The Impact and Feasibility of an Optional Experiential Learning Activity and Study Sessions on Study Engagement

by

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ABSTRACT

THE IMPACT AND FEASIBILITY OF AN OPTIONAL EXPERIENTIAL LEARNING ACTIVITY AND STUDY SESSIONS ON STUDENT ENGAGEMENT

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Background: With expanding class sizes, it is important to develop learning initiatives to increase student engagement. Studies have found large class size to be associated with decreased engagement – a construct strongly associated with learning and performance outcomes. Experiential learning activities and study sessions, which address the four underlying predictors of engagement identified in the literature (interest, autonomy, self-efficacy, and belonging), may effectively engage students and improve their academic performance.

Objective: To examine the impact and feasibility of an optional experiential learning activity and study sessions on student course engagement and academic performance.

Methods: An intervention study was conducted in two large first and second year undergraduate nutrition courses at University of Guelph, Ontario, in fall 2012 and winter 2013. All students ($n = 980$) were invited to participate in an out-of-class optional experiential learning activity and study sessions. The experiential learning activity involved completion of, and reflection on, a 3-day food record, a tour of a health assessment research lab, and body composition (% body fat) assessment. Study sessions were instructor-led and addressed study/test-taking strategies difficult course content, and review of practice questions. To examine impact on student engagement and academic performance, baseline and follow-up Classroom Survey of Student...
Engagement scores and %tile ranks, respectively, were compared. Participation rates and results from satisfaction surveys were used to examine feasibility.

**Results:** There was an increase from baseline to follow-up in both student engagement (Active and Collaborative Learning 22.1% increase, \( p < .001 \); Student-Faculty Interaction 11.2%, \( p = .038 \); Level of Academic Challenge 15.6%, \( p < .001 \)) and performance (%tile rank \( \Delta M = 7.63 \)). One hundred seventy-two (17.6%) students participated in the experiential learning activity, and attendance per study session ranged from 4 to 29 students. Satisfaction survey results indicate students became more interested in the course after participating in the experiential learning activity. Students appreciated the instructors’ support in offering study sessions. No further conclusions about study sessions can be made due to low attendance.

**Conclusion:** Results suggest an experiential learning activity can generate interest and increase engagement and performance in large undergraduate nutrition courses.
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1.0 Introduction

University enrollment has increased substantially over recent years. In the past decade, full-time undergraduate enrollment in Canada and the U.S. has increased by 44 and 31% respectively (Association of Universities and Colleges of Canada [AUCC], 2011). Future projections report enrollment will continue to rise (AUCC, 2011). To accommodate the large influx of students, class sizes have been expanding, especially among introductory-level courses. At University of Guelph alone, the number of first year classes with more than 250 students has increased from 3 to 23% between 2005 and 2011, and the number of first year classes with 100 to 250 students has increased from 4 to 26% (Council of Ontario Universities, 2013).

The growing university population has resulted in focused efforts to increase and assess student engagement, as student engagement is a widely accepted indicator of education quality. In North America, the National Survey of Student Engagement (NSSE) (National Survey of Student Engagement [NSSE], 2012), which assesses levels of engagement, has been used in nearly 800 colleges and universities (NSSE, 2012). Research has found that behavioural, cognitive, and psychological engagement are associated with numerous positive student outcomes. Examples of indicators of student engagement include participating in class discussions (behavioural), utilizing deep learning strategies (cognitive), and having a positive attitude toward the class material (psychological). However, studies have found that large class size is associated with decreased levels of student engagement. Thus, educators need to develop effective learning strategies to increase engagement in large classes.

It is important to address the underlying motivating factors of student engagement to develop effective engagement initiatives. Self-Determination Theory (Ryan & Deci, 2000) identifies four predictors of student engagement: interest, autonomy, self-efficacy, and belonging. Interest is a psychological state that propels one towards a specific activity or topic.
Autonomy involves being self-initiating and self-regulating of one’s own actions (Deci, Vallerand, Pelletier & Ryan, 1991). Self-efficacy involves having strategies for success (Skinner, Wellborn & Connell, 1990), and feeling confident (Dweck, 1986). Finally, belonging involves having a sense of care, support, and relatedness with others (Ryan & Deci, 2000). Substantial research supports the effectiveness of addressing these four factors on increasing student engagement. Altogether, with increasing class sizes, instructors need to develop effective learning initiatives that support students’ interest, autonomy, self-efficacy, and belonging to increase student engagement.
2.0 Literature Review

2.1 Increasing Enrollment and Class Sizes

University enrollment has increased substantially in recent years. In the past decade, full-time undergraduate enrollment in Canada and the U.S. has increased by 44 and 31% respectively (AUCC, 2011). In addition, according to projections made from Statistics Canada, enrollment rates will increase up to 14% between 2010 and 2020 (AUCC, 2011). The National Centre for Education in the U.S. projects full-time enrolment in four-year U.S. universities will increase by 19% from 2007 to 2018 (Hussar & Bailey, 2009).

To accommodate the large influx of students, post-secondary institutions have been expanding their capacities. In Canada, universities have more than doubled their capacities within the past 30 years (AUCC, 2011). Consequently, there has been an increase in class size, especially in introductory-level first and second year courses. At the University of Guelph alone, the number of first year classes with more than 250 students has increased from 3 to 23% between 2005 and 2011, and the number of first year classes with 100 to 250 students has increased from 4 to 26% (Council of Ontario Universities, 2013). In 2009, about two thirds of Ontario universities reported that 30 per cent or more of first year courses had more than 100 students (Kerr, 2011). Across Canada and the U.S., universities are experiencing a similar growth in class sizes as a result of increased enrollment (AUCC, 2011; Council of Ontario Universities, 2013).

