Evaluating the Outcomes of a Peer-Mentoring Program for Transitioning Postsecondary Students

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Abstract

A peer-mentoring program was initiated in 2003 for students in an introductory biology course at a university in Ontario, Canada. Students could attend up to 5 peer-mentoring sessions during the 12-week fall semester. Quantitative-survey, participation, and academic data spanning 5 years were reviewed for the purpose of evaluating the program. An objectives-oriented approach was used to determine if the program was meeting its goals to improve students' introductory biology grades, facilitate transitioning experiences, and encourage students to pursue studies in biology. Data analysis revealed characteristics of participants and showed that students who participated in the program felt that it was a valuable experience. Students attending 3 or more sessions performed significantly better in their introductory biology courses than those attending fewer sessions. There were no indications that the peer-mentoring program had any impact on students' perceptions of transitioning to university or on their program selection preferences. Recommendations are made to improve the peer-mentoring program to better align its components and objectives.

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CHAPTER ONE: INTRODUCTION TO THE STUDY

In this research study, I utilized a group comparison design to evaluate a peer-mentoring program that was offered to all students registered in the first introductory level biology course at a university in southern Ontario, Canada. This program was initiated in 2003 with the overall goal to support students academically and socially as they transitioned from high school to university.

Within an objectives-oriented evaluation framework (Fitzpatrick, Sanders, & Worthen, 2004), this program was evaluated in light of its objectives to determine whether students who attended the peer-mentoring sessions regularly achieved higher grades in the 1st-year biology course, were more positive about their 1st-year transitioning experiences, and were more likely to select biology as a major than those students who did not participate in the biology peer-mentoring program.

In an effort to determine the value of the biology peer-mentoring program, the program was evaluated based on its attainment of the program's explicit and implicit objectives. Using and analyzing data that had been previously collected through academic records, attendance records, and end-of-semester surveys, I was able to determine whether the biology peer-mentoring program met its objectives. These quantitative data sets allowed me to use various statistical tests to determine whether there were differences between the participating and nonparticipating students in terms of their characteristics, academic achievement, ease of transitioning, and program selection.

Background of the Problem

During the summer of 2003, a new program was developed within the biology department at a university in southern Ontario, Canada. This university offers a broad

range of undergraduate and graduate studies, as well as research and medical programs. The peer-mentoring program was designed as an upper-level university credit course and was offered to 3rd- and 4th-year students interested in gaining leadership, teaching, and mentoring experience. It was developed with the goal of helping 1st-year students to transition from high school to university and to succeed in their introductory biology courses. The program was implemented in the fall of 2003, the year of the double-cohort. Due to a change in the Ontario curriculum that affected the total number of years of secondary education, one cohort of students entered university after the completion of Ontario Academic Credits (i.e., OAC., or Grade 13) under the old curriculum, while a second cohort of students entered university after completion of Grade 12 under the new curriculum. The second cohort students were typically a year younger than the Grade 13 cohort. Many questions were raised within the department as to whether students had the support needed for a successful transition from high school to university, especially the younger students.

The university did not have a support system in place that was available to all 1st-year students. As such, the biology department supported an initiative to create a mentoring program that was available to all students who enrolled in the introductory level biology course. The majority of 1st-year science students are required or elect to enroll in each of the two introductory biology courses.

All 1st-year biology students were placed in tutorial sections by the registrar's scheduling system. During these scheduled tutorial times, upper-year students who had recently taken the 1st-year biology courses acted as peer mentors and facilitated group peer-mentoring sessions. During these sessions, the 1st-year students discussed study

strategies, transitioning issues, and course-related material under the facilitation of the peer mentor. At the end of each semester, electronic surveys were available for students to complete through their course-specific learning management system, WebCT. Students were offered 0.5% participation marks to complete all of the surveys that were available. One of these surveys included questions that were used for the purpose of this thesis. Although data were collected from these surveys at the end of every fall semester from 2003 to 2007, along with participatory records and academic records from each of these years, there had not been any analysis of the data that related to the peer-mentoring program.

Statement of the Problem Situation

This study was performed primarily for professional reasons. The peer-mentoring program instituted within the university's department of biology in 2003 had never been evaluated. It was assumed by some to have great benefits for the students, while others within the department viewed it as unnecessary and without much value. These assumptions were not based on any empirical data, even though quantitative data had been collected. Each semester, I created survey questions and administered them to students electronically with the intention of reviewing the data and proposing improvements to the program. The early questions asked of the students were designed haphazardly at a time when I knew very little about program evaluation and educational research. Between 2003 and 2007, I added new questions, revised some questions, and continued to collect data from students, some years anonymously and other years with names attached. This resulted in very large and overwhelming sets of data that remained unanalyzed. The only analysis prior to this study included tallies of how many students

responded to each survey, and in some more ambitious years, what percentage of students selected the available answer options. Thus, since the program's inception, it had never been formally evaluated and it was unknown whether this program was having any effect on transitioning, program selection, or academic outcomes. Prior to pursuing my Master of Education degree, I was not clear on how these data should be analyzed.

After conducting a literature search, I realized that this university's biology peer-mentoring program was unique in several ways. Most notably, it had data that dated back 5 years, and thus could be investigated throughout its existence to some degree. Early data collections were limited, but each year the data collected became more detailed and thorough. My literature search did not reveal any similar programs that had this many years of data available to analyze.

Further, this particular program appeared to be unique with respect to its size. Its enrollment was extensive and included between 1,200 and 1,400 students annually over the course of 5 years, providing a sample size of over 7,000 participants. Unlike most program evaluations examined in the literature, this particular program seemed to be rare in that it was not limited to any particular gender or ethnic group, or to a group of at-risk students. All students who enrolled in the introductory biology course were enrolled in the mentoring program and were assigned a peer mentor. They were told that their participation was optional and that they could choose to participate (or not) at any point during the semester. Attendance was recorded for each individual. Each individual who attended three or more sessions with their assigned peer mentor had the opportunity to complete a peer-mentor evaluation at the end of the semester. Completion of this restricted survey, along with seven other surveys that were not restricted on the basis of

attendance, contributed to 0.5% of the final grade. The survey data required for this research were contained within an unrestricted survey to which every student had access.

Theoretical Framework

The goal-based model or objectives-oriented approach to program evaluation was conceptualized and popularized in the mid-1900s by Ralph Tyler when he directed a large educational study involving 30 secondary schools and 300 colleges and universities in the United States (Fitzpatrick et al., 2004). According to Tyler, evaluation is a process of determining the extent to which a program's objectives are attained. Thus, to evaluate a program, the program evaluators must be clear on what the program objectives are and how they can be measured. Data are then collected that will help to determine whether each objective is attained and then to justify improvements, maintenance, or termination of the program. The simplicity and practicality of this approach has allowed it to dominate the thinking and development of evaluation, since the 1930s (Luo & Dappen, 2005; Madeus & Stufflebeam, 1989).

The objectives-oriented approach provided a simple and practical way with which I could evaluate the biology peer-mentoring program at this university and judge to what extent the biology peer-mentoring program had met its objectives.

Purpose of the Study, Questions, and Hypotheses

The purpose of this study was to evaluate the biology peer-mentoring program using an objectives-oriented approach to determine whether the program has value and should be continued as is, continued with improvements, or terminated.

As such, knowing the program's objectives was imperative to generating appropriate research questions. In consulting with the initial program developers and

with the staff and faculty that were involved in delivering the peer-mentoring program, I was able to determine that the initial goal was to aid students, especially the younger of the two cohorts, in their transition from high school to university. Other implicit goals of the peer-mentoring program included a hope that it would help 1st-year students achieve academic success in their 1st-year biology courses and that it would encourage students to pursue further studies in the area of biology beyond their initial year of studies.

With these objectives in mind, I reviewed the questions that were asked of the students over the past 5 years through the use of end-of-semester questionnaires to determine whether it would be possible to evaluate the program against its objectives. Indeed, many of the questions provided data that were used to evaluate the objectives of the program.

The existing survey data, along with academic and participation records, could be used to answer the following questions that guided the focus of this evaluation study:

1. What were the characteristics of students (gender, living arrangements, year of study, expected grade, and high school preparation) who chose to participate in the biology peer-mentoring program?
2. Did students who participated in the biology peer-mentoring program achieve higher academic success in the 1st-year biology course than students who participated less in the program? If so, were there any relationships between attendance and academic achievement?
3. Did the high-attendance participants differ in their perceptions of transitioning from high school to university as compared to students who participated less frequently?

4. Were high-attendance students more likely to select biology programs of study for their second and upper years of university education than students who participated less frequently?

I anticipated that this study would help to elucidate some of the characteristics of students who opted to participate in the mentoring program (research question 1). I hypothesized that those students who participated in the peer-mentoring program would have higher grades in the 1st-year biology course (research question 2), be more positive about their 1st-year transitioning experiences (research question 3), and be more likely to select biology as a major (research question 4) than those students who participated in the biology peer-mentoring program less frequently.

Importance of the Study

I was interested in evaluating this program because I was involved in creating the program at a time when I had no formal training or understanding of curriculum design, transitioning issues, or mentoring. Many courses and programs at the postsecondary level are designed by individuals with expertise in the content but not in teaching or educational practices. This research will provide to faculty and administrators within my department an example of how to evaluate a program using methods and methodologies accepted in the field of education.

Furthermore, this research may be important to other departments, faculties, and postsecondary institutions that are considering implementing mentoring programs or other programs that aim to increase student achievement and help students transition to postsecondary studies. This thesis applied the standard practices of program evaluation outlined by Fitzpatrick et al. (2004) to a very specific mentoring program that was

offered to approximately 1,400 students on an annual basis. In conducting this study, one of the goals was to identify some of the factors that influence a student's choice to participate in an optional program.

Scope and Limitations of the Study

One limitation of this study involved my sample and its lack of randomly assigned control or comparison groups. I would have liked to randomly assign students into two groups: one group comprised of students who would have had access to the biology peer-mentoring program but not to the regular university tutoring services, and a second group encompassing students who would have had access to the university tutoring services but not to the biology peer-mentoring program. However, this would have been ethically inappropriate. Consequently, all students had access to both programs.

Furthermore, students self-selected into groups based on the extent to which they chose to participate in the biology peer-mentoring program. Therefore, it is possible that the differences I found between the groups were not caused by the mentoring program, but rather by differences in the participants. For example, if the high-attendance group achieved higher grades than the lower attendance groups, I would need to determine if students in the former group were harder workers and higher achievers—and were therefore more likely to choose to participate in the mentoring program—or if the grade differences were truly a result of the mentoring program. This study was not able to definitively indicate whether the peer-mentoring program was the true cause of any identifiable differences between the groups.

The instruments that were used to collect data were not tested for reliability or validity. Thus, results of the data analysis may not be completely accurate. However, the purpose of this study was to perform a program evaluation and suggest methods of improving the program. Recommendations involve modifications to the survey instrument in order to improve its psychometric properties.

Finally, one may question whether this study is indeed research or merely an evaluation. The intent of the evaluation helps determine whether the evaluation is also research. If the main intent is to help the program staff better understand the outcome(s) of the program so they may improve the program in the next cycle or decide whether to continue to fund the program, Boulmetis and Dutwin (2005) suggest that this is evaluation and not research. They suggest that an investigator is probably doing research if the main "target audience is the sponsor or members of the professional field who want insight into how they [could] improve practice across similar programs or promote this process to other programs" (p. 138). The intent of this study was certainly to improve the program and make decisions on whether to continue to fund the program; however, it went further. I expected that members of the professional field as well as members from other departments and universities might gain insight into how to evaluate similar programs and how to improve practices within similar programs. Furthermore, I hoped that the results from this study would allow others to decide whether the benefits of this peer-mentoring program could likely support similar program implementation initiatives within their own departments, faculties, or institutions. Therefore, this study should be considered both evaluation and research.

