time to increase student participation in the voluntary focus groups. The researchers explained the purpose of the research study to the students and obtained informed consent to participate. The students made the decision voluntarily to leave the classroom and move to a nearby room in order to participate in the twenty-minute focus group, where light snacks and beverages were provided. No other incentives were offered by researchers. The primary researchers conducted all focus groups using a semi-structured guide. Focus groups were audio recorded and transcribed verbatim by the research assistant. A note-taker was also present at every focus group to capture dialogue and student feedback. In total, 11 focus groups were conducted with over 130 students, representing about one-third of the total studio students.

After completion of the student focus groups, each teacher was asked to complete a semi-structured interview with the primary researchers in order to determine the teacher's perceptions of the learning studio experience. Interviews were conducted in an interactive, dialogic manner that requires self-disclosure on the part of the researcher, which in turn encourages reciprocity (Hesse-Biber, 2007). Every faculty member agreed to participate except one, who was a part-time faculty member and did not wish to participate after the conclusion of the semester. Ten faculty interviews were conducted. The interviews were audio-recorded and related field notes transcribed verbatim by a transcriptionist (Loftland & Loftland, 1995), who was the main research assistant. Transcripts were then cleaned by the primary researcher and all identifying data were removed to protect participant confidentiality. Data analysis took place concurrently with data collection, with the ultimate aim of becoming immersed in the data (Polit & Beck, 2008) and allowing for emerging analysis to inform subsequent interviews (Tesch, 1990). This interactive process provides a dialectical framework where it is possible to present findings and check descriptive and analytical validity (Lather, 1993; 1998), and is consistent with a conventional content analysis method (Downe-Wamboldt, 1992; Hsieh & Shannon, 2005). Coded data were sorted by coding category using NVIVO 9 software.

A standard set of interview questions was used for the focus groups and for the individual interviews. The questions were designed to elicit comments from the students and teachers concerning their perceptions of the impact of the learning studios compared to a classroom. The questions addressed student learning, participation and satisfaction. The questions attempted to identify which of the technologies were most commonly used and which had the greatest impact on learning and teaching. The effect of the learning studios on teaching methodologies was explored. In the teacher interviews, the impact on faculty teaching satisfaction was also investigated.

Analysis

Quantitative

Student Achievement and Success

Table 3 below provides the student median age, percentage female and mean grade point (GP) for each section in the pairs of classroom and learning studio. It may be noted that there is relative consistency in the gender and age measures from the classroom to the learning studio sections (with the previously noted exceptions of HIS1003 and DDC2013), consistent with the initial assumptions concerning the control of these potential variables.

Table 3: Paired-Sections with Student Median Age and Percent Female

Course	Classroom			Learning Studio		
	No.	**Age**	**Female**	**No.**	**Age**	**Female**
BSN1713	58	20.0	83%	60	20.8	85%
CYW3012	39	20.3	90%	35	20.5	91%
CYW3023	38	20.4	90%	37	20.7	89%
DDC2013	25	22.1	80%	12	26.0	75%
ENG3413	26	21.0	39%	26	21.5	39%
HAT1063	67	22.5	54%	73	21.7	64%
HIS1003	17	22.5	53%	7	20.0	14%
MKT3423	14	21.7	57%	21	23.0	33%
NSG4263	62	22.5	100%	55	24.5	93%
PSW1023	75	26.7	84%	81	26.0	75%
SRA4303	33	21.2	30%	24	21.4	37%

At Lambton College, students are awarded a letter grade upon completion of a course. For the purpose of calculating an average grade, the college assigns a grade point value to each letter grade. A four-point grade scale is used, in which a grade of A is assigned a grade point of 4.0, a grade of A- is assigned a grade point of 3.7, and so on, until a grade of F is assigned a grade point of zero. This grade-point scale is applied to the grades in this study for the calculation of grade points.

For each section of each course, the mean grade point is calculated. These section mean grade points and standard deviations are presented in Table 4. A two-tail t-test for a difference in grade point means is then calculated for each pair of classroom and studio sections, using a null hypothesis of no difference in the means. The resulting t values and corresponding p values (probability of error in rejecting the null hypothesis) are presented in Table 4.

Table 4: For Course Paired-Sections: Section Sizes, Grade Point Means and Standard Deviations, and Differences in the Mean Grade Points with Associated t and p Values

	Classroom			Learning Studio			Difference		
	Mean			Mean			Mean GPs		
Course	n	GP	SD	n	GP	SD	Diff.*	t	p
BSN1713	58	2.81	.70	60	2.92	.67	.11	.84	.40
CYW3012	39	2.99	1.22	35	3.57	1.20	.58	2.17	.03
CYW3023	38	3.21	.93	37	3.41	.65	.20	1.10	.28
DDC2013	25	3.03	1.12	12	2.65	1.33	-.38	-.92	.36
ENG3413	26	1.88	1.22	26	2.24	1.08	.36	1.11	.27
HAT1063	67	2.80	1.15	73	2.94	1.29	.14	.71	.48
HIS1003	17	2.74	1.44	7	2.29	1.37	-.35	-.71	.49
MKT3423	14	3.34	.74	21	2.72	1.09	-.62	-1.87	.07
NSG4263	62	3.78	.32	54	3.65	.36	-.13	-2.06	.04
PSW1023	75	3.41	1.02	81	3.53	.86	.12	.75	.46
SRA4303	33	3.32	.53	24	3.40	.46	.08	.58	.57

* The difference is calculated as the learning studio mean minus the classroom mean.
The shading indicates a t value with an associated p < .05.