2.2 Student Engagement

With increased university enrollment and expanding class sizes, there has been greater emphasis on student engagement. Recently, student engagement has been attracting growing attention by the government and educational researchers (Leach & Zepke, 2011). Numerous
positive student outcomes are associated with student engagement, making it an ideal indicator of quality in universities (Leach & Zepke, 2011).

The concept of student engagement originated from Astin’s (1984) research on student involvement. Astin (1984) defines involvement as “the quantity and quality of physical and psychological energy that students invest in the college experience”. Additional research on quality of effort (Pace, 1980) and indicators of good practice in undergraduate education (Chickering & Gamson, 1987), evolved into the present-day definition of student engagement: “the amount of time and effort students put into their studies and other educationally purposeful activities” (NSSE, 2013, para. 2). The Australian Council for Educational Research similarly defines engagement as “students’ involvement in activities and conditions that are linked with high-quality learning” (Australian Council for Educational Research, 2013, para.7).

Extensive research has identified the various activities of engagement and conditions associated with high-quality learning and positive student outcomes. Recent reviews of literature have organized these factors into three constructs of engagement: behavioural, cognitive, and psychological engagement (Fredricks, Blumenfeld & Paris, 2004; Jimmerson, Campos, & Greif, 2003).

Behavioural engagement relates to students’ active response to learning tasks or instruction (Chapman, 2003). Examples include asking questions and participating in discussions with teachers or peers (Chapman, 2003). According to Hativa (2001, p. 108), “[i]t is through involvement and activity that learners participate genuinely and meaningfully in the learning process. This engagement enables them to modify their prior knowledge and construct their own understanding”. Numerous studies in various student samples have consistently demonstrated a positive correlation between behavioural engagement and achievement-related outcomes.
(Connell, Spencer & Aber; 1994; Connell & Wellborn, 1991; Marks, 2000; Skinner, Wellborn & Connell, 1990). Behaviourally engaged students are more likely to persist and complete degree requirements (Finn, 1989; Fredricks et al., 2004; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006). Students who participate also show improvement in their communication skills (Berdine, 1983; Dancer & Kamvounias, 2005), and group interactions (Amrstrong & Boud, 1983). More behaviourally engaged students have been found to demonstrate less memorization, and higher levels of cognition such as interpretation, analysis, and synthesis (Smith, 1977). According to Bransford (1979), active involvement facilitates the retention of information as well. In addition, preparation and involvement in class discussions are associated with students who learn better (Daggett, 1997; Garard, Hunt, Lippert, & Paynton, 1998; Weaver & Qi, 2005), become better critical thinkers, (Garside, 1996; Jones, 2008; Smith, 1997), and have self-reported gains in character (Kuh & Umbach, 2004).

Cognitive engagement relates to the effort and mental processes students employ during classroom learning activities and instruction (Helme & Clarke, 2001). Specifically, it involves the employment of deep versus surface learning strategies (Fredricks et al., 2004). Deep learning involves understanding underlying concepts through application and drawing connections (Entwistle, 2000). In contrast, surface learning involves memorizing separate facts whereby the intention of the student is to cope with and complete the task (Entwistle, 2000). Numerous positive student outcomes are also associated with cognitive engagement. Cognitively engaged students exert more mental effort, employ more deep learning strategies, create more connections between ideas, and thus achieve greater understanding of course material (Weinstein & Mayer, 1986). Studies have found that students who use such metacognitive strategies perform better on various indicators of academic achievement (Carini, Kuh & Klein, 2006; Zimmerman, 1990).
Laird, Shoup, Kuh and Schwarz (2008) analyzed results from 80 000 students, and found that across all disciplines, engaging more frequently in deep learning was associated with greater educational gains, higher grades, and greater satisfaction in university. Similarly, a study conducted among first year undergraduate students, found that cognitive engagement was positively correlated with self-reported gains in general education, practical competence, and social and personal development, even after controlling for students’ demographic characteristics and pre-university entrance grades (Reason, Cox, McIntosh & Terenzini, 2010).

Psychological engagement relates to students’ emotional reactions to learning tasks and instructions (Chapman, 2003). Examples include high levels of interest, perceptions, and attitudes toward the course (Chapman, 2003). As with behavioural and cognitive engagement, positive student outcomes are associated with psychological engagement. Goodenow (1993) identified a positive association between psychological engagement and adaptive school behaviours, including task persistence, participation, and belonging. Enjoyment and hope expressed by students within the classroom have been linked to achievement outcomes (Frenzel, Thrash, Pekrun, & Goetz, 2007). A study by Berry & Plecha (1999) found that enthusiasm and confidence are associated with improved performance on exams. Among undergraduate psychology students, positive emotions, such as enjoyment, were positively related to Grade Point Average (Pekrun, Goetz, Frenzel, Barchfeld & Perry, 2011). Sagayadevan and Jyaraj (2012) suggest that positive attitude and openness towards learning are associated with increased behavioural and cognitive engagement, learning, and subsequently, student achievement. One study found that students who more strongly experience positive (i.e., hope and pride) versus negative emotions (i.e., anger, boredom, anxiety, and shame) in a course are likely to adopt more deep approaches to learning (Trigwell, Ellis & Han, 2012). Altogether, substantial research
demonstrates that behavioural, cognitive, and psychological factors contribute to overall engagement and student success.