Summary

This study aimed to evaluate the biology peer-mentoring program, which had been in operation for 5 years. Data were collected from students each year, with more extensive data being collected from the most recent years. However, my knowledge of how to best analyze the data in order to evaluate the biology peer-mentoring program was lacking prior to my studies in the field of education, and consequently the data remained largely unanalyzed between 2003 and 2007. To determine whether the program was meeting its objectives, I employed an objectives-oriented approach to evaluation. I reviewed data that had the potential to answer the question of whether the program was meeting its objectives. Before discussing further details of the methods (in chapter 3), the following chapter presents a review of the literature to provide some background information on the purposes and benefits of mentoring programs in academia.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

In this chapter, I summarize the findings from my literature search on the topic of mentoring programs designed to aid students at the undergraduate level, with an emphasis on students transitioning to university from high school. My search method is explained, followed by a summary of the current trends related to university students and an explanation of why institutional support is needed during transitioning periods. Mentoring is one type of program that can help students to transition, but before current issues and examples of mentoring programs are explored, I discuss the problematic outcome of an inconsistent definition of what mentoring actually is and what it encompasses. Peer-mentoring and other types of mentoring relationships are discussed, with special attention to the variety of mentor-to-protégé ratios and relationships in existence in current educational mentoring programs. I review and critique several mentoring programs that have been implemented for students transitioning from high school to university or college and then discuss the evaluative efforts and survey methods used for determining whether those mentoring programs are successful.

Parameters of the Literature Search

For this review of related literature, I searched through the following databases: Educational Resources Information Center (ERIC—the United States national bibliographic database of education literature); Education Research Complete (ERC); Education: A SAGE Full-Text Collection (which includes 26 full-text peer-reviewed journals published by SAGE); Educational Administration Abstracts (which includes journal articles related to the administration of primary, secondary, and postsecondary

educational facilities and programs); and CBCA Complete (which indexes Canadian journals, magazines, and newspapers).

My search parameters included (in varying combinations with various suffixes) the following terms: peer-mentor, mentor, peer-learn, academia, postsecondary, undergraduate, university, college, transition, survey, electronic, and program evaluation. I found that I was more successful in locating useful articles if these search terms were entered into the abstract and/or title search fields rather than the keyword search field. These literature searches provided me with many articles that I subsequently used to generate new searches by author. During these database searches, I came across an article in *Mentoring and Tutoring*. The title of this journal seemed very pertinent, so I browsed through all of the recent issues of *Mentoring and Tutoring* directly at the publisher's web site, looking for articles pertaining to peer-mentoring or peer-learning programs offered to undergraduate students.

Some article titles were misleading; upon reading the articles, I found that they were neither related nor useful in my review of the literature. Such articles were excluded from this review. Other articles were excluded if the mentoring program was not aimed to provide support for students or if the mentoring program did not include an academic component (e.g., programs designed to aid students as they transition from university to the workforce). After carefully reading and selecting the relevant and related literature from my initial search, I grouped the remaining 21 articles and books into themes and prepared an annotated bibliography that formed the basis of this review. My working list of relevant publications and literature broadened as I followed reference trails and identified gaps during the preparations of my annotated bibliography and the

preparation of my draft of this chapter. Thus, the literature search process continued through to the end of the writing stage. In the end, I included 63 articles and books that were grouped into the following major themes: (a) Student trends in postsecondary education, (b) the need for institutional support during transitioning periods, (c) definition of mentoring, (d) types of mentoring relationships, and (e) evaluation of mentoring programs.

While writing the literature review section, I realized that I needed to include some background on the topic of biology education at the undergraduate level. I performed an additional literature search using the same databases mentioned previously, but in the end found more relevant publications by starting with the Association of Universities and Colleges of Canada's [AUCC's] list of educational research and subsequently following reference trails.

Student Trends in Postsecondary Education

Postsecondary education is a broad term that has been used interchangeably with college and university education in the literature. To provide some clarification, the term *college* refers to different levels of studies in different countries. In Canada, college is used to describe postsecondary institutions that offer diploma-based programs, often referred to as a community college in the United States. An institution that offers degree-based programs is called a university in Canada, but a college in the United States. The term *university* is sometimes used in American literature to refer to educational institutions that offer graduate level (master's and doctorate) degrees. Astin's (1977, 1993) research on the American college student has been extensive. After collecting 30 years of survey data from 1st-year college students, Astin (1998) prepared a report on the

trends of the changing college student—changes he felt were precipitated by the women's movement. More women are aspiring to pursue graduate studies and obtain graduate degrees, and gender differences in traditionally male-dominated careers are narrowing and, in some cases, have been eliminated. Astin also reported on overall trends towards materialism and stress, and away from studying and developing philosophies of life. Knowing what motivates students, what students believe, and what goals they bring with them will allow curriculum and program designers to create instructional strategies that appeal to students, encourage students to learn and study, and help students succeed at their academic endeavours. Since Astin's (1993, 1998) findings were published, many universities and colleges have developed or improved their support services available to students transitioning from high school.

In his research on college students, Astin (1993) reported the results of a survey involving more than 200 institutions, 20,000 students, and 25,000 faculty members. This study (a) discussed how students change and develop in college; (b) revealed how college can enhance that development; and (c) showed how academic programs, faculty, and student peer groups can affect students' college experiences. Astin found that a student's peer group is the single most important source of influence on growth and development during the undergraduate years, more so than faculty or parents. Similarly, Kuh (1995) found that students' gains in cognitive complexity (e.g., reflective thought and knowledge application) were attributed approximately equally to peers and academic activities.

Astin (1993) also reported that a student's academic outcomes (retention, graduation with honours, enrollment in graduate school, and achievement on standardized knowledge tests) are positively correlated with the number of hours spent studying per

week. Students' values, beliefs, and aspirations tend to change in the direction of the dominant values, beliefs, and aspirations of the peer group. Astin spoke of a peer group being a collection of individuals with whom a student identifies and affiliates and from whom a student seeks acceptance or approval. Next to the peer group, the faculty represent the most significant aspect of students' undergraduate development. Dennis, Phinney, and Chuateco (2005) surveyed self-identified ethnic minority first-generation students and found that, as Astin suggested, perceived support from peers was a much stronger predictor of academic success (i.e., strong grades and adjustment) than support from the family. Other more recent research has further suggested strong links between peer relationships and adjustment outcomes (Clossen & Henry, 2008; Swenson, Nordstrom, & Hiester, 2008).

Given the important role of peers in postsecondary education, it stands to reason that a peer-mentoring program, especially a group peer-mentoring program, would help a student meet other individuals in a similar situation with whom the student might identify. A student's peer mentor might also provide a less intimidating link to faculty, as peer mentors are often student representatives of the faculty or department.

Scientific and Biology Education in Postsecondary Studies

Research in biology is rapidly changing and advancing with powerful new innovations in technology. The recent discoveries in DNA genomics have elucidated recurrent motifs and mechanisms that are strengthening an appreciation for the fundamental unity of life (National Research Council [NRC], 2002). The distinction between the physical and biological sciences is blurring and research in the field is becoming more interdisciplinary as processes and systems are studied at higher levels of

complexity, and as methods of communication and interaction are increasingly becoming more advanced. Although multidisciplinary projects are seemingly the future of scientific research and communication, scientific education largely lacks this emphasis. Interdisciplinary education is rare at the graduate level and is even less common at the undergraduate level; thus in recent years, science educators in all disciplines of science across all levels are being urged to adopt active-learning strategies that promote interdisciplinary learning in place of the traditional lecture-based approach to teaching (Allen & Tanner, 2005; Morse & Jutras, 2008; NRC, 2002, 2003).

Why has this call for active-learning approaches not spread widely and quickly through the postsecondary education system? The lecture is likely the oldest teaching method and has survived the invention of print, television, computers, and Internet (McKeachie, 2002). The lecture emphasizes transmission of knowledge from the lecturer to the students in such a way that the goal for the students is to know, by memorization and recall, the content that is covered. This knowledge is assessed, especially in large classes, by means of summative term tests and exams, often with a multitude of selected response questions (McKeachie, 2002; NRC, 2002; Tanner & Allen, 2003, 2004). In fact, when large-class instructors rely solely on traditional forms of instruction, "the individuals learning the most in this classroom are the professors. They have reserved for themselves the very conditions that promote learning: actively seeking new information, organizing it in a meaningful way, and having the chance to explain it to others" (Huba & Freed, 2000, p. 3). Although it is not impossible in larger classes, other approaches to instruction are easier to implement in smaller classes. For example, inquiry-based approaches designed and developed in small-class settings offer much promise for

implementing active learning in postsecondary classrooms (Allen & Tanner, 2005). Instructors find it more difficult to implement such strategies in the large classes that are predominant in introductory course options in higher education.

Increasingly larger class sizes seem to be the trend, especially as Canadian universities are currently serving more than 1.5 million full- and part-time students (AUCC, 2007). In Canadian universities, while faculty employment and student enrollment rates have been rising (18% and 56% growth, respectively, between 1987 and 2006), the funding per student has dropped from $21,000 in the early 1980s to $15,000 in 2006-2007 (AUCC, 2007, 2008). These conditions, which support the need for large-enrollment classes, are unlikely to change in the foreseeable future, and thus large classes are likely here to stay (Allen & Tanner, 2005).

Several publications urge science professors to change their style of teaching, and lately there have been some suggestions in the literature about how to go about doing this with large classes. Suggestions have included assigning students the task of creating concept maps for each module in the course (Morse & Jutras, 2008); developing hierarchical biology concept frameworks (Khodor, Halme, & Walker, 2004); using technology, such as clickers, to engage the students in lecture (Allen & Tanner, 2005); and requiring students to apply new evidence to their preconceptions to either build on or counter these preconceptions (Tanner & Allen, 2003). Slowly, this educational reform is being realized by science educators, but the traditional large-enrollment lecture is still the most common type of teaching that students will experience when students begin their university education in Canada.

Need for Institutional Support During Transitioning Periods

An educational institution's efforts and services must venture beyond knowledge transmission and lecturing in order for its students to learn effectively and to succeed in postsecondary studies. Levine (2007) examined the essential thinking skills and habits that students need to be successful in postsecondary education and beyond. His findings suggest that the ability to become an in-depth comprehender (interpretation), to acquire a project mentality (instrumentation), to build and sustain productive fulfilling relationships (interaction), and to attain malleable self-insights that inform self-launching (inner direction) are the four key attributes that are needed for success. The primary teaching focus at the university level is on instruction and knowledge transmission through the traditional lecture environment (Barr & Tagg, 1995) where essential thinking skills and habits are not typically developed. Having the skills for higher-level thinking may not be sufficient for academic success. Both the student's support network and his or her ability to adapt to new learning and social environments have an impact on the student's persistence to graduation. Institutions are recognizing this and responding by implementing various support services, collaborative learning environments, and transition programs. Thus, the mission of higher education institutions is slowly changing from one that provides instruction to one that produces learning (Barr & Tagg, 1995).

Support Services

Support services offered within postsecondary institutions include formal mentoring programs that have been designed and developed to positively influence ease of transition, academic achievement, and student retention (Astin, 1993; Budge, 2006; Jacobi, 1991; Tinto, 1987; Tremblay & Rodger, 2003). Transitioning from high school to

university can be difficult for students. Many factors are involved in predicting the academic success of students entering university. As suggested by Astin (1993), the ability of a student to meet academic standards is not the only factor that affects student success. According to Salinitri (2005), other factors include the ability to adapt to new social situations, peer pressures, financial pressures, and different teaching styles. Skills, such as time management and organization, are large factors in transitioning successfully to university.

Collaborative Learning Opportunities

In trying to answer whether and what type of learning programs make a difference in student learning and persistence to graduation, Tinto (1995) found that students involved in community and collaborative learning programs, where students learn with and from their peers, were involved in a wider range of learning activities, learned more, and persisted at a higher rate than did similar students in more traditional learning settings. In being part of such shared learning experiences, the students found academic and social support for their learning among their peers and they became more actively engaged in their learning.

It is clear then, that academic ability is not the only factor that predicts academic success at the postsecondary level. Social and academic support from peers is repeatedly reported in the literature as desired by and beneficial to students. The development of essential thinking skills and habits (Levine, 2007), as well as involvement in shared learning experiences (Tinto, 1995) are instrumental in easing the difficulties of transitioning to postsecondary education and increasing the likelihood of a student persisting to graduation.