Across the 11 courses, there are seven in which the mean grade point increased from classroom to studio and four courses in which the mean GP declined. At the p < .05 level, there are only two courses in which a statistically significant change was observed: CYW3012 had an increase in the mean grade point and NSG4263 had a decrease in the mean grade point.

Within each course section, there is a mix of genders. To determine if there may be a gender effect in the grade point changes, the test for difference in means was applied for the female subset in each course. Table 5 presents the differences in the mean grade points and the associated t and p values resulting from the tests.

Table 5: Course Paired-Sections Female Subset: Differences in Mean Grade Points and Associated t and p Values

Course	Classrooms		Studios		Difference*		
	No.	Females	No.	Females	Mean GPs	t	p
BSN1713	58	48	60	51	.22	1.57	.12
CYW3012	39	35	35	32	.59	2.19	.03
CYW3023	38	34	37	33	.21	1.00	.32
DDC2013	25	20	12	9	-.62	-1.24	.23
ENG3413	26	10	26	10	-	-	-
HAT1063	67	36	73	47	.46	1.62	.11
HIS1003	17	9	7	1	-	-	-
MKT3423	14	8	21	8	-.78	-2.46	.03
NSG4263	62	62	55	51	-.14	-2.13	.04
PSW1023	75	63	81	61	-.03	-.22	.82
SRA4303	33	10	24	9	.21	.81	.43

*The difference in mean great points is calculated as the learning studio mean minus the classroom mean.
The shading indicates a t value with an associated p < .05.

The differences for the mean grade point for the female subset follow a similar pattern in direction and significance to the differences for the total students. This might be expected because of the preponderance of females in most sections. In one course, MKT3423, the decrease in the mean grade point from classroom to studio was not significant for all students, but becomes significant ($p < .05$) for the female subset.

Across all of the courses for all students, the direction of change in the mean grade points is mixed, although a majority does show an increase. For the two courses in which there is a significant change in the mean grade point, there is one increase and one decrease. Overall, the course-by-course analysis does not reveal strong evidence of a positive effect of the learning studios on student achievement. The analysis for the female subset in the courses similarly reveals no strong evidence of a positive effect by the learning studios on student achievement.

As a further test for the effect of the studios, and in order to determine if the studios may have an effect when the gender and age of the students are taken into consideration, general least-squares linear regression analysis is employed. For the analysis, the age and gender of the student at the time of the course are used. Age is considered both as the age in years at the midpoint of the course and, in a separate regression, as one of three age groups: Young (< 21.6 years), Medium (21.6-34.5 years) and Senior (> 34.5 years). Gender and age groups are entered into the regression analysis as binary dummy variables (0, 1). Male and Young are set as the base or zero value.

General linear regression equations were calculated across all classroom sections using individual student data. Each equation is of the general form GP = $\alpha + \beta_1$ Variable 1 + β_2 Variable 2 + … + ε, where α is the

constant, β_i are the coefficients for the variables, and ε is a random error in a linear equation describing the relationship between the variables and GP (student's grade point). More specifically, equation C from Table 6 below is of the form GP' = a + b_1 Studio + b_2 Gender + b_3 Age, where GP' is the estimated grade point, a is the constant or y-axis intercept, b_1 is the Studio coefficient, Studio is the variable indicating whether the course was taught in a classroom or a studio, b_2 is the Gender coefficient, Gender is the student's gender (male=0, female=1), b_3 is the Age coefficient, and Age is the student's age measured in years at the mid-point of the course.

Four regression equations were estimated in a step-wise manner, always, however, maintaining the Studio variable in the equation. Regression A uses only the Studio variable to estimate GP. Studio is a bivariate dummy variable that uses a 0 for classroom and a 1 if the course is delivered in a studio. The resulting equation GP' = a + b_1 Studio becomes GP' = 3.09 + .083 Studio. This equation may be interpreted as indicating that when the course is delivered in the classroom (i.e., Studio = 0), then the predicted GP is 3.09. If the course is delivered in a studio (i.e., Studio = 1), then the predicted GP is 3.17 (3.09 + .083). For the Studio coefficient, the t value = 1.20 is too low for the hypothesis b_1 = 0 to be rejected, for $p < .05$. Thus, Studio effect is not statistically significant and Studio has no predictive powers for GP.

In successive regressions, the variables Gender, Age and Age-Squared, and the interaction variables Studio-Gender and Studio-Age were entered into the calculations. The results for the four regressions are presented below in Table 6.