2.3 Influence of Large Class Size on Student Engagement

While large class sizes, by their very nature, accommodate large numbers of students and therefore help to address ever-expanding enrollments, they have at the same time, been associated with lower levels of behavioural, cognitive, and psychological factors of engagement, and subsequently poorer student outcomes (Cuseo, 2007). Behaviourally, students reported that the most dissatisfying consequence of large introductory courses was the lack of instructor-student interactions and opportunities for questions and discussions (Wulff, Nyquist & Abott, 1987). Stones (1970) found that 60% of 1,000 college students surveyed, deterred from asking questions due to the large number of people in the class. An observational study by Karp & Yeols (1976) revealed a negative correlation between class size and the number of actively participating students. In classes of fewer than 40 students, 4 to 5 students accounted for 75% of all classroom interactions (Karp & Yeols, 1976). Furthermore, students in large introductory courses reported they more easily lost attention and became more easily distracted by classroom noise and student conversations (Wulff et al., 1987). Cooper and Robinson (2000) also reported declines in attendance in large classes down to 30 to 40% by the end of the semester.

With respect to cognitive engagement, large class size is associated with reduced levels of deep learning in the classroom (Cuseo, 2007), while small class size is associated with the development of higher-level thinking skills (Dunkin & Barnes, 1986; MacKeachie, 1980). Fisher and Grant (1983) analyzed audiotapes of 155 class sessions in 40 undergraduate courses in both public and private institutions and found that class size significantly affected the level of cognitive skills employed by students in the classroom. In large classes, student responses to
instructor-posed questions reflected low levels of cognition (i.e., factual recall), versus high levels of cognition (i.e., analysis) in small classes.

Students also have more negative attitudes and perceptions towards large classes and are thus less psychologically engaged (Cuseo, 2007). One study found that students reported higher levels of course dissatisfaction for introductory courses than they did for smaller-sized classes (Carbone & Greenberg, 1998). Students also feel more anxious about participating in large classes (Smith, 1992). Rather, McKeachie’s (1980) review of literature revealed that students expressed a strong preference for small-sized classes, and according to Light (2001), student satisfaction with their overall academic experience is positively correlated with the number of small classes in which they are enrolled.

Low levels of behavioural, cognitive, and psychological engagement in large classes have been found to be associated with decreased learning and performance. Carbone and Greenberg (1998) found that, of the 800 students enrolled in large classes surveyed, only 25% agreed with the statement, “The size of the class does not affect my ability to learn.” A study of the impact of increased class sizes on academic performance revealed that the percentage of A and B+ grades awarded decreased with increased enrollment (Linsay & Paton-Saltzberg, 1987). Similarly, Franklin (1991) discovered an inverse relationship between class size and course grades. A study of first-year seminars also found that students enrolled in smaller-sized sections of the course achieved higher first-term GPAs (Fidler & Hunter, 1989).

Large class size has numerous negative implications on engagement, and subsequently, the learning and performance of students. Unfortunately, large classes are most prevalent among the introductory-level courses in which students enroll during their initial university years (Stanley & Porter, 2002) – a pivotal time for engaging students (Cuseo, 2007). According to the
Persistence in Post-Secondary Education in Canada report, first-year students accounted for 14 of the overall 16% dropout rate (Parkin & Baldwin, 2009). Furthermore, disengaged students in large classes may become passive learners and develop poor learning habits that also affect their performance in senior years (Cuseo, 2007). Auster and MacRone (1994) reported that participation in early year university classes was a reliable predictor of participation in later year classes. Thus, educators need to identify the underlying predictors of poor engagement in large classes, and develop effective learning initiatives that engage students in their initial years of university.

2.4 Underlying Predictors of Student Engagement

According to Maslow (1970), “[m]otivation drives behaviour and effort towards success”. It involves the direction, intensity, and quality of one’s energies (Maehr & Meyer, 1997), and answers the question of why for a given behaviour. Thus, motivation literature, specifically, the Self-Determination Theory (SDT) (Deci et al., 1991), can be used to inform the development of effective engagement initiatives which target the primary initiating or motivating factors that drive students to engage in a course.

2.4.1 Interest

First, according to SDT, students are more motivated to engage with topics that interest them. This is because humans have an inherent tendency to explore and learn (Ryan & Deci, 2000). This natural inclination to engage with topics of interest is essential to cognitive and social development as it develops one’s knowledge, skills and self-concept (Csikszentmihalyi & Rathunde, 1993; Ryan, 1995; Ryan & Deci, 2000).

According to Hidi and Renninger (2006), interest is a psychological state that, in later phases of development, is also a predisposition to reengage. It is the outcome of an interaction
between a person and a particular object, activity, or content (Hidi & Baird, 1986; Krapp, 2000; Renninger & Wozniak, 1985; Schiefele, Krapp, Prenzel, Heiland & Kasten, 1983). Thus, interest propels one towards a specific activity or topic (Schiefele, 1991). Researchers have distinguished two types of interest: situational and personal (Flowerday, Schraw & Stevens, 2004). “Situational interest is context-dependent, short-lived, and based on spontaneous attraction” (Renninger, Hidi & Krapp 1992; Schraw & Lehman, 2001). Contextual factors that trigger situational interest include novelty, exclusivity, or salient informational content (Wade, 1992). In contrast, personal interest, also referred to as topic interest, is more long-term and content-specific (Schiefele, 1999). It is conceived of as a relatively enduring preference for certain topics, subject areas, or activities (Hidi, 1990; Prenzel, 1988; Renninger, 1990; Renninger & Wozniak, 1985; Schiefele, 1990). Factors that elicit personal interest include pre-existing knowledge, personal meaning, experiences, and relevance (Alexander & Jetton, 1996; Schiefele, 1991; Tobias, 1994). Personal interest has been found to positively impact attention, recognition, and recall (Renninger & Wozniak, 1985); persistence and effort (Krapp & Lewalter, 2001; Prenzel, 1992; Renninger & Hidi, 2002; Renninger & Leckrone, 1991); and academic motivation (Ainley, 2006; Alexander & Murphy, 1998; Murphy & Alexander, 2002; Schiefele, 1999). In comparison with situational interest, personal interest is associated with greater overall engagement (Schiefele, 1991). Instructors should therefore seek to develop students’ personal interest in a course.