Transition Programs in Postsecondary Education

Several other studies have indicated the need for social support programs to facilitate the transition process from high school to university (Lamothe et al., 1995; Pratt et al., 2000; Wintre & Bowers, 2007). Many universities are now including programs to aid students in transitioning to university (Tremblay & Rodger, 2003) and to aid students in acquiring some of the key attributes described by Levine (2007). Summer preparation programs (see Hicks, 2005; Walpole et al., 2008) and mentoring programs exist at postsecondary institutions to help facilitate transition and adjustment to university life and improve retention rates. Researchers are now realizing that academic advising, orientations, tutoring, skills development, 1st-year experience courses, and mentoring are critical components of successful first-year experience (FYE) programs. These programs have been provided, formally and informally, on an optional or required basis and for the purpose of imparting knowledge and experience to students transitioning to postsecondary studies (Gelb, 2007; VanderStoep & Pintrich, 2008).

Definition of Mentoring

Throughout the review of the literature, it became very apparent that a significant issue existed with the terminology used to describe mentoring programs. A general lack of consistency and lack of agreement on what constitutes a mentoring program is evident in the literature.

Lack of Consistency

Mentoring, and especially peer mentoring, is not well defined in the literature. Jacobi's (1991) report on her literature review found that the term *mentor* was used inconsistently in the literature. Fifteen years later, and much more recently, Budge

(2006) reviewed the literature to provide insight into the different types of mentoring programs. Through her review of 40 published articles describing mentoring and peer-mentoring programs both outside and within postsecondary educational institutions, Budge identified that there are many different definitions of the term mentoring. She agreed with Jacobi that one of the most apparent problems within the literature was the lack of consistency in defining mentoring among organizations and educational institutions that design mentoring programs. Budge's literature search provided eight different definitions of mentoring:

> (1) a more advanced or experienced individual guiding a less experienced individual; (2) an older individual guiding a younger individual; (3) a faculty member guiding a student; (4) an individual providing academic advising; (5) an individual who shares their experience with another individual; (6) an individual who actively interacts with another individual; (7) an experienced individual guiding a group of individuals; and (8) an experienced, older individual who guides a younger, less experienced individual via internet resources. (p. 79)

Crisp and Cruz (2009) have most recently reviewed the current literature focusing on mentoring literature as it related to the "college student." In their analysis of 94 theoretical essays and empirical studies, they also found that very few authors included an operational definition of mentoring. This absence of an operational definition undermines the validity of research (Crisp & Cruz, 2009; Jacobi, 1991). If one mentoring program uses the definition that mentoring involves simply an individual who actively interacts with another individual while another mentoring program is based on the idea that mentoring involves an experienced, older individual who guides a younger, less

experienced individual via internet resources, the outcomes of the research that attempts to evaluate these programs will not likely be comparable nor useful to other programs that use a different definition of mentoring.

Age Issues

From these definitions, age appears to be a relatively important factor in the establishment of a mentoring relationship, in that the mentor is often expected to be the older individual. However, I feel that age differences are irrelevant when it comes to establishing who acts as the mentor and who acts as the protégé. The important factor is that the mentor has some further expertise in a particular area and can provide support in some way to a less-experienced individual. For example, it is reasonable to imagine a scenario where a young individual would have more current knowledge and experience in the field of information and communication technologies and thus be more likely to act as a mentor to an older individual in this rapidly advancing field. The older individual may be more experienced in another area, and therefore a reciprocal and helping relationship can be formed between the two individuals, where age really becomes irrelevant. In higher education, age differences are often minimal or nonexistent, especially when one student acts as a mentor to another student.

Components of Mentoring

Most of these definitions suggest that mentoring involves a mentor who offers guidance, support, training, teaching, coaching, counselling, or interaction with a person or student (or a group of people or students); however with such a broad array of components within these definitions, problems may arise again.

Does it matter whether one mentoring program offers guidance, while another offers counselling, and a third offers teaching? There is no literature that indicates differences between programs that provide guidance versus counselling, but there is evidence that differentiates programs on the basis of the type of support that is offered. Kram and Isabella (1985) grouped the types of support into two main functions of mentoring: a task- or career-related function (providing advice, support, and information related to task accomplishment) and a psychosocial function (providing emotional and psychological support). Jacobi (1991) agrees that mentoring relationships are helping, reciprocal, and personal relationships that include any or all of (a) emotional and psychological support; (b) direct assistance with career, academic, and professional development; and (c) role modeling. More recently, Nora and Crisp (2007) cited evidence that effective mentoring programs could provide (a) psychological and emotional support, (b) degree and career support, (c) academic subject knowledge support, and (d) role modeling. Crisp (2009) further provided an instrument to measure the developmental support functions that should be provided to students.

Regardless of what the mentors provide, relative to their protégés, mentors show greater experience, influence, and achievement within a particular organization or environment. However, some programs employ the concept of peer mentoring. Although peer mentors will show greater experience and achievement than their protégés, the difference in experience and achievement levels are usually less pronounced. Peer teaching or peer tutoring, as opposed to peer mentoring, is an instrumental strategy in which advanced students, or those in later years, take on limited instructional roles (Boud, 2001). Boud's definition of peer teaching (or peer tutoring) could quite easily fit

into some of Budge's (2006) eight definitions of mentoring. *Mentoring* might thus be an umbrella term that encompasses more specific types of mentoring relationships, some of which might be based on academics, careers, emotional well-being, talent, or any other issue or combination of issues. In fact, mentoring has taken place throughout history, as evidenced through many biographies of famous artists, musicians, scientists, philosophers, and scholars who have played a key role in shaping their protégés' destinies (Ehrich, Hansford, & Tennent, 2004), suggesting that mentoring is indeed a broad term that encompasses many specific types of mentoring relationships.

Labels and Definitions Used in This Thesis

Labelling is another issue in that it relates to the terminology used to describe not only the mentoring program, but also the people involved in the mentoring relationship. The label used to identify the less-experienced member in the mentoring relationship varies from author to author, but the most consistent terms used are *protégé*, *mentee*, and *student*. I personally dislike the term mentee as I find it provides connotations about an individual's mental status or capabilities. As such, I will subsequently refer to the less-experienced member of a mentoring relationship as a protégé or, in the case that the protégé is also a student at an academic institution, a student. Although the mentor or peer mentor may also be a student in the same academic institution, I will refer to these individuals as mentors or peer mentors rather than students, so as not to confuse them with the students who are also protégés.

Further, and for the purposes of my thesis, I have defined mentoring as an umbrella term that describes a relationship between two or more people whereby one individual takes on a role to provide guidance, instruction, and support to less-

experienced individuals. I thus defined peer mentoring within the academic realm as a relationship between two or more students whereby one student, only slightly more experienced, takes on a mentor role and provides guidance, instruction, and support to another less-experienced student or group of students.

Types of Mentoring Relationships

Many varieties of mentoring relationships exist. These relationships can vary in how traditionally and how formally they operate. There are also variations with respect to who is involved in the mentoring relationship and how many people are involved.

Traditional Versus Nontraditional

The traditional mentoring arrangement is an informal form of mentoring that involves one mentor and one protégé finding each other and agreeing to work together (Budge, 2006). A nontraditional mentoring arrangement is any mentoring relationship that deviates from this model.

Formal Versus Informal

Informal mentoring relationships are often entered into because one individual approaches another that he or she feels would be a good mentor. They may also be formed when a potential mentor initiates or approaches an individual who might benefit from having a mentor. On the other hand, and more recently, formal mentoring programs are being established in a variety of institutions and corporations, whereby the mentoring relationship is formalized and guided by some parameters. However, these parameters differ from one formal program to the next (Crisp & Cruz, 2009; Jacobi, 1991). Programs can differ in the amount of training provided for the mentor, or whether the mentor is trained at all. Some programs randomly assign mentors to protégés while

others allow the protégé to select the mentor. Other programs assign mentors through a matching process. Location and frequency of meetings are other common factors that vary significantly between programs.

Mentoring Versus Peer Mentoring

In addition to training provided to the mentor, there are further variations when considering the mentor's age, ability, and experience as compared to that of the protégé. The more traditional mentoring relationships involved a mentor who was typically much older and much more able or experienced at a particular task, trade, talent, or skill. In fact, many of the definitions identified by Budge (2006) indicated that by definition the mentor is someone who is substantially older and more experienced than the protégé. Some mentoring initiatives, especially in educational settings, are recruiting individuals to act as peer mentors. Peer mentors are typically selected not because of their age, but because they have very recently experienced a similar condition or transitioning event that some of their peers are about to encounter.

Mentor-to-Protégé Ratios

Mentoring relationships can be set up as group relationships whereby a group of protégés meets simultaneously with one mentor for support, guidance, and learning. A common group-mentoring setting in postsecondary education involves groups of 1st-year students who meet on a regular basis with an upper-year student facilitator or volunteer for the purpose of improving the experience and success of the 1st-year students (Gordon & Connor, 2001; Miller & Packham, 1999).

The question of whether students prefer a group or an individual environment when meeting with their mentor was addressed in a Hong Kong study. Mee-Lee and

Bush (2003) found that 1st-year university students assigned to a mentor (a staff or faculty member) in varying ratios preferred group mentoring to individual mentoring. This preference may have been based on the idea that faculty or staff members were perceived as intimidating, and thus students preferred a group environment, or potentially that students genuinely prefer a group environment. On the other hand, communities or collaborations that allowed for shared learning experiences within a group of students were not only preferred by students, but also beneficial to them (Tinto, 1995), thus the Hong Kong 1st-year students may have preferred a group environment for the learning potential.

Packard, Walsh, and Seindenberg (2004) introduced a twist on the idea of group mentoring by comparing dyadic mentoring relationships (one mentor – one protégé) with the idea of a networking mentor relationship (many mentors – one protégé). In this scenario, many mentors acted individually as a mentor to an individual protégé. Their survey results indicated that 1st-year college students were more likely to seek and experience mentoring in the form of a dyadic relationship with one mentor, often with a family member or a recent high-school teacher, while 4th-year college students were more likely to seek and experience mentoring in the form of a network of multiple mentors, which included college faculty, family, and peers. Both groups of students experienced psychosocial mentoring functions and sponsorship from mentors, but 4th-year students reported more challenge from their mentors than 1st-year students. Thus, sometime between 1st and 4th year, students appeared to have made a shift in their preferences from single to multiple mentors.

Mentoring relationships that involve multiple protégés with one mentor or multiple mentors with one protégé clearly show the idea of mentoring has changed and broadened from the traditional informal meetings of one mentor and one protégé.

Evaluation of Mentoring Programs in Postsecondary Education

The current political attitude towards educational accountability has sparked a standards-based reform whereby evaluation is used primarily to demonstrate accountability and to assist in making decisions about whether to continue, refine, or terminate a program (Levine, 2002). The literature indicates that there is little accountability demonstrated and the overall efficacy of mentoring programs remains questionable (Crisp & Cruz, 2009; Jacobi, 1991; Kahveci, Southerland, & Gilmer, 2006; Underhill, 2006).

Outcomes of Mentoring

A literature review of more than 350 research-based articles on the topic of mentoring in the fields of business (151 articles), medicine (82 articles), and education (159 articles) made inferences about the nature and outcomes of mentoring (Ehrich et al., 2004). These authors identified the most positive outcomes for mentors in the field of education to be collegiality, collaboration, networking, reflection, and professional development. Support, empathy, help with subject-specific knowledge, help with resources, discussions, and the ability to share ideas were the most positive outcomes for the protégés. They also noted that the institution benefited from the mentoring programs in the way of improved education, improved grades, improved attendance, and better behaviour from the students.

However, mentoring programs are not without their problems. The most common problematic outcome for the mentors and protégés reported in the literature is the lack of time dedicated to the program (Ehrich et al., 2004). Other issues identified included personality mismatches, lack of training or professional expertise, and added responsibilities or commitments. Common problems identified by institutions involved the management's lack of financial support to the mentoring program and lack of encouragement to participate in the program. Ehrich et al. concluded from their literature review that mentor training, support for the program, selection and matching of mentors and protégés, and program evaluations are essential components of effective mentoring programs.