In none of the estimated equations does Studio become statistically significant for predicting a student's grade point. Gender and Age and Age-Squared enter and remain significant. Gender (Male = 0, Female = 1) indicates that a female is predicted to have a grade point greater than a male by approximately .5, all else being constant. Each increase of one year in a student's age, all else being constant, is predicted to increase his or her grade point by approximately .09, with a caveat. The negative coefficient (-.001) for Age-Squared indicates that age has a diminishing effect. By approximately age 45, the age effect has been maximized and each additional year results in a slight drop in the predicted grade point.

It may be hypothesized that there is some interaction between Studio and Gender, and Studio and Age. That is, Studio may have an effect that varies with Gender or Age. The interaction variables were entered into the equation. For both of the interaction variables, the t value is too small to allow the null hypothesis (the coefficient = 0) to be rejected. There are no interaction effects for gender and age.

Table 6: Regression Analysis of Student Grade Points, Gender, and Age for All Classroom Sections and Studio Sections

	A	B	C	D
Constant	3.09	2.73	1.22	1.11
t	*64.7*	*38.7*	*2.86*	*2.54*
Studio	.083	.092	.082	.393
t	*1.20*	*1.37*	*1.25*	*1.53*
Gender		.516	.505	.527
t		*7.01*	*6.92*	*5.13*
Age			.091	.094
t			*3.15*	*3.23*
Age Squared			-.001	-.001
t			*-2.45*	-2.34
Studio-Gender				-.050
t				*-.35*
Studio-Age				-.011
t				*-1.22*
S	1.02	.994	.981	.981
R^2 (adj.)	.5%	5.2%	7.9%	7.9%
n	883	883	878	878

Regression equations were also calculated replacing the Age variable with the age groups (Young, Medium, Senior), entered as binary dummy variables. The age group variables proved not to be significant as predictors of student grade points.

Gender and Age are significant variables for predicting grade point. However, it may be possible that the gender and age effects differ depending on whether a classroom or studio is used. If this is the case, the studio effect should cause a difference in the Gender and Age coefficients in the two equations. To test for this effect, separate linear regression equations were calculated with the Gender and Age variables for the classroom sections and the studio sections. The results are presented in Table 7.

The coefficients and t values for Gender and Age are consistent from the Classroom equation to the Studio equation, and with the previously estimated equation values above. There is a difference between the classroom and studio equations in the values of the Gender and Age coefficients. However, testing for a difference between the Gender coefficient in the classroom equation and the Gender coefficient in the studio classroom equation finds that the difference is too small to reject the null hypothesis of no difference for p < .05. Testing for a difference in the Age coefficients also fails to reject the null hypothesis for p < .05. Thus, there is no difference for Gender and Age from classroom to studio. Although the equation constant increases

from the classroom equation to the studio equation, the difference is not statistically significant. This finding is consistent with the earlier findings and conclusions that there is no effect on grade points when moving from classroom to studio.

Table 7: Regression Analysis of Student Grade Points, Gender, and Age for Classroom Sections and Studio Sections

Classroom Sections

Predictor	Coefficient	Standard Error	t	p
Constant	2.03	.181	11.19	.000
Gender	.540	.104	5.18	.000
Age	.027	.007	4.16	.000
S	.998			
R^2 adj.	8.9%			
n	444			

Studio Sections

Predictor	Coefficient	Standard Error	t	p
Constant	2.47	.180	13.75	.000
Gender	.480	.102	4.69	.000
Age	.015	.006	2.36	.018
S	.969			
R^2 adj.	5.5%			
n	427			

The regression analysis results are consistent with the results from the mean differences analysis. Although some studio effect is suggested, the evidence is not strong and not statistically significant. The evidence is insufficient to conclude that the studios have an impact on student achievement.

Student Success

Student success is defined as a passing grade or, alternatively, as not receiving a failure (F grade) or a withdrawal (W grade). If the studios are effective in improving student success, then there should be a lower proportion of unsuccessful students in the learning studios than in the classrooms.

Table 8 presents the number and proportion of unsuccessful students for each of the two sections in each course, and the Z and p values resulting from the significance tests for the differences in the proportions.

Table 8: Course Paired-Sections: Number of Students, Unsuccessful Students and Unsuccessful Ratio, and the Z and p values for Difference in Ratios

| | Classroom | | | Studio | | | | |
| | No. of Students | | | No. of Students | | | | |
Course	Sect.	F or W	Ratio	Sect.	F or W	Ratio	Z	p
BSN1713	58	0	.00	60	1	.02	1.01	.31
CYW3012	39	4	.10	35	2	.06	-.73	.47
CYW3023	38	2	.05	37	1	.03	-.57	.57
DDC2013	25	1	.04	12	1	.08	.49	.63
ENG3413	26	5	.19	26	2	.08	-1.24	.22
HAT1063	67	5	.07	73	6	.08	.17	.87
HIS1003	17	3	.18	7	1	.14	-.21	.84
MKT3423	14	0	.00	21	1	.05	1.02	.31
NSG4263	62	0	.00	54	0	.00	-	-
PSW1023	75	4	.05	81	2	.02	-.92	.36
SRA4303	33	2	.06	24	0	.00	-1.46	.15

A test for differences in proportions was applied to the classroom and studio sections for each course. A significant change in proportions (ratios) occurred in none of the pairs of sections. It may be noted that the Unsuccessful ratio for the individual course sections is generally very low. Secondly, none of the courses display a large change in the ratio from classroom to studio. Thirdly, there is no clear pattern in the direction of the ratio changes. None of the changes in the Unsuccessful ratios are significant for $p < .05$. There is insufficient evidence to support any conclusion regarding the impact of the studios on student success in completing the courses.