In addition, the Four Phase Model of Interest Development (Hidi & Renninger, 2006) describes the development of interest through four phases from situational to personal interest. According to Hidi and Renninger (2006), interest develops first from triggered situational interest, which if sustained, evolves into maintained situational interest, followed by emerging
personal interest, and finally, well-developed personal interest. Triggered situational interest can be sparked by novel and surprising environments. Maintained situational interest evolves when situational interest is held and sustained through meaningfulness of tasks and/or personal involvement. Emerging personal interest is characterized by positive feelings, stored knowledge, and stored value whereby the student values the opportunity to reengage in similar contexts. Finally, well-developed personal interest is characterized by even more positive feelings, stored knowledge, and stored value whereby students not only value but actively pursue additional learning opportunities, ask questions, and seek out answers.

Kolb’s Theory of Experiential Learning (1984) can be used to further elaborate on how to support the development of emerging and well-developed personal interest. According to Kolb (1984), “learning is grounded in experience and involves a transaction between the person and the environment.” It is through this transactional process that students can integrate current experience with their previous knowledge, values, and beliefs, thus increasing the relevance of, and personal interest in, the studied material. The experiential learning process involves four stages: 1) concrete experience, 2) reflective observation, 3) abstract conceptualization, and 4) active experimentation. Concrete experience involves taking part “fully, openly, and without bias in new experiences” (Kolb, 1984). The learner participates in an actual experience critical to the subject matter (Kolb, 1984; Kolb & Fry, 1975). Reflective observation involves “reflect[ing] on and observ[ing] experiences from many perspectives (Kolb, 1984). In this stage, the learner personalizes the experience by reflecting on it and relating it to their own life (Kolb, 1984; Kolb & Fry, 1975). Abstract conceptualization involves “creat[ing] concepts that integrate observations into logically sound theories” (Kolb, 1984). During this stage, the learner attempts to integrate the experience into a theory he/she can relate to (Kolb, 1984; Kolb & Fry, 1975).
Finally, active experimentation involves using theories to make decisions and solve problems” (Kolb, 1984). Thus, the learner assesses the theory in different situations (Kolb, 1984; Kolb & Fry, 1975). Together, The Four Phase Model of Interest Development (Hidi & Renninger, 2006) and Kolb’s Theory of Experiential Learning (Kolb, 1984) can be used to inform how instructors can, through an intriguing, experiential learning activity, stimulate and deepen students’ situational and personal interest in a course.

Numerous studies across various disciplines further support the effectiveness of an experiential learning activity on increasing students’ interest, engagement, and performance in a course. Real-life case studies in marketing and business courses (Chavan, 2011; Greene, 2011; Polito, Kros & Watson, 2004; Rambruth & Daniel, 2011), field trips in biology courses (McLaughlin & Johnson, 2006; Sukhontapatipak & Srikosamatara, 2012), and laboratory model demonstrations in chemistry (Wang, 1996) and physics (Singh, 2002; Wee, 2012) courses have all shown to increase relevancy, interest, engagement, and learning in the course. Within health science disciplines, many courses include a laboratory component to enable students to apply course concepts to real-life practice (Cohen, Drury & Wright, 1988; Weigle et al., 2007). Cited in the literature, many experiential learning activities in health sciences have been successfully implemented in smaller-size upper-year courses versus large introductory-level courses (Chow & Phoon, 2003; Martin, Watkins & Ramsey, 2004; Tarnus & Bourdon, 2007; Yar, 2008).

However, in food and nutritional sciences in particular, very few studies have examined the feasibility and impact of an experiential learning activity on learning and performance in large enrollment courses (Bohn & Schmidt, 2007). Bohn and Schmidt (2008), educational researchers in the department of food science and nutrition, provide an explanation for this and state:
Because of the use of real-life experiences, experiential learning activities are often viewed as impractical and potentially unfeasible instructional tools to employ in a large enrollment courses. However, the reported benefits of using experiential learning activities in smaller classroom settings strongly suggest the need for determining how to develop and implement a doable experiential learning activity for the large enrollment classroom.

Based on a review of the literature, no experiential learning studies have formally assessed impact on student engagement. A majority of studies assessed impact on engagement through informal student feedback and activity satisfaction surveys (i.e., Bohn & Schmidt, 2007; Tarnus & Bourdon, 2006). Thus, while extensive research has found that experiential learning activities effectively increase interest and learning outcomes, more research is needed to formally assess feasibility and impact of activities on student engagement, and particularly in large enrollment nutrition courses.

2.4.2 Autonomy

Regarding not only the content of the course, but also concerning the learning environment, SDT further posits that individuals have a natural inclination to engage in an environment that promotes their sense of autonomy, self-efficacy, and belonging (described further below). Ryan & Deci (2000) identify autonomy, self-efficacy, and belonging as three psychological needs essential for overall well-being. Similar to Learning Theory (Hull, 1943) which asserts that all behaviours are motivated by physiological needs, SDT asserts that learning is motivated by individuals’ psychological needs for autonomy, self-efficacy, and belonging. Satisfaction of these needs results in optimal learning and development (Ryan & Deci, 2000). Humans have a natural inclination to engage in environments that provide psychological
satisfaction, and it is in these environments that optimal learning and development occur (Ryan & Deci, 2000).