In her meta-analysis of over 100 articles regarding mentoring adults in the workplace, Underhill (2006) found that the majority (65%) of the studies published were based solely on descriptive self-report survey results or solely on interviews. Only 22% of the studies used a comparison group and 4% used a quasi-experimental longitudinal (pretest-posttest) design. Kahveci et al. (2006) contended that the bulk of research on mentoring programs in undergraduate institutions is descriptive in nature and that there is scant comparative information about the relative impact of these programs. Salinitri (2005) agreed that, although implementation of mentoring programs in 1st-year university is in response to a national concern regarding decreasing rates of retention, further research is needed to evaluate national initiatives including mentoring programs.

To evaluate a mentoring program for low-achieving 1st-year students at the University of Windsor, Salinitri (2005) designed a study with an experimental group of 53 students and two comparison groups. One comparison group comprised students

enrolled in a skills-development credit course (University 101), while the other comparison group was not involved in any intervention program. She found that her mentoring program had a dramatically positive effect on retention, overall grade point average (GPA), major GPA, number of course credits obtained, and academic status. In another study, Kahveci et al. (2006) used a comparative pre/post test design to examine the effectiveness of a mentoring program in retaining undergraduate women in science, math, and engineering. The authors concluded that students who participated in the mentoring program were more likely to choose a major in science, math, or engineering than those students who did not participate in the mentoring program.

In the absence of comparison groups, multiple measures should be employed. Sengupta and Leung (2002) used mixed methods to evaluate a staff-developmental initiative in Hong Kong. Questionnaires, case studies, and interviews were conducted over a 2-year period to determine the impacts of a one-on-one mentoring program to assist faculty in English language learning. Likewise, McCormack and West (2006) judged their group mentoring program to be effective for university women through use of questionnaires, focus groups, and interviews.

Empirical studies using appropriate methodologies in the area of mentoring at the postsecondary level are scarce in the literature (Crisp & Cruz, 2009). However, the few studies that do exist seem to agree that mentoring has positive effects on retention and other academic achievement indicators. Further, although many of these studies have indicated that there is some positive effect on student achievement or academic success, it is questionable as to whether the mentoring program caused these effects. Instead, a third factor may be involved (perhaps the students' level of motivation) that is the causal

factor. It is interesting to note that recent literature reviews (Budge, 2006; Crisp & Cruz, 2009) have not identified any methodologically sound empirical studies that have reported positive effects on adjustment to university.

Program Evaluation

Course and program quality in higher education are most often evaluated through survey research by means of questionnaires that students complete (Husbands & Fosh, 1993; Mayes, 2001; Saroyan & Amundsen, 2001). With the widespread growth of information and communication technology (ICT) in university education, electronic versions of student questionnaires seem to be a logical next step in evaluating university courses or programs (Moss & Hendry, 2002). Further, with growing class sizes, electronic questionnaires have the potential of reducing the administrative burden, cost, and resources related to paper-based questionnaires (Moss & Hendry, 2002; Porter, 2004; Shannon & Bradshaw, 2002; Smither, Walker, & Yap, 2004). However, regardless of how the data are collected, an approach to program evaluation is required to lay the foundation of the evaluation.

The program evaluation model most often used is the goal-based model, also called the objective attainment model and objectives-oriented approach (Boulmetis & Dutwin, 2005). Tyler is credited with conceptualizing and popularizing the objectives-oriented approach to evaluation in the 1930s and 1940s when he directed a large educational study that spanned 8 years (Fitzpatrick et al., 2004). His model or approach requires the evaluator to first identify the purpose or goal of some activity or program and then focus the evaluation upon the extent to which those purposes or goals are achieved. Objective achievement is used as the method of judging the extent of success or failure of

the program. The practical purpose of this approach is to justify improvements, maintenance, and termination of a program. The simplicity and practicality of this approach have allowed it to dominate the thinking and development of evaluation since the 1930s (Luo & Dappen, 2005; Madeus & Stufflebeam, 1989).

Summary

This chapter summarized the literature that is related to the implementation and evaluation of mentoring programs in undergraduate education that are targeted to supporting students. Mentoring is one type of program that can help students transition, though reports in the literature on the effectiveness of these programs are scant. The uestion of how to best evaluate a program is not generally agreed upon; however, most program evaluations are based upon an objectives-oriented approach.

In this research study, I used an objectives-oriented approach to evaluate the biology peer-mentoring program and determined whether students who attended the mentoring sessions were different from their nonparticipating counterparts in terms of their 1st-year biology course grades, perceptions about their 1st-year transitioning experiences, and program selection preferences for their subsequent years of studies.

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CHAPTER THREE: METHODOLOGY AND PROCEDURES

In this study, I used an objectives-oriented approach to program evaluation. I primarily used a group comparison design when analyzing the available data. Where group differences were found to exist, further tests were used to determine whether relationships existed between the variables in question. The aim was to determine whether the biology peer-mentoring program was meeting its objectives. To do this, I reviewed data that had been collected through academic records, attendance records, and surveys administered to students at the end of each semester. These quantitative data allowed me to test whether there were any differences between students who participated in the peer-mentoring program at a low, average, or high level of attendance. I was specifically interested in whether differences existed between these groups in terms of academic achievement, ease of transitioning from high school to university, and 2nd-year program selection.

Research Design

The intent of this study was to evaluate a program by determining whether it has been meeting its goals for the program participants. Therefore, a group comparison design was utilized as the primary focus where the groups were defined based upon a student's level of participation in the peer-mentoring program. Ideally, the research design would have been set up in such a way that students were randomly assigned to participate in the biology peer-mentoring program, a control program, or no program at all, providing the foundations of a true experimental design. However, this was not feasible or ethically appropriate. Therefore, instead of trying to control for or manipulate these variables, my approach relied on group comparisons, similar to the comparisons

used for experimental designs, though without the randomization and control. The goal was to provide evidence for whether or not there were differences in academic achievement, reported ease of transition to university, or program selection between students who participated in the program at varying rates. The study, which had no intent to imply cause and effect, was evaluative in nature, framed within the objectives-oriented approach or goal-based model. The objectives of the biology peer-mentoring program formed the basis of my research questions. In answering my research questions, I thereby was also evaluating the program.

The methodology of this study was positivist in its approach and followed the scientific approach, with data being collected and analyzed objectively in a manner that could produce reproducible and verifiable results.

The data were exclusively quantitative. They came from three separate sources: (a) academic records that included term grades as well as assignment, quiz, test, and exam marks from students in the introductory biology course; (b) participation records that indicated how many peer-mentoring sessions each student attended throughout the semester; and (c) survey data that originated from questionnaires that used selected-response items as shown in Appendix A.

Site and Participant Selection

This research was conducted within the biology department at a university in southern Ontario. The university is a mid-sized university with approximately 20,000 full-time students.

Data had been collected from individuals who were enrolled in the 1st-year biology courses between 2003 and 2008. Approximately twelve- to sixteen-hundred 1st-

year students enroll in the introductory biology course annually. This represents over 95% of all 1st-year science students at the university.

Participants included all students who registered into the 1st introductory-level biology course offered in the fall semester of each year. This biology course is intended for science students and acts as a prerequisite course for many 2nd-year biology, chemistry, biochemistry, and psychology courses. The registrar's office scheduled all registered students into tutorial sections that ran every other week in 50-minute timeslots. This was in addition to students' lecture and lab section assignments. The tutorials were delivered as peer-mentoring sessions, facilitated by upper-year biology students acting as peer mentors. Trained peer mentors were instructed to permit up to 30 minutes of the session to facilitate learning activities that specifically applied to the lecture content of the introductory biology course. The remaining 20 minutes of each session was intended to help the students adjust to life at university through group social and learning activities that were not specific to the content of the introductory biology course. A total of five peer-mentoring sessions were available for each student to attend. Attendance in the peer-mentoring sessions was optional for the 1st-year students. Typically, between 60% and 75% of students attended three or more sessions during the course of one semester.

Note that the sample consisted of students enrolled in a course for which I was an instructional coordinator. Participation in the peer-mentoring program and surveys were optional to the students. It is thus important to be aware that results generated may not represent a population of all 1st-year postsecondary students or a population of all 1st-year science students.

To encourage participation, students were offered 0.5% of their final grade to participate in quizzes and surveys on WebCT. Including the questions (see Appendix A) within one of the available surveys for this participation grade likely generated a higher response rate than if these research questions were administered as an anonymous survey outside the parameters of the course.

Data Collection and Preparation

In this section, I briefly explain the methods that were previously used to collect data. However, because this research relied on the secondary use of data, the focus of this section is primarily on how these data were obtained and prepared.

Data Collection

Permission to use previously collected data was obtained from the chair of undergraduate studies in biology. Students were informed at the time that they began the questionnaires that their responses would (a) be kept confidential, (b) not be reviewed until after their grades were finalized and submitted to the registrar's office, and (c) hopefully help improve the 1st-year biology program and the peer-mentoring program. Research Ethics Board (REB) clearance (see Appendix B) was obtained from Brock University and subsequently through the university at which this research was conducted.

Data were collected at the end of each fall semester between 2003 and 2007. These data included students' academic records including their mid-term marks and final grades, students' attendance records indicating their participation in the peer-mentoring program, and survey responses.

During the 2007-2008 academic year, the academic and attendance records were collected from 1,474 students in the fall semester. Survey data were collected from 1,192

of 1,474 students (81%) enrolled in Biology 1A03. Questions relevant to this research varied from year to year. Seventeen questions (see Appendix A) from the 2007-2008 available survey data were selected on the basis that they related to one of the four research questions and comprised the survey data used for this study. The three sets of data were then linked and depersonalized. Academic, attendance, and survey data were collected and reviewed from previous years, dating back to the 2003-2004 academic year.

Preparing and Organizing the Data

Beginning with the 2007-2008 survey data, the data from each question on the survey were scored according to the scoring column shown in Appendix A. Most of the questions were treated as single-item scores. These included the questions for age, gender, living arrangements (on- or off-campus), year of study, expected grade (in the introductory biology course), location (of high-school studies), high-school grade, program preference for level II studies as of September, and program preference for level II studies as of December.

The letter grades used for expected grade and high-school grade were converted into a numeric value using a 12-point GPA scale where an F (0-49%) has a value of 0, D- (50-53%) is equal to 1, D (54-56%) is equal to 2, D+ (57-59%) is equal to 3, continuing up to 12 for A+ (90-100%) grades.

The four questions that pertained to assessing a student's ease of transitioning (Trans1, Trans2, Trans3, and Trans4) were scored on an individual single-item basis and then summed into a TransTotal variable that was used for analysis.

The five questions that pertained to assessing a student's perceived value of the peer-mentoring program (Value1, Value2, Value3, Value4, and Value5) were combined

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The four questions that pertained to assessing a student's ease of transitioning (Trans1, Trans2, Trans3, and Trans4) were scored on an individual single-item basis and then summed into a TransTotal variable that was used for analysis.

The five questions that pertained to assessing a student's perceived value of the peer-mentoring program (Value1, Value2, Value3, Value4, and Value5) were combined

to provide a summed score (ValueTotal). It was assumed that students who indicated that the peer-mentoring sessions should have been longer in duration found the sessions beneficial or valuable. These students were willing to spend more of their free time in the organized peer-mentoring program, indicating a positive perception of the program; thus, a higher value score was assigned. Additionally, the sessions were offered every other week. Students who indicated that tutorials should have been offered more often (once a week, as opposed to the semi-weekly system that was employed) were given a higher score, while responses that indicated the desire for less frequent sessions (once a month or only in the weeks that there was a test) or no sessions at all were given lower scores.

Academic records included midterm marks for the major assessment components of the course (Test 1, Test 2, and the final exam) as well as a final mark (ranging from a possible 0% to 100%) in the course.

Participation records included a checklist of attendance for each student at each possible mentoring session. Five mentoring sessions were scheduled; therefore, the maximum participation recorded for any individual was five and the minimum attendance was zero.

Prior to analysis, data were entered into the Statistical Package for the Social Sciences (SPSS, v17.0). The data were inspected and cleaned of scores that were outside the accepted range or otherwise indicated data entry errors. The database was examined for missing data. Respondents who skipped three or more questions were eliminated from the data analysis. A missing value was included for other nonresponses or "I don't

remember" responses. Data analysis was possible once the data had been organized, prepared, and input into SPSS.