Student Satisfaction

Compared to traditional classrooms, learning studios provide more comfortable, movable furniture, a more flexible room arrangement, and more teaching and learning technology. All of this can enable a greater variety of teaching methods and facilitate experimentation with new methods, such as active learning. As a result, it was hypothesized that student satisfaction with the course and the teaching for classes taught in learning studios would increase.

Near the end of each semester, the college conducts a survey of student perceptions of and satisfaction with the course and teacher in approximately half of the sections delivered in that semester. For each full-time teacher, two sections are surveyed – one section is chosen by the dean and one section is chosen by the

teacher. The survey, known as the Students' Perception of Learning (SPL) survey, was undertaken in both the classroom and studio sections of eight of the 11 courses included in this study. The sections – of the eight courses in which both the control and experimental sections were surveyed – were selected by the dean or teacher without knowledge of this study and so, for the purposes of this study, the eight courses considered were chosen from the 11 by happenstance. The students' responses to selected items from the survey instrument are compared across both sections in the course in order to identify any changes in satisfaction.

The SPL survey instrument consists of 22 items. Each item is made up of a statement concerning some aspect of the course or its delivery and five response choices: "strongly agree", "agree", "neutral", "disagree", "strongly disagree." Of the 22 items on the survey, four were identified as having particular relevance in discerning differences in student satisfaction arising from the move from a classroom to a studio. These item statements are the following:

> #5 – The course is well-designed and helps me to learn.
> #8 – Overall, I have learned from this course.
> #15 – The professor uses a variety of teaching methods.
> #22 – Overall, the professor is effective.

The percentage of "strongly agree" and positive ("strongly agree" plus "agree") responses are considered for each item and compared across both sections. Table 7 below presents the responses, in percentages, from the SPL surveys.

In seven of the eight courses, there was an increase in the positive or strongly positive responses on at least one of the items. Only one course, DDC2013, showed a generally negative change in student satisfaction. In six of the eight courses, at least three of the four items showed an increase in the favorable responses. In three of the eight courses, there was at least one item in which the increase in the "strongly agree" or positive responses was statistically significant for $p < .05$. (The null hypothesis is that there is no difference between the classroom percentage and the studio percentage.) For the second and fourth items (Overall, I have learned from this course; Overall, the professor is effective.), six of the eight courses showed increases, a number of which were statistically significant.

For the selected items on the student survey, there was a general increase in satisfaction within the learning studios sections in seven of the eight courses. Two of the survey items consistently showed a greater satisfaction in the studios than in the classrooms. Broadly speaking, the student responses to the SPL survey items demonstrate that there was increased student satisfaction when moving from the classrooms to the learning studios, with the increase achieving statistical significance on six course-item occasions. In light of the small sample sizes for some sections, some care should be exercised in extrapolating conclusions to the general population.

Table 9: Student Survey "Strongly Agree" and Positive Response Percentages for Items Concerning the Course and Instructor in Classroom and Studio Sections

> Survey Items
>
> #5   The course is well designed and helps me to learn.
>
> #8   Overall, I have learned from this course.
>
> #15   The professor uses a variety of teaching methods.
>
> #22   Overall, the professor is effective.

Item		CYW3023 C	CYW3023 LS	p	CYW3002 C	CYW3002 LS	p	MKT3423 C	MKT3423 LS	p	HAT1063 C	HAT1063 LS	p
n =		22	33		29	27		13	17		27	32	
#5	Positive	87	97		79	82		100	100		60	56	
	S Agree	55	63		41	30		77	76		30	31	
#8	Positive	85	97		82	85		100	100		80	67	
	S Agree	52	68		43	44		85	94		52	32	
#15	Positive	95	90		79	78		92	100		77	85	
	S Agree	59	61		48	48		77	65		42	44	
#22	Positive	100	100		79	96	.04	100	100		81	68	
	S Agree	71	84		48	74	.04	92	94		44	29	

Item		NSG4263 C	NSG4263 LS	p	DDC2013 C	DDC2013 LS	p	ENG3413 C	ENG3413 LS	p	PSW1023 C	PSW1023 LS	p
n =		35	36		16	5		12	14		51	55	
#5	Positive	98	100		100	100		16	64	.00	100	96	
	S Agree	49	56		73	40		8	14		71	67	
#8	Positive	100	100		100	80		16	77	.00	100	98	
	S Agree	54	60		83	60		8	15		71	76	
#15	Positive	100	100		100	100		58	64		100	100	
	S Agree	71	69		93	80		8	14		75	94	.00
#22	Positive	100	100		93	80		25	85	.00	100	100	
	S Agree	74	77		86	60		8	14		72	98	.00

C = Classroom, LS = Learning Studio, S Agree = Strongly Agree, Positive = Strongly Agree + Agree

Shading indicates an increase in percentage from classroom to studio.

p = probability of error in rejecting hypothesis that there is no difference between the two percentages.