Recent research further supports the significance of these three social-contextual factors (autonomy, self-efficacy, and belonging) in increasing student engagement. Schuetz (2008) attempted to construct a theoretical framework to explain results from Community College Survey of Student Engagement (CCSE). CCSE works in partnership with NSSE to assess levels of engagement in post-secondary institutions across North America (Center for Community College Student Engagement, 2014). Schuetz (2008) collected surveys from 1000 undergraduate students, and also conducted semistructured interviews with 30 students. Schuetz (2008) found that students’ sense of autonomy, self-efficacy, and belonging best explained their engagement results. Subsequent research by Zepke, Leach & Butler (2010) support Schuetz’s (2008) findings. Zepke et al. (2010) developed a survey to assess motivators of student engagement. The survey was administered across 8 post-secondary institutions, and results were collected from 1246 first-year students. Results confirm that autonomy, self-efficacy, and belonging are all important factors in motivating students to engage in their learning.

Elaborating further on each of the three environmental predictors of engagement, autonomy involves being self-initiating and self-regulating of one’s own actions (Deci et al., 1991). Thus, in addition to developing students’ interest in course content, instructors can increase student engagement by creating a learning environment that promotes their students’ autonomy or independence. Numerous studies support the positive association between autonomy and engagement (Black & Deci, 2000; Levesque, Zuehlke, Nicola & Ryan, 2004; Sierens, Vansteenkiste, Goossens, Soenens & Dochy, 2009; Vansteenkiste, Simons, lens, Sheldon & Deci, 2004; Williams & Deci, 1998). For example, Ryan and Deci (2000)
investigated students’ perception of their instructors’ autonomy support in an introductory organic chemistry course. Students’ perceptions of their instructors’ autonomy support predicted increases in self-initiated or active participation, perceived confidence, and enjoyment, and decreases in anxiety over the semester (Ryan & Deci, 2000). One intervention study was also conducted by Vansteenkiste et al. (2004) among 200 female college students. The study examined the effect of learning text and physical exercises framed according to intrinsic (community, personal growth, health) versus extrinsic (money, image) goals, and in an autonomy supportive versus controlling manner. Phrases such as “you can” and “if you choose” versus “you must” and “you’d better” were used in the autonomy-supportive versus controlling condition. Vansteenkiste et al. (2004) found that intrinsic goals and an autonomy supportive environment had a significant positive effect on deep processing, persistence, and performance.

As demonstrated by Vansteenkiste et al. (2004), instructors can support students’ autonomy by offering choice, encouraging self-initiating behaviour, and increasing their responsibility in learning (Zimmerman, 1995; Deci et al., 1991). Furthermore, choice, self-initiating behaviour, and responsibility, are essential for self-regulated learning – a widely researched educational construct associated with increased student engagement (Boekaerts, 1999). According to Pintrich (1995), “[s]elf-regulated learning involves the active, goal-directed, self-control of behaviour, motivation, and cognition for academic tasks by an individual student. It involves the active control of various resources students have available to them, such as their time, study environment, and faculty members and peers (Pintrich & Garcia, 1994; Pintrich, Smith, Garcia & McKeachie, 1993). The individual student, not a parent or teacher, must be in control of his/her actions (Pintrich, 1995). With respect to engagement, self-regulated learners are actively engaged participants in their own learning, psychologically, cognitively, and
behaviourally (Boekaerts, 1999). Psychologically, self-regulated learners report high interest,
confidence, and enjoyment in their learning (Borkowski & Muthukrishna, 1992; Zimmerman &
Martinez-Pons, 1990). Cognitively, self-regulated learners set goals and self-evaluate to employ
metacognitive processes optimal for deep learning and comprehension of material (Corno, 1986,
1989; Ghatala, 1986; Pressley, Borkowski & Schneider, 1987). Lastly, behaviourally, they
actively seek out advice, information, and places to further their learning (Henderson, 1986;
learners, faculty can provide opportunities for student choice and control in academic tasks
(Pintrich, 1995) – a critical aspect of self-regulated learning (Winne, 1995; Winne & Perry,
2000). As Zimmerman (1994) describes, students must have some choice and control over their
learning if self-regulated learning is to occur. For example, instructors can provide
supplementary learning activities, catered towards various learning styles, where participation is
voluntary. This enables students to become engaged participants in their learning, by
encouraging them to evaluate their learning needs, the benefits of the activity, and then actively
choosing whether or not to participate. Altogether, autonomy, specifically choice, is critical for
self-regulated learning and thus student engagement.

Autonomy-supportive learning strategies, such as inquiry-based learning, are also
associated with increased engagement and learning outcomes. Inquiry-based learning involves
stimulating learning with questions or issues to engage learners in constructing new knowledge
(Sproken-Smith, Walker, Batchelor, O’Steen & Angelo, 2012). The instructor plays a greater
facilitator role and students’ learning is more self-directed (Lee, 2012). Autonomy increases in
learning environments that are less structured and guided, and more discovery-based (Staver &
Bay, 1987). Such environments are open to inquiry and students have the opportunity to
formulate their own questions (Staver & Bay, 1987). A recent survey of 940 students across 15 undergraduate classes found that more discovery-based open inquiry techniques were associated with higher student course ratings, engagement, and learning outcomes (Spronken-Smith et al., 2012). Thus, in addition to choice, creating learning opportunities that allow students to explore and ask questions can increase engagement.

2.4.3 Self-efficacy

In addition to autonomy, self-efficacy is a key construct to promoting students’ engagement and learning (Linnenbrink & Pintrich, 2003). Early behavioural and educational psychologists have acknowledged being self-efficacious (Bandura, 1977), having confidence (Dweck, 1986), and having strategies and capacities for success (Skinner et al., 1990), to be a key motivating construct for learning. Self-efficacy is also a critical component of Social Cognitive Theory (Bandura, 1989), a theory which addresses factors (i.e., social, environmental, and cognitive) that influence behaviour change. Specifically, the higher one’s self-efficacy, the more likely he/she is to engage in favourable learning behaviours (Bandura, 1989).