The overall sample was described based on the factual variables that were analyzed. I calculated basic information (number of respondents, percentage of sample) for gender, living arrangements, program, year, and high school prep (location of high school studies). These variables all used categorical scales. I also calculated basic information for the rest of the categorical variables, including level II program preference (September vs. December), transitioning (1, 2, 3, and 4), and perceived value (1, 2, 3, 4, and 5). For each of the continuous interval variables (expected grade, high-school grade, term mark, exam mark, final mark, and participation), I calculated and described the measures of central tendency (mean, median, and mode), as well as measures of variability (range and standard deviation).

Data Analysis

Data were analysed to provide insight and answers to my four research questions:

1. What were the characteristics of students who chose to participate in the biology peer-mentoring program?
2. Did students who participated in the biology peer-mentoring program achieve higher academic success in the 1st-year biology course than students who participated less frequently in the program? If so, were there any relationships between attendance and academic achievement?
3. Did the high-attendance participants differ in their perceptions of transitioning from high school to university as compared to students who participated less frequently?

4. Were high-attendance students more likely to select biology programs of study for their second and upper years of university education than students who participated less frequently?

Before addressing the analyses associated with each of these four questions, I will first discuss the descriptive analysis conducted.

Characteristics of Participants

What were the characteristics of students who chose to participate in the biology peer-mentoring program? The null hypothesis was that there were no differences in terms of gender, living arrangements, year of study, expected grade, or high school preparation between the participation groups. Alternate hypotheses suggested that the participation groups were different in one or more of these variables. To test whether the null hypothesis was true, I used chi-square tests for nonnormally distributed data and ANOVA tests for normally distributed data to test whether the participation groups were significantly different from each other.

In these and all subsequent tests, the standard 0.05 alpha level was used to determine whether the null hypothesis would be rejected.

Participation and Academic Success

Did those students who participated in the biology peer-mentoring program achieve higher academic success in the 1st-year biology course compared to those students who participated less frequently in the program? If so, were there any relationships between attendance and academic achievement? The null hypothesis suggested that there were no differences in academic outcomes between any of the participation groups. The alternate hypothesis suggested that one group would have significantly higher grades than the other

group. To test whether the null hypothesis was true, I used one-way ANOVA tests to test whether the academic achievement means (on Test 1, Test 2, the exam, and the final mark) were significantly different between any of the participation groups. For these ANOVA tests, I used six participation groups, representing each of the possible attendance options (attendance in 0, 1, 2, 3, 4, or 5 sessions) to help determine the most appropriate method of grouping the attendance for further tests.

Scatter-plots, correlations, and simple linear regressions were subsequently performed to determine the extent of the relationship between attendance and final mark variables. A multiple regression was also employed to determine whether previous biology grades and current expected grades could reliably predict academic achievement.

Participation and Perceptions of Transitioning

Did the high-attendance participants differ in their perceptions of transitioning from high school to university as compared to average or low-attendance participants? The null hypothesis suggested that there were no differences in perceptions of transitioning between any of the participation groups. The alternate hypothesis suggested that students who participated in the peer-mentoring program had a different perception of how easily they transitioned compared to their peers who did not participate as fully in the peer-mentoring program. To test whether the null hypothesis was true, I used a Kruskal-Wallis and chi-square test to determine whether the nonnormally distributed mean scores for perceptions of transitioning were equal between the participation groups.

Participation and Program Selection

Were high-attendance students more likely to select biology programs of study for their second and upper years of university education than less frequent participants? The

null hypothesis stated that all students were equally likely to select 2nd-year biology programs, regardless of the extent to which they participated in the peer-mentoring program. The alternate hypothesis suggested that those students who participated fully in the peer-mentoring program were more likely to select a biology program for their second and upper years of study. To test whether the null hypothesis was true, I used a chi-square test to test whether one group preferred to select biology programs more so than other groups.

Overall, to answer my research questions, chi-square tests, ANOVA tests, Kruskal-Wallis tests, correlations, and regressions were used.

Ethical Considerations

Prior to commencing this study, approval (Appendix B) was sought and obtained from the Research Ethics Review Board (REB) at Brock University and subsequently through the university at which the research was conducted.

This study involved using data that were previously collected for the purpose of academic record-keeping as well as for curriculum and program improvement. For this study, the data were not only used for the purpose of program evaluation and improvement, but also for the purpose of a master's level thesis. Personal identifications were included in most of the data that were available for use in this study. This included all academic records, all attendance records, and some survey data. Most survey data were collected anonymously, but in the 2003 and 2007 fall semesters, the survey data were collected with personal identifiers so that survey responses could be linked to academic and attendance records. The most significant ethical issue related to this study involved the issue of informed consent. Students were not given the opportunity to

provide their consent for their data to be used in this study. Furthermore, it was not feasible to contact all participants (over 7,000) to ask for their consent to use their data. Thus, to protect the rights and privacy of the individuals from whom data have been collected, I worked with the data only after they were depersonalized. This required that for each semester, data available from the three sources (academic records, attendance records, and survey data that includes identifications) were first linked and then personal identifiers (including first name, last name, and student ID numbers) were deleted from the spreadsheet. This depersonalization was performed by the chair of biology undergraduate studies. To further protect the privacy of the participants, this study only reports on trends found in the data. It does not report on any one student's individual records or data, thus eliminating the chance that any student could be identified.

Summary

Using an objectives-oriented approach with a focus on group comparisons, I evaluated the biology peer-mentoring program. To determine whether the biology peer-mentoring program had been meeting its objectives, I analyzed data that had been collected through academic records, attendance records, and surveys administered to students at the end of each semester. These quantitative data allowed me to use various statistical tests to determine whether there were differences between the different participation groups in terms of academic achievement, ease of transitioning, and program selection. Where differences were found, further questions were investigated to determine whether the involved variables were indeed related.

CHAPTER FOUR: PRESENTATION OF RESULTS

This chapter provides details on the results emerging from the statistical analyses that I performed on the academic, attendance, and survey data available in an effort to be able to evaluate the biology peer-mentoring program. I begin this chapter with a description of the data that were available. Then, primarily using the 2007-2008 data, I continue with a report on the general characteristics of the overall sample. Finally, I examine whether there are any differences between low, average, and high-attedance participants with respect to academic achievement, perceived ease of transitioning, and program selection. Where appropriate, I also report any relationships found between attendance and these three variables.

Available Data

Because this study relied on the use of data that were previously collected, the available data were first reviewed and scrutinized to determine whether and to what extent they could be utilized to answer my research questions. The three types of data available included academic data from the first introductory biology course, attendance data from the biology peer-mentoring program, and survey data from the electronic end-of-term surveys.

Academic Data

Academic data for the introductory biology course, including midterm test marks, exam marks, final marks (0-100%), and final grades (F to A+), were available from the fall semester of the 2003-2004 academic year through to the 2007-2008 academic year.

The academic data obtained from the introductory biology course from the fall semester of the 2007-2008 academic year included final grades for 1,473 students. Grade distributions were calculated for the October midterm (Test 1), the November midterm (Test 2), the December exam, and the overall mark achieved in the course. Average scores were 64.0% (*SD* = 16.0) for Test 1, 58.9% (*SD* = 14.5) for Test 2, and 58.6% (*SD* = 13.3) for the final exam, consistent with previous offerings of the course. After including the lab component in the course, the overall average mark in the course was 64.0% (*SD* = 11.4).

Attendance Data

Each year, there were five peer-mentoring sessions available in which the students could participate. Attendance data from the biology peer-mentoring program were available from the fall semesters of the 2003-2004, 2005-2006, and 2007-2008 academic years. These data reported how many sessions—from a total of five—each student attended. There were 25 cases where students were added to the course late or switched sections midway through the semester, resulting in complete attendance records for 1,448 students out of the 1,473 students who completed the course in 2007. Any student who dropped the course during the semester was also removed from the attendance records.

Attendance data from 1,448 students in the 2007-2008 academic year indicated that 6.3% attended no sessions, 5.4% attended one session, 4.1% attended two sessions, 31.4% attended three sessions, 27.0% attended four sessions, and 25.8% attended all five sessions. On average, students attended 3.45 sessions (*SD* = 1.39). This compared to a mean attendance of 2.78 (*SD* = 1.72, *N* = 1,513) from 2005-2006 and to a mean attendance of 3.01 (*SD* = 1.67, *N* = 1,210) in 2003-2004.

During the 2004-2005 and 2006-2007 years, the peer mentors reported attendance as either three or more sessions (reported as Y) or two or fewer sessions (reported as N). Because the detailed attendance data were not reported by the peer mentors in these years, these datasets were excluded from the analyses within this thesis. However, in comparing the frequencies at which students participated in three of more sessions versus two or fewer sessions, it was evident that attendance increased over the 5 years such that 63% of students attended three or more tutorials in 2003, 64% in 2004, 68% in 2005, 70% in 2006, and 84% in 2007.

Survey Data

Survey data existed from all years, but were limited to three or four questions in the first 3 academic years and became more useful and extensive in the latter 2 years. Data were collected anonymously in all years except 2007-2008 and thus could not be connected to the academic or attendance data. In 2003-2004, a question was included in the survey to ask students how many peer-mentoring sessions they attended. Therefore, in 2003-2004, academic data could be connected with attendance data that were reported by the peer mentors, and survey data were connected with attendance data that were self-reported by the students.

Of 1,473 students enrolled in the introductory biology course in 2007-2008, 1,178 took part in the end-of-term electronic survey, representing an 80% response rate. This survey revealed that the majority (62.8%) of the respondents were female. Slightly more than 95% of the respondents completed their high-school education within Ontario, while 1.8% completed their education in another Canadian province or territory, and 2.9% completed their high-school education outside Canada. The survey results revealed that

the majority of respondents lived in residences on-campus (62.3%). The age of survey respondents ranged from 17 to 44, with more than 95% of the sample in the 17-19 age range. The majority of the students enrolled in the course were general science students in their first year of studies (72.5%), while 17.6% of the students were in other 1st-year programs (e.g., Medical Radiation Science, Kinesiology, Arts & Science, and Social Science). The remaining 10% were not in their first year of study.

The mean self-reported expected grade (on a 12-point scale where 0 is equal to an F, and 12 represents an A+) in the course was 7.35 (SD = 2.39) representing a B- or 70-72% overall grade. The mean self-reported grade from the high-school prerequisite course (using the same 12-point scale) was 10.86, representing an A- or 80-84% (SD = 1.20).

Survey data were not analyzed from the 2006-2007 academic year as these data could not be connected with the attendance or academic data in any way. Survey data from previous years were too limited to provide any use, except for the 2003-2004 survey question that asked students to self-report their attendance in the peer-mentoring program.

Data Summary

The most useful data came from the 2007-2008 academic year and became the focus of the subsequent data analysis. The following sections, therefore, report primarily on the 2007-2008 data, except where indicated otherwise.

Characteristics of Participants

What were the characteristics of students who chose to participate in the biology peer-mentoring program? To answer this question, I grouped students into three groups based on their participation in the peer-mentoring program. The data previously revealed

that the average attendance in the program was 3.01 (2003-2004), 2.78 (2005-2006), and 3.45 (2007-2008), but in all 3 years, the median attendance was 3. Using this information, I grouped the students into three groups. The low-attendance group included students who attended 0, 1, or 2 sessions. The average-attendance group included students who attended 3 sessions. The high-attendance group included students who attended 4 or 5 sessions.

A chi-square analysis revealed that the null hypothesis, which stated that males and females were equally likely to fall into any of the three participation groups, could not be rejected (χ^2 (2, N = 1,158) = 3.12, p = .21), thus indicating that there were no differences between males and females in the number of sessions that they attended. Further chi-square analyses showed that students who completed their high-school diplomas within Ontario were not different than students from other Canadian provinces or territories, or from outside Canada in terms of their attendance in the peer-mentoring sessions (χ^2 (4, N = 1,158) = 5.69, p = .22). It was hypothesized that students living on-campus may have attended more peer-mentoring sessions than those living off-campus, simply on the basis of convenience and proximity. However, the null hypothesis for this test could not be rejected, suggesting that on-campus students were no more or less likely to attend sessions than off-campus students (χ^2 (2, N = 1,157) = 2.01, p = .37). A significant difference was identified between the three groups when investigating whether the students' current year of study had any impact. Indeed, those students who were in their first year of study participated in more sessions than students in the second or subsequent year of study (χ^2 (2, N = 1,158) = 6.87, p = .03).