Qualitative

Comfortable Classroom

The learning studio creates an environment that is both physically and psychologically comfortable. Students highlighted the features of the learning studio that contributed to the comfortable environment: a spacious physical layout, flexible furniture (both tables and chairs) and relaxed seating. Students and faculty consistently highlighted this learning studio characteristic as critical to engagement with course material. Students almost unanimously identified the environment as the most important impact of the learning studio on their learning process and outcomes.

Students stated that the physical layout of the learning studio space promoted an increase in physical comfort due to the comfortable chairs, flexible table seating, and the open space of the classroom. Fire Science students did not feel as "cramped" as in the lecture hall environment of a traditional classroom. Students felt that this physical comfort contributed to "a more relaxed setting" which ultimately created fewer distractions. Similarly, students within a sports and recreation administration program stated that they "wouldn't mind having all classes be three hours if they were in learning studios" due to their increased capacity to focus. Students suggested that the layout and flexibility of the learning studio helped them to pay attention and increased their engagement. One faculty member enjoyed the way the learning studio enhanced his lessons and suggested that:

> "technology didn't draw me to the room, it was the environment."

Ultimately, students suggested that the comfortable physical environment of the learning studio contributed to an increased ability to engage in course material and in the learning process.

Both students and faculty stated that the welcoming environment of the learning studio had a positive impact on the learning process. Specifically, students stated that the learning studio created a "welcoming" and "relaxing" environment in contrast to the "jail cell" feeling of many of the traditional classrooms on campus. Students in a health sciences program felt that:

> "[the learning studio] gave [students] a different attitude toward learning because it created a different atmosphere. It set a relaxed setting… like you are not even in class."

Faculty members were aware of these changes in their students, suggesting that they perceived student satisfaction to be much higher during their learning studio classes in contrast to traditional classrooms. One faculty member even commented that the learning environment flexibility and comfort address a common need of faculty members to "create the space for learning."

Students felt that this environment not only contributed to their learning but also made them feel more welcome in the classroom and engaged on a more personal level. Students in a nursing program felt that their professor became more interactive in the learning studio. These students experienced increased emotional safety and reported that they were not "forgotten at the back of a lecture hall." The learning studio seemed to meet the emotional needs of students within the classroom setting, a change that may ultimately contribute to

the learning process and course engagement. The majority of students felt that the comfortable learning studio space contributed to improvements in learning outcomes. One student stated:

> "I feel that the environment impacted my learning. I would have done worse in a regular classroom. It was easier to learn in a learning studio compared to a regular classroom… I [didn't] dread going to class."

Although many students wanted "all [their] classes changed to a learning studio," some students identified that heavy theory- or content-driven courses might be challenging in this setting. Some faculty agreed with the idea that heavy theory content "wouldn't work" in the learning studio. In fact, the majority of staff interviewed, while early adopters of active learning strategies, were still resistant to moving the "meat and potatoes" of their course to a learning studio setting. However, some students and faculty disagreed and felt that the learning studio would only enhance theory courses by encouraging the application of the course material. Interestingly, in contrast to the view that "covering content" can be difficult in a learning studio, some faculty called for the delivery of theory courses in a different way and suggested that new way may create "a better result."

Working Together

Within the learning studio, group or team work was utilized as an instructional method for students to engage in discussions, problem solving and critical thinking. One faculty member had previously attempted to incorporate group work into her course, but she found it challenging to implement in a lecture hall, with her efforts often resulting in "chaos." This professor suggested that discussions were better organized to tease out learning in a variety of styles in the learning studio. Many faculty noticed that as a result of working in groups, students were able to learn group process skills which resulted in better learning outcomes. Physical features, such as the moveable furniture, allowed students to have control over their environment and arrange the space according to their needs. White boards not only helped to provide privacy for groups, but helped to "break down barriers in groups" by allowing quieter students to contribute to the discussion. Faculty members noticed an increasing comfort level in discussions as the course progressed. One professor in a community services program commented that her students were:

> "able to engage in more in-depth, critical thinking when they can break into their "think tank" pods and put their ideas onto whiteboards to share with peers."

Most students felt that the learning studio encouraged the practical application of knowledge related to their future career choices by developing their ability to work effectively in groups. Students reflected that they were doing more work outside of class even though they received sufficient time in class to discuss course material. Students explained that classroom discussions were moving out into the hallways and social media as students wanted to continue to engage in learning. The business program professor commented that:

> "students were learning from each other and that is what the class is all about."