Numerous studies have found self-efficacy to strongly influence engagement and performance. Walker, Greene and Mansell (2006) examined intercorrelations among measures of identification with academics, self-efficacy, motivation, and engagement among 191 college students, and found self-efficacy to be a predictor of cognitive engagement. Similarly, Prat-Sala and Redford (2010) found that among 163 first-year psychology students, those classified as high in self-efficacy were more likely to use deep (i.e., understanding) versus surface (i.e., memorization) approaches to studying, and were more motivated to engage in the course overall. Among 165 undergraduate students in a human development course, high, medium, and low academic self-efficacy all significantly predicted levels of student participation and exam
performance (Galyon, Blondin, Yaw, Nalls & Williams, 2012). Similar studies present similar findings (Chowdhury & Shahbuddin, 2007; Glynn, Brickman, Armstrong & Taasoobshirazi, 2011; Spence & Usher, 2007; Zusho, Pintrich & Coppola, 2003). Furthermore, Breso, Schaufeli and Salanova (2011) examined the effect of a 4-month program that consisted of 4, 2-hour sessions where the main objective was to decrease exam anxiety and to increase students’ beliefs of self-efficacy. Results showed that self-efficacy, engagement and performance increased in the intervened group when compared to control groups. Additional studies also support the effectiveness of decreasing anxiety in a course on increasing students’ motivation and academic performance (Glynn, Taasoobshirazi & Brickman, 2009; Partin et al., 2011). Thus, one way instructors can increase self-efficacy, engagement, and performance is by providing opportunities for students to learn study and test-taking strategies, thereby decreasing their anxiety in the course.

2.4.4 Belonging

Finally, instructors can increase student engagement by increasing students’ sense of belonging in the class. Students are more likely to engage and flourish in contexts characterized by a sense of security and relatedness (Ryan & Deci, 2000). From infancy, studies have shown that security and maternal support predicted more exploratory behaviour (Frodi, Bridges, & Grolnick, 1985). When children worked on an interesting task in the presence of an adult stranger, they showed less motivation to engage in the task when the adult ignored them and failed to respond to their initiations (Anderson, Manoogian & Reznick, 1976).

While the significance of feeling a sense of belonging and security stems from early developmental psychology, it is also important for undergraduate students (Kuh & Hu, 2001). In higher education, students’ sense of belonging can be fostered by providing opportunities that
increase student-instructor interactions. In doing so, instructors can build more supportive relationships with students, and students can feel more socially supported in their learning. According to Kuh and Hu (2001), student-faculty interaction has substantial positive effects on students’ efforts in educationally purposeful activities, and contributes to estimated learning gains and satisfaction. Many studies have examined the effect of quality and frequency of student-faculty interaction (Delaney, 2008; Flannelly, 1990; Klem & Connell, 2004; Komarraju, Musulkin & Bhattacharya, 2010; Lundberg & Schriener, 2004; Rugutt & Chemosit, 2009; Thompson, 2001). For example, two first-year and two fourth-year classes at University of North Carolina were surveyed with the College Student Experience Questionnaire, and data showed that high levels of student-faculty contact coincided with high student scores on quality of effort measures (Flannelly, 1990). In another study, analyses of 1 500 first-year responses to Your First College Year survey, identified significant relationships between students’ interaction with faculty and perceived growth in knowledge, academic adjustment, and satisfaction with courses (Delaney, 2008). Also, after controlling for relevant factors, interaction with faculty significantly predicted overall satisfaction and academic performance (Delaney, 2008).

Furthermore, according to Komarraju, et al. (2010), while most interactions with faculty occur within the formal classroom setting, students who experience less formal interactions outside of class tend to be more motivated, engaged, and actively involved in the learning process. Thompson (2001) found that informal student-faculty interactions contributed to the success of science and math students in community colleges. Kuh (1995) explored out-of-class college experiences among 149 students and found faculty contact to be one of the contributors to valued college outcomes. Thus, instructors should provide students additional learning opportunities to further interact, support and engage students in the course.
Altogether, students will be more engaged in a course that is interesting and promotes their sense of autonomy, competence, and belonging. Instructors can increase student engagement through an experiential learning activity to develop their personal interest in course content. Regarding the social-contextual learning environment, instructors can further engage students by developing learning initiatives that increase students’ sense of autonomy, self-efficacy, and belonging in the course. Instructors can promote autonomy by providing students choice to participate versus not, and opportunities for students to explore and ask questions. Instructors can promote self-efficacy by also teaching study and test-taking strategies to decrease anxiety. Finally, creating opportunities to increase student-faculty interaction, especially outside the classroom, can further increase engagement.

2.5 Preliminary Studies

Faculty in the Applied Human Nutrition program at University of Guelph have attempted to increase student engagement with various initiatives in recent years. The following initiatives, while not published, informed the development of the learning initiative for this study. In fall 2008, students from a fourth year undergraduate nutrition class were invited to a health assessment lab to participate in an optional experiential learning activity. Students underwent testing of their body composition, resting metabolic rate, and bone density using the lab’s cutting-edge research equipment. Based on its success, the initiative was offered in the same course in winter 2010. In both years, there was ≥ 80% participation rate. Also, in fall 2011, a learning initiative was conducted in a fourth year undergraduate nutrition class. Students were invited to attend, weekly one-hour study sessions held by the course instructor. Participation was voluntary and sessions addressed test-taking strategies, practice questions, and difficult course content. Informal feedback suggested that the students found the sessions very beneficial.
Students appreciated the instructor’s support and felt more confident answering practice questions. Quantitative data support this feedback: after participating in 5 sessions, students scored 16% higher on the final exam than on the midterm.