The mean expected grade on a 12-point grade scale from F through A+ was 6.99 (SD = 2.61, N = 136) for the low-attendance, 7.29 (SD = 2.36, N = 353) for the average-attendance, and 7.44 (SD = 2.38, N = 668) for the high-attendance groups. A grade point of 7.0 is equal to B- and represents a final mark range of 70-72%. This apparent increase in expected grade between the three attendance groups was not statistically significant according to an ANOVA test (F (2, 1156) = 2.16, p = .12). Self-reported high-school grades also showed a slight difference between attendance groups, where low-attendance participants reported slightly lower high-school grades (M = 10.7, SD = 1.29, N = 131) than average-attendance participants (M = 10.8, SD = 1.20, N = 343) and than high-attendance participants (M = 10.9, SD = 1.16, N = 656), but again these differences were not significant (F (2, 1,129) = 1.78, p = .17). A grade point of 10.0 is equal to A- and represents a final mark range of 80-84%. Although neither of these findings was statistically significant, each suggested that there may be a trend between either students' expected grades or high-school grades and their choice to participate in the program.

Investigating further to determine whether a relationship existed between attendance and either expected grade or self-reported high-school grade, significant relationships were revealed through correlation analyses. Attendance in the program was weakly related to expected grade (r (1,157) = .061, p =.04) and also to self-reported high-school grade (r (1,130) = 0.070, p =.02), indicating that students with higher previous grades and higher grade expectations were marginally more likely to participate in the program.

Not surprisingly, students who attended peer-mentoring sessions more frequently rated the value of the peer-mentoring program higher, suggesting a significant positive

relationship between attendance and perceived value of the program (r (963) = .272, p < .01).

Participation and Academic Success

Did students who participated in the biology peer-mentoring program achieve higher academic success in the 1st-year biology course compared to those students who participated less frequently in the program? Were there any relationships between attendance and academic achievement?

To answer the first question, the data were examined to determine whether they could be used for and met the assumptions of a one-way ANOVA test. Normal distributions of the data sets were confirmed. Equal variances were assumed as per Levene's test for homogeneity of variances (F (2, 1,447) = 2.16, p =.56). The ANOVA was initially performed without grouping the students into the three participation groups to help determine if the low-, average-, and high-attendance groups were indeed appropriate. The participation factor thus had six attendance groups, based on the actual number of sessions, from 0 to 5, that were attended by students. Table 1 shows the average final marks and standard deviations that each attendance group achieved in the course. The ANOVA revealed highly significant differences among the six attendance groups (F (5, 1,442) = 25.0, p < .01). A post-hoc Bonferroni test (Table 2) showed that students who attended two or fewer peer-mentoring sessions differed significantly from those who attended three or more sessions, with respect to academic achievement. Further, the Bonferroni post-hoc test showed there was significant difference in academic achievement between the groups that attended three sessions versus those students who attended five sessions (as shown in Table 2).

Table 1

Summary of Mean and Standard Deviation (SD) of 2007 Final Grades for Each of the 6 Attendance Groups (0-6 sessions)

Attendance*	N	Mean	SD
0	91	55.8	12.7
1	78	56.6	12.5
2	60	59.4	10.2
3	454	64.1	10.9
4	391	65.6	10.4
5	374	66.4	10.7
Total	1448	64.0	11.3

*Number of peer-mentoring sessions attended.

Table 2

Post-hoc Bonferroni Tests Comparing Final Marks Achieved and Grouped by Attendance

(I) Attendance	(J) Attendance	Mean Difference (I-J)	SE	*P*	95% Confidence Interval	
					Lower Bound	Upper Bound
0	1	-.711	1.68	1.00	-5.67	4.23
	2	-3.53	1.81	.78	-8.86	1.80
	3	-8.22**	1.25	.00	-11.9	-4.54
	4	-9.76**	1.27	.00	-13.5	-6.03
	5	-10.6**	1.27	.00	-14.3	-6.84
1	0	.711	1.68	1.00	-4.24	5.66
	2	-2.81	1.87	1.00	-8.32	2.69
	3	-7.51**	1.34	.00	-11.4	-3.58
	4	-9.05**	1.35	.00	-13.0	-5.07
	5	-9.88**	1.36	.00	-13.9	-5.89
2	0	3.53	1.81	.78	-1.80	8.86
	1	2.81	1.87	1.00	-2.69	8.32
	3	-4.70*	1.50	.03	-9.10	-.293
	4	-6.23**	1.51	.00	-10.7	-1.79
	5	-7.06**	1.52	.00	-11.5	-2.60
3	0	8.22**	1.25	.00	4.54	11.9
	1	7.51**	1.34	.00	3.58	11.4
	2	4.70*	1.50	.03	.293	9.10
	4	-1.54	.752	.62	-3.75	.676
	5	-2.37*	.761	.03	-4.61	-.128
4	0	9.76**	1.27	.00	6.03	13.5
	1	9.05**	1.35	.00	5.07	13.0
	2	6.23**	1.51	.00	1.79	10.7
	3	1.54	.752	.62	-.676	3.75
	5	-.831	.789	1.00	-3.15	1.49
5	0	10.6**	1.27	.00	6.84	14.3
	1	9.88**	1.36	.00	5.89	13.9
	2	7.06**	1.52	.00	2.60	11.5
	3	2.37*	.761	.03	.128	4.60
	4	.831	.789	1.00	-1.49	3.15

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

This supports the idea of grouping students into a low- (0-2 sessions), average- (3 sessions), and high- (5 sessions) attendance groups. However, these results did not make it clear whether students who attended four sessions should be grouped into the average-attendance or into the high-attendance groups as they were not significantly different from those students who attended three sessions, nor were they significantly different from those who attended five sessions.

Data from additional grading components, including scores on tests and exams, were reviewed in an effort to resolve this issue of where to group the students who attended four sessions. ANOVA tests were repeated using Test 1 (F (5, 1,147) = 8.91, p < .01), Test 2 (F (5, 1,147) = 12.7, p < .01), and the final exam (F (5, 1,147) = 11.53, p < .01) scores. Data from previous years were analyzed to help confirm that the groups created for the analysis of this study were logical and appropriate. ANOVA tests were performed using final mark and attendance data from the 2003-2004 (F (5, 1209) = 19.0, p < .01) and 2005-2006 (F (5, 1512) = 37.9, p <.001) academic years. All five ANOVA tests revealed that highly significant differences existed in academic achievement between the six participation groups (0 to 5 sessions). The post-hoc tests— either Bonferroni tests if variances were homogenous between groups or Tamhane tests if the variances were not equal across the participation groups—revealed where these differences were found. In all five of these post-hoc tests, there were no significant differences between students who attended 0, 1, or 2 sessions. There were also no significant differences between students who attended 3 or 4 sessions or between students who attended 4 or 5 sessions. None of these tests revealed whether it would be more appropriate to group those students who attended 4 sessions with the average-attendance

or with the high-attendance group. It appears then that there is no reason not to group the students who attended four sessions into the high-attendance group, especially as attendance in three sessions was rewarded with a portion of the participation grade (resulting in 0.1% of the overall grade), and attendance in four or more sessions went beyond the minimum requirements.

The analyses thus far indicated that there was indeed a difference in academic achievement between the different attendance groups. However, whether a relationship existed between these two variables has not yet been addressed. To determine whether attendance in the program was related to academic achievement in the introductory biology course, a scatter-plot of final mark versus attendance was constructed (R^2 = 0.072) using the data from the first semester of the 2007-2008 academic year. A correlation analysis between final mark (M = 64.0, SD = 11.3, N = 1,448) and attendance subsequently showed a highly significant yet moderate relationship between these two variables (r (1,146) = .269, $p < .01$). A linear regression analysis revealed that attendance was a significant predictor of final marks (B = 2.12, β = .269, t = 10.6, p <.001), accounting for 7.2% of the variance in academic achievement.

Reviewing and analyzing historical data dating back to 2003 revealed similar relationships. A correlation analysis revealed that the final mark achieved in the course in the fall semester of 2003-2004 (M = 72.6%, SD = 9.79, N = 1,427) and attendance in the peer-mentoring program were related at a statistically significant level (r (1,210) = .263, $p < .01$). The linear regression analysis revealed that attendance was again a significant predictor of final marks (B = 1.53, β = .263, t = 9.47, p <.001) accounting for 6.8% of the variance. Similar results using the 2005-2006 data showed a slightly stronger

relationship (r (1,513) = .330, $p < .01$) between final mark and attendance and a slightly stronger ability of attendance to predict final marks ($B = 1.53$, $\beta = .330$, $t = 13.6$, $p < .001$), this year accounting for 10.8% of the variance in final marks. In all three data sets, attendance was able to predict an average of 8.3% of the variance found in final marks in the course.

As determined in the previous section, students' expected grades and self-reported high-school grades were both weakly related to attendance. To determine the extent to which these variables related to final marks, a multiple regression analysis was performed using the data from 2007-2008, as this was the only year that expected grades and self-reported high-school grades were part of the available data. A regression model (see Table 3) indicated that together the three independent variables (attendance, expected grade, and self-reported high-school grade) accounted for 43.9% of the variation in final grades ($B = 2.45$, $\beta = .550$, $t = 23.4$, $p < .01$). Although all three variables were found to be significant predictors of the final grade, the expected grade predictor has the most impact on the model, accounting for 38% of the variation in the final grade on its own ($B = 2.76$, $\beta = .619$, $t = 27.0$, $p < .01$). This is not entirely surprising as students had been made aware of approximately half of their final mark by the time they engaged in the survey.

Those students who participated at higher levels in the peer-mentoring program achieved higher marks in the introductory biology course, as indicated from three academic years between 2003 and 2008. A relationship between these two variables exists and a regression analysis revealed that attendance in the peer-mentoring program accounted for approximately 8% of the variance in the final marks in the biology course.

Table 3

Summary of Multiple Regression Analysis for Variables Predicting Final Grade

Variable	B	SE (B)	Beta	t	p
(Constant)	24.1	2.25		10.7*	.00
Attendance	1.22	.188	.145	6.47*	.00
Self-reported high-school grade	1.74	.211	.194	8.25*	.00
Expected Grade	2.45	.105	.550	23.4*	.00

Note. $R^2 = .439$. * $p < .01$

Participation and Perceptions of Transitioning

Did the high-attendance participants differ in their perceptions of transitioning from high school to university as compared to students who participated less frequently? To answer this question, students from the 2007-2008 dataset were divided into the three attendance groups discussed earlier: high-attendance participants (students who attended 4 or 5 peer-mentoring sessions), average-attendance participants (those who participated in 3 sessions), and low-attendance participants (students who attended 2 or fewer sessions). Summed transition scores were not normally distributed, thus a nonparametric Kruskal-Wallis test using the chi-square test statistic was used to determine that there were no significant differences between attendance groups (χ^2 (2, N = 1,156) = 2.28, p = .32).

A scatter-plot and subsequent correlation analysis between overall transition rating (M = 11.0, SD = 2.62, N = 1,156) and attendance in the peer-mentoring program showed no relationship between these two variables (r (1,154) = -.023, p = .43), indicating that participation in the peer-mentoring program was not related to students' perceptions on how easy or difficult it was to transition from high school to university.

This question could only be addressed using the 2007-2008 data as the survey data from other years were either collected anonymously or did not include the transitioning questions at all.

Participation and Program Selection

Were high-attendance students more likely to select biology programs of study for their second and upper years of university education than less frequent participants? Program selection questions were only asked in the most recent survey (2007-2008

academic year). Thus, to answer this question, students from the 2007-2008 cohort were grouped into the low-attendance, average-attendance, and high-attendance groups. A new variable was created by comparing students' preferred program specialization from September and December to track program preference changes between the start and end of the academic semester. In September, 452 students planned to select a major in biology (see Table 4). However, 180 students changed their preference to another program outside biology by the end of their first semester. Of the 668 students who did not plan to major in biology as of September, 101 students decided that biology was their program of choice by December. It became evident, when comparing program selection changes with attendance (see Table 5), that those who attended the biology peer-mentoring sessions frequently were no more or less likely to prefer biology majors than those students who attended fewer sessions (χ^2 (6, N = 1,101) = 4.65, p = .59).