Faculty members witnessed students experiencing the freedom to ask critical questions, apply theory and problem solve together in groups, which permitted students to engage in the learning process. While some students and faculty felt that this increase in classroom "noise" due to group work or discussion was at times problematic and distracting, many faculty members noted that students were far more fully engaged and, in this environment, they suddenly did not mind group work.

Teaching-Learning Methodology

The physical layout of the learning studio encouraged some faculty members to implement active learning strategies for the first time and others to implement these strategies more effectively. There were two distinct groups of faculty member experiences with active learning strategies. Some used the opportunity provided by the learning studio to add and implement creative active learning strategies into existing lecture-based courses, while others were early adopters of active learning methodology who used the learning studio to deliver their course material the way they had originally intended, but had been unsuccessful because of the barriers faced in the traditional classroom. Both groups of faculty used various active learning strategies in the learning studio and indicated that the physical layout of the space permitted the implementation of a variety of teaching strategies (e.g., poster presentations, group work, case studies, discussions/debates, etc.) that were previously difficult to use given the restrictions of a traditional classroom. One early-adopter professor stated that, for him:

> "the room made it easier to do what I wanted to do. I didn't look at overhauling the course, but rather I looked at this as an opportunity to experiment."

This particular course was "application-based" or "group work"-oriented, so the delivery of this course material worked well in a learning studio space. In contrast, the majority of professors tended to resort by default to a more didactic, "lecture-based" model of teaching and learning in a classroom setting, a teaching style that uses PowerPoint as the main medium to introduce and engage students in the course material. In contrast, many faculty members highlighted that the studio space allowed them to engage their students using a variety of methods that addressed multiple learning styles. Many faculty members felt that the learning studio environment did not give primacy to one learning style and argued that all can be incorporated within this setting.

The majority of faculty members did not view the incorporation of active learning strategies or the transition to the learning studio as creating more work for them. Most did not report any increases in preparation or work load, but rather simply a shift in their philosophy of teaching and learning. As one faculty member explained:

> "faculty need to challenge themselves to be prepared for the learning studio format... [professors] need to teach in it in order to learn how to use it and it will get easier."

Another faculty member stated:

> "I had used all kinds of strategies before the learning studio but had to make modifications, now I'm able to teach the course without modifications... it became easier preparing to teach because I was essentially able to do everything without constraints."

Although some faculty believed these differences to be ones in "personal style," there are clear philosophical underpinnings that are shaping processes of teaching and learning that may, in turn, be impacted by the learning studio. As a result of the changes in teaching strategy, PowerPoint slides became a supplement to the learning process rather than the main method of course delivery. Overall, the learning studio proved to be a venue that provided for flexibility in instructional methods and many more options for active learning.

Students wondered if perhaps the learning studio would force professors to change and deliver their content more effectively, using creative methods to increase student engagement. Students suggested that without this shift in teaching philosophy a professor could potentially deliver a completely lecture-based course within

a learning studio space. Students in a nursing program stated that the success of the learning studio "depends on the professor" and that without a shift towards implementing active learning, the learning studio would be utilized like any other classroom but "with more comfortable chairs." Thus, students clearly highlighted the importance of implementing active learning strategies within the learning studio setting.

Power Structure

Some faculty who were early adopters of active learning strategies appear to have created a more equal balance of power in their classrooms. Many students described perceived power imbalances within traditional classrooms, stating that within traditional classrooms a distinct hierarchy is evident, an experience which many students likened to a "jail cell." This imagery is powerful and some faculty substantiated these perceptions, stating that "faculty must own the space" and that "students are guests in the classroom." Other professors described the importance of "controlling" the classroom regardless of physical layout. However, some of those same faculty members who made the previous comments also agreed that students are more engaged and easier to motivate within the studio setting.

Despite the inevitable power imbalance at play within the classroom, many of the students felt that they were:

> "not being talked at, this [experience] was much more comfortable and facilitated conversation, which was engaging."

Some students suggested that the learning studio broke down barriers, and they recognized that the learning studio created a comfortable environment for their professors. Students in a business administration program commented that:

> "A traditional classroom emphasizes a teacher versus student model where the learning studio environment is much more student-focused and students are more engaged as a result… This also places the teacher at the center of engagement and the advantage is that the teacher is amongst us."

One faculty member with several years of experience in the use of a more didactic approach stated:

> "I can't say enough good things about [the learning studio], I don't want to teach in a regular classroom."

Students in a health care theory course felt that the learning studios allowed for more effective communication. Students were engaged in group work and were able to "bounce ideas off one another" and "learn from one another." A faculty member in a health program stated that in the learning studio:

> "students get comfortable and they breathe easier, this impacts their learning. They need to know this is their room, they decide where to sit, and it's the whole power piece."

Many students noted that the professor "moved around the classroom " in the studio and they felt that the physical layout created a more equal footing for the student in contrast to a lecture hall as there was no "front of the class." Students felt that the learning studio reduced the hierarchical structure that dominates the traditional classroom setting. As a result, they felt that they were more engaged with their peers, professor and course material, and that the greater engagement ultimately impacted their learning. From a student perspective, the learning studio seemed to facilitate this transition toward a more collaborative style of teaching and learning.