Results from the optional experiential learning activity and study sessions, in addition to support from the literature, suggest that together they address the four underlying predictors of student engagement. Specifically, the experiential learning activity increased students’ interest in course material. Allowing students to choose whether or not to participate was autonomy-supportive. Finally, the instructor-led study sessions increased students’ self-efficacy and support or belongingness in the course. However, one limitation of these earlier initiatives was that impact on student engagement was not assessed. These earlier initiatives were also implemented in upper-year classes. Thus, the feasibility and impact on student engagement of similar initiatives in large introductory-level nutrition classes have not yet been examined.
3.0 Rationale, Hypotheses, Objectives

Class sizes are expanding rapidly due to the recent increase in university enrollment. There is also a growing body of literature on student engagement - a widely accepted indicator of educational quality. Numerous positive student outcomes are associated with behavioural (i.e., active participation), cognitive (i.e., deep versus surface learning), and psychological (i.e., attitude, enjoyment) student engagement. Of concern however, studies have found that large class size is associated with low student engagement.

Early research has identified four underlying predictors of engagement: interest, autonomy, self-efficacy, and belonging. Interest is a psychological state that propels one towards a specific activity or topic, and is thus amenable to instructional influence (Schiefele, 2006). Autonomy involves being self-initiating and self-regulating of one’s own actions (Deci et al., 1991). Competence involves having strategies for success (Skinner et al., 1990), and feeling confident (Dweck, 1986). Belonging involves having a sense of care, support, and connectedness with others (Ryan & Deci, 2000). Substantial research supports the effectiveness of addressing these four factors on increasing student engagement. Thus, instructors should develop learning initiatives that increase students’ interest, autonomy, self-efficacy, and belonging, to increase engagement.

Informed by the above literature, and the development and success of previous learning initiatives, this study implemented both a lab-based experiential learning activity and out-of-class study sessions to address the four underlying predictors of engagement. The purpose of the experiential learning activity was to increase students’ interest in course material, and the purpose of optional participation in both the experiential learning activity and study sessions was to promote autonomy. Also, the purpose of study sessions was to develop students’ self-efficacy.
and belonging. Previously, similar learning initiatives were conducted in smaller-sized upper year classes, and did not examined impact on student engagement. To address limitations of these earlier learning initiatives, this study introduced and assessed the impact of the experiential learning activity and study sessions on student engagement within large introductory classes.

Thus, the overall goal of this research was to examine the impact and feasibility of an optional experiential learning activity and study sessions on student engagement and academic performance in large undergraduate introductory-level nutrition courses.

**Objectives**

1. To examine the impact of an experiential learning activity and study sessions on student engagement and course performance in large introductory-level undergraduate nutrition classes.

2. To examine the feasibility. More specifically, we will examine the reach and acceptability of the experiential learning activity and study sessions.

**Hypotheses**

1. It is hypothesized that participation in the experiential learning activity and study sessions will result in an increase in student engagement as compared to baseline measures. Participants will also experience a greater increase in course performance versus non-participants as assessed by %tile rank change between the midterm and final exam.

2. The study sessions and experiential learning activity will be feasible to implement and acceptable to students.
   a. Participation rates will be high and students who are currently struggling in the course will enroll (reach).
   b. Participants will report a high level of satisfaction (acceptability).
4.0 Methods

4.1 Study Design

The purpose of this study was to examine the impact and feasibility of an optional experiential learning activity and study sessions on student engagement and academic performance in introductory-level nutrition classes. This was an intervention study with a pre-post uncontrolled design to assess student engagement, and a quasi-experimental design to assess academic performance. This study was approved by University of Guelph Research Ethics Board (Appendix A).

4.2 Sample and Recruitment

Participants were undergraduate students in one of two large introductory nutrition courses. NUTR*2050 (Family and Community Nutrition) was a second year course of 262 students held in fall 2012. NUTR*1010 (Nutrition and Society) was a first year course of 567 students held in winter 2013. NUTR*1010 is a mandatory course for all Bachelor of Applied Science students (i.e., students in the Applied Human Nutrition, Adult Development, or Child, Youth, and Family program), and is a prerequisite for NUTR*2050. NUTR*2050 is a mandatory course for only Applied Human Nutrition students. Bachelor of Applied Science students are given priority enrollment in both courses. Should space remain available, students from any program may enroll in NUTR*1010 as an elective, or NUTR*2050 if they had previously taken NUTR*1010.

Enrollment in either course was the only inclusion criteria for this study. Participation was entirely voluntary. Students received no penalty for choosing not to participate; however, bonus marks were given to participants who completed the optional assignment as part of the experiential learning activity.
The experiential learning activity and study sessions were described in the course outline as an opportunity for students to improve their course performance after the first midterm exam. Interested students attended an information session held within one week of the release of midterm exam grades. The information session was held immediately after class in NUTR*2050. All students were welcome to attend. In NUTR*1010, the information session was held later in the day in a separate classroom. Also, due to the large class size in NUTR*1010 (600 students), enrollment in the experiential learning activity was limited to the first 100 students to arrive to the information session; subsequent students were put on a wait list. However, in both NUTR*2050 and NUTR*1010, there was no limit for study sessions; all students were welcome to attend. To enroll in this study, students signed up for the experiential learning activity and provided informed consent (Appendix B) at the information session. Students were still able to participate in the learning opportunities if they chose not to be involved in this research. Students provided permission to use their data for use in a separate biological research study in the consent form collected at the initial information session.

4.3 Learning Initiative

The learning initiative consisted of two components; an experiential learning activity, and study sessions.