These results indicate that participation in the peer-mentoring program therefore had no obvious impact on what programs students preferred for their upper-level programming choices.

Summary

Of the descriptive characteristics examined in this study, students' current year of study and perceived value ratings were the only characteristics that revealed differences between the three participation groups (0-2 sessions, 3 sessions, and 4-5 sessions). Further, significant differences did not exist when examining students' perceptions about ease of transitioning or students' preferred program options for subsequent years of study. The academic achievement data revealed differences between the participation

groups, where academic achievement in the introductory biology course was higher for those students who participated the most in the peer-mentoring program.

In the following chapter, the significance of these results is discussed with a focus on evaluating the extent to which the peer-mentoring program's objectives were met during its first 5 years of operation.

Table 4

Frequency Distribution Showing Students' Program Preference as of September and in December

Program Preference			
September	December	Frequency	%
Biology	Not Biology	180	16.1
Not Biology	Not Biology	567	50.6
Biology	Biology	272	24.3
Not Biology	Biology	101	9.00
Total		1120	100

Table 5

Cross-Tabulation of Students by Program Preference Change (September to December) and Attendance Grouping

Attendance		Program Selection Preference (Sept to Dec)				
		Biology to Not Biology	Not Biology to Not Biology	Biology to Biology	Not Biology to Biology	Total
Low	Count	22	59	35	13	129
	Expected	20.7	65.6	30.9	11.8	129
Average	Count	60	172	71	34	337
	Expected	54.1	171	80.7	30.9	337
High	Count	95	329	158	54	636
	Expected	102	323	152	58.3	636
Total	Count	177	560	264	101	1102
	Expected	177	560	264	101	1102

CHAPTER FIVE: SUMMARY, DISCUSSION, AND RECOMMENDATIONS

This chapter begins with a summary of the study and proceeds to discuss the results of the data analysis. Here, I use these results to evaluate the biology peer-mentoring program using an objectives-oriented framework. The program was designed with the hope that it would help 1st-year students attain higher grades in the introductory biology course, make a smoother transition from high school to university, and select a biology program as a major or specialized honours program. These objectives became the focus of the program evaluation. Data that had been collected for 5 years were reviewed and analyzed to determine whether students who participated in the biology peer-mentoring program were different than students who chose to participate to a lesser extent or not at all.

Summary of the Study

Data that had been previously collected between 2003 and 2007 were reviewed and analyzed, largely using a group comparison design. Students were divided into groups based upon their participation rates in the biology peer-mentoring program. Differences between these groups were investigated through analysis of the quantitative data that were collected from academic records in the introductory biology course, attendance records in the peer-mentoring program, and quantitative survey responses provided by the students in the introductory biology course. Where differences existed, a correlation and regression analysis was performed between the variable that showed differences and the participation variable.

Students who participated highly in the biology peer-mentoring program were no different from less frequent participants in terms of gender, living arrangements, high-

school location, expected grade in the university introductory biology course, or in self-reported high school grades for the prerequisite course. First-year students, for whom the program was intended, were more likely than upper-level students to participate in the program. Students who saw value in the program attended the sessions more frequently.

Data from multiple years consistently showed that students who attended peer-mentoring program sessions more frequently achieved higher academic grades in biology. The most recent dataset included results from surveying students for their self-reported high-school grade and expected grade in the introductory biology course. These data indicated that self-reported high-school grade and expected grade were also involved in predicting final marks in the introductory biology course.

No differences or relationships were found in perceived ease of transitions between attendance groups, indicating that participation in the peer-mentoring program had little effect on how students rated their transition from high school to university. Likewise, there were no identified trends in program selection based upon comparing participation rates in the peer-mentoring program.

In the remainder of this chapter, the significance of these results is discussed, the biology peer-mentoring program is evaluated in light of these results, and recommendations are presented.

Discussion

The analyses resulting from the data available for this study revealed that students who participated in four or five peer-mentoring sessions were more likely to be 1st-year students. This is not surprising given that the students were told through lectures that the peer-mentoring program was designed to provide new students with the support,

guidance, and advice from upper-year students who had "been there, done that" with respect to the transition to undergraduate studies at the university. Recall that this peer-mentoring program aimed to provide academic support (task-related function) and transitioning support (psychosocial function), two of the main mentoring functions that were discussed by Kram and Isabella (1985) and supported by Jacobi (1991). Without a working knowledge of how to navigate the university environment, a mentor's ability to fulfill these main functions of a mentoring program would be compromised (Terrion & Leonard, 2007). That "been there, done that" experience, acquired through successful completion of at least a portion of their university studies, is important to establish a working relationship between peer mentor and protégé. Although all students were encouraged to attend the sessions for both academic and transitioning support, upper-year students were likely to see less need for transitioning support since they themselves would have already been through at least a year of university studies.

It is also not too surprising that the highest value ratings came from students who attended the most sessions. The peer-mentoring program was available for everyone registered in the introductory biology course, but participation in the program was not a requirement, thus providing individual students the option to attend or not depending on whether they found any value in the program. Although programs within academia can have both intrinsic and instrumental value, programs are not necessarily of value to those individuals who do not recognize any intrinsic value in either its academic or social manifestations (Watts & Bridges, 2006). Because attendance was optional, students who attended one or two sessions and found them to have little value would have been more likely to stop participating than those students who rated the program as more valuable.

As hypothesized, a positive relationship between value rating and participation was revealed.

Grouping students into participation groups based on their attendance in the peer-mentoring program proved to be quite challenging. Data consistently showed that those students who participated in two or fewer sessions attained significantly lower grades than those who participated in three or more sessions, thus providing clear boundaries for the low-attendance group. However, those students who participated in more than three sessions caused some uncertainty in defining groups. The students who attended three sessions were almost always different from those students who attended five sessions in academic achievements, indicating that there should be at least three groups. The answer to where to group the students who participated in four sessions was not apparent as these students were often not different from either the group that attended three sessions or the group that attended five sessions. The decision to use three groups rather than four was made with the definitions that were in use by the introductory biology course and the peer-mentoring program at the university. Students were offered a small participation grade for completing a peer-mentor evaluation survey that was only available to them if they attended three or more sessions. Consequently, students who attended three sessions may have been completing only the minimum necessary, whereas students attending four or more sessions were completing more than was required for access to this end-of-term survey. The three groups were thus considered to be those that participated in fewer than three sessions, those that participated in three sessions, and those that participated in more than three sessions.

Transitioning

The initial goal of the biology peer-mentoring program was to aid students in their transition from high school to university. According to Jacobi (1991) and Crisp (2009), providing transitioning support would be considered something that addresses the emotional and psychological function of a mentoring program. Kram and Isabella (1985) considered this a psychosocial function. Regardless, it was this objective that formed the basis of the research question that aimed to answer whether students who participated in the peer-mentoring program were more likely to indicate an easier transition to university studies.

In this study, the surveys that were available included only four questions that related to transitioning. The score on each item was summed into a total transitioning score and the mean summed scores were compared between each of the participation groups. No significant differences between the groups were identified either in the summed score, or for any of the individual items that comprised the summed score. These data therefore suggest that participation in the biology peer-mentoring program had no effect on how students rated their transitioning experience and thus it appears that the biology peer-mentoring program was failing to meet its primary objective. The recent literature review by Crisp and Cruz (2009) did not provide any evidence to indicate that mentored students adjusted more readily to university than nonmentored students. Lamothe et al. (1995) did report empirical evidence that mentored students, as opposed to a control group, adjusted better to university and rated their sense of social support higher than nonmentored students.

This is likely due to the fact that there has not been an agreed-upon definition of mentoring, nor has there been an easy way to measure the effects of mentoring. These

issues have also been a problem for this study. The transitioning questions that were asked of the students were not part of any survey that was previously studied or tested for reliability and validity. Therefore, this preliminary finding should be confirmed before too much weight is assigned to this finding. Administering a survey instrument designed specifically to measure transitioning and interviewing students on their transitioning perspectives are two alternative methods of collecting data. Baker and Siryk's (1984) Student Adaptation to College Questionnaire (SACQ) or Crisp's (2009) College Student Mentoring Scale (CSMS) include survey questions that would have been able to more reliably measure students' social support systems and adaptations and adjustments to university. These additional data would then allow for confirmation or contradiction of the findings from this study.

Academic Achievement

Another program objective was to help students achieve academic success in their introductory biology course. Similar to results reported by Tremblay and Rodger (2003), students who participated in two or fewer peer-mentoring sessions performed significantly worse overall in the introductory biology course, as indicated by the ANOVA test results. Students who participated fully in the peer-mentoring program (attending all five available sessions) performed significantly better than those who attended three sessions or fewer. Those students who attended four sessions fall somewhere in between and, for the reasons described above, have been grouped with the full-program participants. This establishes that there were indeed differences in academic achievement between the participation groups, but it also raises some further questions.

Is it possible that students who opt to participate in the peer-mentoring program are those students who are already high academic achievers? Reviewing the available data on past academic performance in the field of biology showed that there were no significant differences between those students who were high-attendance participants to those who chose to participate less fully or not at all. This therefore suggests that it was not just the high-achieving high-school students who opted to participate in the peer-mentoring program. Tremblay and Rodger (2003) found similar trends. When comparing academic achievement results between a peer-mentored group and two control groups, no academic achievement differences were identified. However, when they considered participation levels in the mentoring program and compared program participants who met with their mentors on a monthly basis or more often, differences were identified indicating that program participants achieved higher grades. These authors also included a survey on academic motivation and found no effects between high participation, low participation, and no participation.

Was participation in the peer-mentoring program the only predictor of academic achievement in the introductory biology program? The multiple regression analysis showed that at least two other factors can help predict a student's academic achievement, including high-school grades from the prerequisite course and expected grades in the introductory course in addition to attendance in the peer-mentoring program. The equation

$$y = 24.1 + 1.22 * \text{attendance} + 1.74 * \text{hs grade} + 2.45 * \text{exp grade}$$

can be used to predict a student's final mark in the biology course. This equation suggests that participation in the peer-mentoring program is one factor that impacts

academic achievement to some degree. Assuming that the other factors are held constant, attendance in one peer-mentoring session relates to an increase of 1.22% on the final mark in the introductory biology course. Attendance in five sessions (the maximum available) related to an increase of 6.1% on the final mark in the biology course.

It is important to note that only 43.9% of the variation in final mark was accounted for by the three factors (attendance, high-school prerequisite grade, and expected grade in the course). This indicates that there were other factors, not addressed by variables for which data existed in this study, that were involved in predicting students' academic achievement in the course. These variables may possibly include motivation, psychological well-being, stress levels, relationships with parents, study strategies, and use of additional academic support. Wintre and Yaffe (2000) used multiple inventories to measure many of these variables in their study on adjustment to 1st-year studies as a function of relationships with parents and found that mutual reciprocity and discussion with parents, as well as the psychological well-being variables, had direct links to adjustment to university, both academically and socially. Participation in the peer-mentoring program was a predictor of the final mark achieved in the introductory biology course. Therefore, it can be concluded that the peer-mentoring program was meeting its objective in helping students to achieve academic success.

Program Selection

Finally, the third program objective was to encourage students to pursue further studies in the area of biology beyond their first year of studies. There were no studies from the literature review that provided evidence for mentoring programs to impact students' undergraduate programming preferences. However, because mentoring and

peer-mentoring programs have been developed and utilized for the purpose of role modelling (Jacobi, 1991; Nora & Crisp, 2007) and because upper-year biology students were acting as peer mentors, it was hypothesized that some of the protégés may be more likely to select biology programs themselves for their study options.

Evidence from this data analysis suggested that students who participated in the peer-mentoring program were no more or less likely to indicate that they were going to select a biology program for their subsequent year of studies. This indicates that the biology peer-mentoring program neither deterred students from nor attracted students to selecting biology programs.