Incorporation of Technology

Although a key component of the learning studio model is the integration and infusion of technology into the classroom environment, the majority of students did not feel that the technologies in the learning studios were fully or even adequately utilized. The features of the learning studio most used by faculty and students were reported to be the positioning of the tables – in support of group work – and of the white boards – in order to enhance the group work and serve as dividers between groups. Although the second visual display screen in the studio was a feature that all students appreciated, they felt that there was "nothing more technology-wise" that was incorporated into, and widely used in, the learning studios. Indeed, students were frustrated that professors did not use other forms of technology such as smart boards. Many students suggested that "using smart boards would have been nice" and noted that they had "previously used smart boards in elementary and high school so it was different not having them at Lambton [College]."

Some students commented that their professors needed additional training in order to incorporate and utilize technology more effectively in the classroom. Many faculty members had suggestions for ways to enhance the training that they received as part of their contract to gain entry to the learning studios. Specifically, most faculty members commented that the training:

> "wasn't really teaching, it was more just showing resources and it was left up to faculty to learn how to use things."

Most faculty were not comfortable with smart boards and felt that one group training session was not enough to incorporate this technology into the classroom. The majority felt that the general training was not as "hands-on as it could have been" and that there was a "disconnect with the active learning principles of the learning studio." Many faculty members highlighted the need for the training to be implemented through active learning principles rather than defaulting back to traditional teaching methods. These comments indicate a need for the college to re-evaluate learning studio training for faculty members in order to address the gaps identified by students and faculty members.

Shortcomings in the Facilities

Although many faculty members highlighted the strengths of the learning studio, shortcomings related to physical space and layout were also identified. Although the flexibility of the furniture was identified as a strength, it was also identified as a problem – or at least a nuisance – as there is no "fixed" or standard location for classroom furniture, and many faculty members are using the space in creative ways. The constant rearrangement of the furniture created set-up complications for the incoming teacher that took away from instructional time. IT shortcomings were noted by both students and faculty. Lengthy log-in procedures and poor Wi-Fi connections frustrated both parties. Students in one focus group noted that their professor "cancelled class" due to frustrations with the IT system log-in process in the learning studio. While this cancellation may have been a singular event, the need for increased IT infrastructure to support technology in the studio was clear. In addition, students and faculty identified a lack of power outlets for laptops or other forms of mobile technology. Other criticisms of the facilities included the swipe card access, which created a noise distraction for both faculty and students when persons were entering or exiting the studio. Some of these shortcomings can be addressed relatively easily, while others may continue to detract from the learning studio experience for staff and students.

Overall Satisfaction

When given the choice, almost all of the students and the majority of faculty members would choose to have their classes in a learning studio again. The majority of the faculty members believed that the learning studio created a comfortable environment that increased student participation and ultimately kept students engaged. One professor noted that, in contrast to teaching in a traditional classroom, "Students seemed to come in [to the learning studio] and were ready to learn." Faculty also provided anecdotal feedback that students were informally describing their satisfaction with the learning studio and that they felt it was easier to understand important information and engage in the class. One professor noted that overall:

> "the learning studio enhances the learning environment… The biggest challenge of any room is keeping students engaged and [in the learning studio] students were more engaged and the environment had the biggest impact."

The interviewed students were looking for Lambton College to continue to invest money in the better learning environments for students that are provided by learning studios, and felt that they deserved "quality learning experiences." Mature students especially called for changes to traditional classrooms. One student noted that learning studios:

> "make you feel professional and provide quality education. I have been in school for many years, learning studios make a difference."

While some students felt that any classroom space could potentially be a learning studio if the physical layout changed, most others felt that Lambton College needed to continue to invest in developing this specific type of learning space as it was useful to any type of learner. The majority of faculty members who were interviewed noted that they were on board with the implementation of learning studios and saw the value of these spaces and their potential impacts on education. One faculty member argued eloquently that "learning studios are one of the many educational tools we need to have at our disposal as educators" in order to successfully engage students in the learning process. Overall, students and faculty were extremely satisfied with the courses in the learning studio setting and sought the continued expansion of learning studio space.

Discussion

The lack of strong evidence that the learning studios improved student achievement and success is notable. One reason for this lack evidence, however, may have preceded the move to the learning studios. Although it was anticipated that the learning studios would lead to greater student achievement and success, neither the tests for differences in the grade point means nor the regression analysis found significant evidence of student improvement in any of the eleven classroom-studio pairs. Results were similar with the anticipated improvement in student success, where there was no consistent, strong evidence that the learning studio led to improvement. A possible explanation for the absence of significant increases in student achievement and success may lie in the pre-existing high level of achievement and success in the control classrooms. In seven of the eleven control classrooms, the mean grade point was at 3.0 or higher. In a substantial majority of the classroom sections, the grade distribution was severely compressed into the highest grades in a very skewed distribution. Furthermore, the student success rate was 94% or above in seven of the eleven control classroom sections. With such high starting mean grade points and success rates, there is relatively little room for observable improvements. The likelihood of finding statistically significant changes is then much reduced.