Summary

Data from this study thus suggest that one out of the three program objectives were met. The only objective that the peer-mentoring program met was in its impact on academic achievement. No evidence existed to support that the program had an effect on transitioning or program selection.

Recommendations

Based on the results of this study, recommendations are made in this section with respect to the biology peer-mentoring program and with respect to future research needed to evaluate such a program.

Biology Peer-Mentoring Program

Before addressing any recommendations, consideration must first be given to continuing the program as is, continuing the program with modifications, or cancelling the program. Given that there is evidence that the program is indeed meeting its objective to aid students with their academic achievement in the introductory biology

course, I believe that the program has value and should therefore be continued. However, as there is no evidence that the program is meeting its objectives to aid with students' transition to university and to recruit students to biology programs, I believe that modifications need to be implemented in the program.

The program designers need to give some serious consideration as to how the peer-mentoring program is different from offering traditional tutorials, especially given that the only benefit elucidated through this study was that the program helps with academic achievement.

The program designers should spend some time reviewing the program's objective on transitioning. Is there any evidence that 1st-year students need and want help with transitioning from high school to university? If so, do they need or want this help through a program linked with an academic course? These questions can be answered through a simple survey that can easily be distributed to students in the introductory biology course through the learning management system. If there is evidence that students feel this is important and that they need this help, then more focus would be needed on developing the biology peer-mentoring program to meets its transitioning goal. One idea would be to include a research project within the peer-mentoring training program that would require the peer mentors to review the literature on transitioning, issues related to transitioning, and measurement of transitioning beliefs. It may also be beneficial to recruit a guest speaker with expertise in transitioning issues and teach the peer mentors how best to be a support person during transitioning periods. Peer mentors could be trained by representatives from various student support services (e.g., residence life services, career services, student development, health services,

counselling services, etc.) so that the peer mentors could better assist the 1st-year students with general campus resources relating to both academic transitioning and social transitioning. It is well documented in the literature that these types of support services can positively influence ease of transition, academic achievement, and student retention (Astin, 1993; Budge, 2006; Jacobi, 1991; Tinto, 1987; Tremblay & Rodger, 2003).

Most of the peer mentors spent at least half of one session reviewing the various programming options for second year. However, this seems not to have had much of an impact on encouraging students to select biology program options for their second year of studies. In order to recruit students into biology programs, the biology department will first need to understand the reasons behind why students choose to or choose not to apply for biology programs in second year. The biology peer-mentoring program would need to then focus on making sure that students are aware of the benefits of a biology program.

As Astin (1993, 1998) suggested, curriculum and program designers can only create instructional strategies that appeal to students and encourage learning and academic success if we know what motivates students, what students believe, and what goals students have. Thus, more research is needed to determine what it is that 1st-year students want and need with respect to transitioning help and programming options for their second year of studies.

Further Research

In addition to identifying what students want and need, an improved research design would help to verify whether the findings of this study are valid and reliable. Ideally, students should be randomly assigned to one of two groups, whereby one group is given access to the biology peer-mentoring program and a second group is given access

to traditional tutorials. A third comparison group would inevitably arise from those students who choose not to participate in the program that was available to them. This would require the development of traditional tutorials and would require resources (funding for curriculum development and hiring teaching assistants). Because only academic benefits were elucidated from this study, it seems that the peer-mentoring program may not be much different than traditional tutorials. Thus, it should not be considered ethically inappropriate to randomly assign students into peer-mentored groups versus traditional tutorial groups for a future study.

As discussed earlier, future research should reevaluate the students' perceptions on transitioning using a tested instrument, such as the SACQ developed by Baker and Siryk (1984). This questionnaire, which was tested for validity and reliability, includes 52 Likert-style items that measure four aspects of adjustment (academic, social, emotional/personal, and institutional attachment). The CSMS survey described by Crisp (2009) may also be helpful in evaluating this peer-mentoring program and in determining any specific transitioning needs of the students that could be addressed through a peer-mentoring program. In addition to quantitative data, the collection of qualitative data, perhaps through interviews or focus groups, may be able to confirm the findings of this study or to provide evidence to the contrary.

It is also very important to study the impact and benefit that the peer-mentoring program may have on the peer mentors, who are upper-year students majoring or minoring in a biology program. The current study focused only on the impact to the protégés and did not investigate the impact on the peer mentors. Before any final decisions are made to cancel or continue the peer-mentoring program, it will be important

to note what immediate and long-term benefits and drawbacks are experienced by the mentors. Preliminary and informal feedback from the peer mentors indicates that the program may have much more value to the mentors than it does to the 1st-year students. This notion is supported by the literature review conducted by Ehrich et al. (2004), which indicated that the most positive outcomes were for the mentors, specifically with respect to collaborations, networking, reflection, collegiality, and professional development.

With the additional knowledge generated from this future research, the biology peer-mentoring program could be improved to maximize benefits for 1st-year students and mentors alike.

Conclusion

This study has provided evidence that the biology peer-mentoring program was successful in meeting one of its three objectives. Those students who attended the peer-mentoring sessions achieved higher grades than those students who did not participate fully in the program. However, there was no evidence that the peer-mentoring program had any impact on students' adjustment and transition from high school to university, nor on program selection preferences. Therefore, the program has not met two of its three objectives.

Before a decision is made to continue or terminate the program, it will be important to conduct the recommended program modifications, perform the suggested future research, and determine the value of the program on the peer mentors. Completion of these tasks should allow for the renewal of the biology peer-mentoring program that would be more able to meet its objectives and better help students adjust to university in academic, social, emotional/personal, and institutional attachment.

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Appendix A

Summary of Variables Garnered and Scored from Survey Questions Posed to the 2007-2008 Cohort of Introductory Biology Students

Variable	Items from questionnaire	Scores
Age[#a]	What is your age? Please enter your age in years in the box below.	17 – 44
Gender[^a]	Are you:	
	a. Male?	1
	b. Female?	2
Living Arrange-ment[^a]	Where do you live during the school year?	
	a. Off-campus	1
	b. On-campus	2
Year of study[^a]	Are you currently enrolled in your first year of your program?	
	a. Yes	1
	b. No	2
Expected grade[#b]	What do you expect your Biology 1A03 mark to be this semester?	
	a. 12 A+	12
	b. 11 A	11
	c. 10 A-	10
	d. 9 B+	9
	e. 8 B	8
	f. 7 B-	7
	g. 6 C+	6
	h. 5 C	5
	i. 4 C-	4
	j. 3 D+	3
	k. 2 D	2
	l. 1 D-	1
	m. 0 F	0
Location[^a]	Where did you complete your high school education?	
	a. In Ontario	1
	b. Outside Ontario, but within Canada	2
	c. Outside of Canada	3
HS Grade[#b]	What was your Grade 12U Biology (or equivalent) mark?	
	a. 90% - 100% A +	12
	b. 85% - 89% A	11
	c. 80% - 84% A –	10
	d. 77% - 79% B +	9
	e. 74% - 76% B	8
	f. 70% - 73% B –	7
	g. Less than 70%	6
	h. I don't remember	999

Variable	Items from questionnaire	Scores
Program (Sept)[^c]	Before you started your first year at the University, what program did you plan to major in?	
	a. A Biology program within the Faculty of Sciences	1
	b. A program within the Faculty of Sciences, but not within the Department of Biology.	2
	c. A program outside of the Faculty of Sciences	2
	d. I had no clue!	999
Program (Dec)[^c]	Now that you have completed one semester at the University, what program do you plan to major in?	
	a. A Biology program within the Faculty of Sciences	1
	b. A program within the Faculty of Sciences, but not within the Department of Biology.	2
	c. A program outside of the Faculty of Sciences	2
	d. I still have no clue!	999
Trans1	On a scale of 1 to 4, how would you rate your preparedness for this introductory biology course?	
	1: My high school education left me much more prepared for Bio 1A03 than the majority of first-year students.	1
	2: My high school education left me reasonably well prepared for Bio 1A03.	2
	3: My high school education left me under-prepared for Bio 1A03.	3
	4: My high school education left me totally unprepared for Bio 1A03 compared to the majority of first-year students.	4
Trans2	How would you rate your transition from high school to university?	
	a. Transitioning was much easier than I thought it would be.	1
	b. Transitioning was a little easier than I thought it would be.	2
	c. Transitioning was a little more difficult than I thought it would be.	3
	d. Transitioning was much more difficult than I thought it would be.	4
Trans3	Now that this semester is coming to an end, how difficult do you think it was compared to your expectations?	
	a. Bio 1A03 was much easier than I thought it would be.	1
	b. Bio 1A03 was a little easier than I thought it would be.	2
	c. Bio 1A03 was a little more difficult than I thought it would be.	3
	d. Bio 1A03 was much more difficult than I thought it would be.	4
Trans4	How long would you say it took you to feel like you had adjusted to university (both socially and academically)?	
	a. About one week	0.25
	b. About one month	1
	c. About two months	2
	d. About three months	3
	e. More than one semester or I still do not feel entirely adjusted	4
TransTtl[#d]	Total Ease of Transitioning Score	3.25 – 16

Variable	Items from questionnaire	Scores
Value1	Would you recommend Biology 1A03 tutorials?	
	a. Yes	4
	b. No	1
Value2	How long should each tutorial run?	
	a. 30 minutes	1.5
	b. 50 minutes	2
	c. 1 hour and a half	2.5
	d. 2 hours	3
	e. There should not be tutorials	1
Value3	How often should tutorials be offered?	
	a. Every week	3
	b. Every second week	2
	c. Every month or only in the week that there is a test	1.5
	e. Never	1
Value4	Do you plan on attending tutorials in Biology 1AA3?	
	a. Yes	4
	b. No	1
	c. I am not planning on taking Biology 1AA3.	999
Value5	Do you feel that the tutorials have improved your overall performance in Biology 1A03?	
	a. Yes – quite a bit	4
	b. Somewhat	3
	c. Not very much	2
	d. Not at all	1
ValueTtl[#a]	Total Perceived Value of Peer-Mentoring Program Score	3.25 - 16

Notes. [^]categorical variable. [#]continuous variable. [a]variable that addresses characteristics. [b]variable that addresses academic achievement. [c]variable that addresses program selection preferences. [d]variable that addresses perceived ease of transitioning.

Appendix B

Brock University Research Ethics Board Clearance Letter

Brock University
Office of Research Services
Research Ethics Office
St. Catharines, Ontario, Canada L2S 3A1
T: 905-688-5550, Ext. 3035/4876 F: 905-688-0748
www.brocku.ca

DATE: August 14, 2008

FROM: Linda Rose-Krasnor, Acting Chair
Research Ethics Board (REB)

TO: Louis Volante, Education
Lori GOFF
Michelle McGinn, Xiaobin Li

FILE: 08-047 - GOFF/MCGINN

TITLE: Evaluating the outcomes of a peer-mentoring program for transitioning post-secondary students

The Brock University Research Ethics Board has reviewed the above research proposal.

DECISION: Secondary Use of Data Accepted.

Please Note

- **Please ensure that the Biology Undergraduate Chair does the de-linking before you get the data**

This project has received ethics clearance for the period of **August 14, 2008** to **August 31, 2009** subject to full REB ratification at the Research Ethics Board's next scheduled meeting. The clearance period may be extended upon request. ***The study may now proceed.***

Please note that the Research Ethics Board (REB) requires that you adhere to the protocol as last reviewed and cleared by the REB. The Board must provide clearance for any modifications before they can be implemented. If you wish to modify your research project, please refer to http://www.brocku.ca/researchservices/forms to complete the appropriate form ***Request for Clearance of a Revision or Modification to an Ongoing Application.***

Adverse or unexpected events must be reported to the REB as soon as possible with an indication of how these events affect, in the view of the Principal Investigator, the safety of the participants and the continuation of the protocol.

The Tri-Council Policy Statement requires that ongoing research be monitored. A Final Report is required for all projects, with the exception of undergraduate projects, upon completion of the project. Researchers with projects lasting more than one year are required to submit a Continuing Review Report annually. The Office of Research Services will contact you when this form ***Continuing Review/Final Report*** is required.

Please quote your REB file number on all future correspondence.

LRK/kw