An increase in student satisfaction clearly accompanied the move to the studios. The analysis of the relevant items in the student course surveys revealed widespread increases in student satisfaction, including statistically significant improvements on seven items across three of the eight courses. More impressively, the qualitative research involving student and faculty interviews revealed widespread student and faculty satisfaction with the learning studios and a strong preference for the studios over the traditional classrooms.

The satisfaction with and the preference for the learning studios flowed from a number of sources. The studios were seen to be more comfortable, both physically and psychologically, and to encourage and facilitate group work and team effort. The studios were thought to diminish the teacher-student power imbalance and generally flatten the hierarchy in the class. Most importantly, the studios were seen to encourage and facilitate the use of active learning teaching methods.

The increased satisfaction in the learning studios did not arise from the increased use of the available technology by the faculty. The comments from the students concerning the use of the available technology, such as smart boards, described the non-use of it. The faculty indicated a need for more and better training in the use of the technology. Indeed, the technology available in the studios was almost totally absent from any of the comments or discussions concerning the effects and effectiveness of the studios.

It is apparent from the interviews that the most important "technology" in the learning studios was the moveable, flexible furniture. It was the furniture and the complementary room space that provided student comfort and the opportunity for new approaches to teaching and different teaching techniques. For students and teachers alike, the studios were a venue in which, because of the furniture and space, the faculty could more easily apply active learning techniques which, in turn, led to greater satisfaction.

Student and faculty comments painted a full picture of the interdependence and interplay between the learning studios and the successful use of active learning strategies. The faculty described how access to the learning studios enabled them to use active learning strategies more easily and more successfully than had been possible in the traditional classrooms, and to implement new active learning strategies not available to them in the classrooms. The students clearly enjoyed, and saw themselves benefiting from, the expanded use of active learning techniques. Both changes contributed to the increase in satisfaction. This study, however, is not able to distinguish between the learning studio effect and an active learning effect; it is not possible to determine how much of the increased satisfaction is due to the learning studios and how much arises from the active learning that is going on within those surroundings. Further study to separate the two effects and measure their relative influence is warranted.

Implications

The greater satisfaction experienced by the students and faculty with the learning studios versus the traditional classrooms is likely to result in a greater demand for learning studios. Evidence of heightened expectations and demand was already present in the faculty and student interviews, and is currently being reported anecdotally. The success of the learning studios in increasing student and faculty satisfaction presents the college administration with the dilemma of continuing or not the relatively expensive conversion of traditional classrooms into learning studios. The decision is made more challenging by the lack of clear quantitative evidence of improved student achievement or success.

With the increased satisfaction that the faculty find in teaching in the learning studios, there is likely to be increased demand for faculty training in order to gain access to the learning studios – studio training has been a prerequisite for faculty access to the studios – and for further training in order to enhance faculty

exploitation of and satisfaction with the studio teaching experience. Interviews indicated that the students too perceived some additional benefits to increased training for the faculty. Any plans for additional training should recognize the differing needs of two distinct groups within faculty: faculty who are new to the studios and who would require training in the use of learning studios and in teaching strategies for them, and the studio-seasoned faculty who would benefit from further training in the use of the technology and advanced training in teaching strategies.

The design of the learning studios will need to be reviewed and revised. A number of irritants and shortcomings were identified by studio users. A teacher's podium – distinct from a technology control panel – at the "front of the room" should be reviewed for possible removal. Less disruptive entry controls would be beneficial. A robust and fully capable IT infrastructure is essential. And, with the growing flow of mobile devices into all learning spaces, the provision of power supplies and complementary technologies becomes important.

Conclusions

This study undertook a quantitative and qualitative examination of student achievement, student success, student satisfaction and faculty satisfaction in learning studios in order to determine if there were gains in these performance measures attributable to the learning studios.

Although there were some general indications, no clear, statistically significant quantitative evidence of greater student achievement or success in the learning studios was found. There was, however, broad, significant and consistent evidence of increased student and faculty satisfaction with the learning and teaching experience in the learning studios relative to the traditional classroom. The increased satisfaction for both parties arose from the more comfortable settings, enhanced group and teamwork, a flattened power structure, and an increase in active learning teaching strategies.

The use of active learning strategies appears to be particularly central to the greater satisfaction in the learning studios. The role of active learning and the interrelationship and interdependence of the learning studios and active learning were beyond the scope of this study, but may well be worth further investigation.

The learning studios clearly contributed to increased student satisfaction with their learning experience. Faculty found greater teaching satisfaction in the learning studios. After the learning studio experience, both students and teachers expected and looked forward to more classes in learning studios instead of traditional classrooms. The success of the learning studio initiative will inevitably lead to greater expectations of and pressures on the institution to direct additional resources into the provision of more learning studios.

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