4.3.1 Experiential Learning Activity

The experiential learning activity involved: 1) touring the University of Guelph Body Composition and Metabolism Laboratory, 2) undergoing a body composition assessment, 3) and completing a 3 day food record, various health questionnaires, and a take-home assignment. The lab visit was 1 hour and facilitated by a graduate research assistant. Participants attended in pairs and were sent a reminder e-mail 1 week prior to their lab visit. In the reminder e-mail, students
were provided with instructions on completing a 3 day food record. Food records were collected at the start of the lab visit and analyzed using The Food Processor for Windows (version 10.12.0; ESHA Research, Salem, OR). The food records were entered by undergraduate research assistants. Results were e-mailed to participants two weeks after the lab visit by a graduate teaching assistant.

Students were given a 10 minute tour of the lab, which included a dual energy x-ray absorptiometer, a metabolic cart, and a BOD POD™. The graduate research assistant explained the clinical and research significance of the lab equipment.

Body composition, including fat-free mass and fat mass, was assessed using a BOD POD™ Air Displacement Body Composition System (software version 4.5.1, Cosmed, Concord CA). This test involved four measurements: height, body weight, body volume, and thoracic lung volume. Participants first changed into a bathing suit and bathing cap, and removed jewellery, as per standard protocol for BOD POD testing. Height was measured to the nearest 0.1 cm using a wall-mounted stadiometer (Medical Scales and Measuring Devices; Seca Corp., Ontario, CA). Weight was measured to the nearest 0.1 kg using the digital scale from the BOD POD. Participants then entered the BOD POD for measurement of raw body volume. They were instructed to sit quietly, limit movement, and breathe normally while in the test chamber. The final step was the measurement of thoracic gas volume used to adjust raw body volume. For this, participants were instructed to continue to sit quietly in the test chamber, and to plug their noses while breathing through a disposable tube connected to the rear of the instrument. Adjusted body volume was converted to body density and then to percent fat mass and fat free mass. The entire BOD POD procedure, undertaken by one of two trained graduate research assistants, took
approximately 20 minutes per participant. Participants received a print-out of their results immediately after their test.

The health behaviour questionnaires took approximately 15 minutes to complete and included questions related to the participant’s mood, sleep quality, and physical activity level.

The take home assignment (Appendix C) included six questions based on the 3 day food record experience (i.e., Identify two things you learned in completing the food record?), and BOD POD results (i.e., How does your percent body fat compare to the “Percent Body Fat Standard for Health” for your age and gender? Is your percent body fat consistent with the Standard? Why or why not?). Assignments from NUTR*2050 were marked by the NUTR*1010 instructor, and vice versa. Students earned bonus marks up to 5% towards their midterm exam grade.

4.3.2 Study Sessions

Weekly 1-hour study sessions were held between the midterm and final exam. Study sessions took place at the same time and location as the information session. Five sessions were held in NUTR*2050 and 7 sessions were held in NUTR*1010. Sessions were led by the course instructor and staff from University of Guelph Learning Services. Learning Services provides consultations on improving student learning skills. One learning strategy was presented each week (i.e., time management, exam preparation, etc.). The course instructor also worked through practice questions with the students, and allotted time to clarify difficult course concepts. Students did not have access to study session content outside of study sessions (i.e., lecture slides and practice questions were not posted online).
4.4 Measures

4.4.1 Impact of Learning Initiative

*Engagement:* The Classroom Survey of Student Engagement (CLASSE) (Smallwood & Ouimet, 2005) is an adapted form of the National Survey of Student Engagement® - a widely used valid and reliable survey that assesses campus-level undergraduate student engagement (Kuh, 2004). The CLASSE is composed of two instruments: the CLASSE Student asks students how frequently they engage in various educational practices within the class, and the CLASSE Faculty asks the instructor how important the various educational practices are in facilitating student success in the class (Smallwood & Ouimet, 2005). For the purpose of this study, only the CLASSE Student (here on referred to as CLASSE) was administered, and adaptations with permission of copyright holders were made. Items irrelevant to the course were removed (i.e., “How often in your class have you been required to prepare written papers or reports more than 5 pages in length?”). In total, the CLASSE administered in this study contained 19 engagement items assessed on a 4-point Likert scale (Appendix D). Items were grouped into the three dimensions of engagement represented in the survey: Active and Collaborative Learning (ACL), Student-Faculty Interaction (SFI), and Level of Academic Challenge (LAC). The response for each item was scored on a scale of 0 to 100. Demographic data (gender, year of study, program, ethnicity, age, full-time/part-time status) were collected as well. At baseline, the CLASSE was administered during the information session. After participating in the learning initiative, the survey was completed in the lab when participants came to submit their optional assignment.

*Performance:* Performance change was assessed by the difference in %tile rank from the first midterm exam grade (baseline) to final exam grade (follow-up). Change in %tile rank was
assessed using grades accessed through CourseLink, the online course management system at University of Guelph for participants and students who did not participate in the ELA.

4.4.2 Feasibility of Learning Initiative

*Reach:* A record of the number of participants who attended the experiential learning activity and study sessions was used to assess attendance. Also, participants’ midterm exam percentile ranks were recorded to determine the academic performance level of students who participated in the experiential learning activity.

*Acceptability:* The Lab Satisfaction Survey (Appendix E) and Study Session Satisfaction Survey (Appendix F) were specifically developed for this study, and were used to assess the overall acceptability of the lab visit and study sessions. Participants’ perceived learning benefit was assessed using close-ended questions on a 5-point Likert Scale that ranged from strongly disagree to strongly agree (i.e., “These learning activities helped me make connections between concepts learned in class”). Open-ended questions were also used to assess participants’ perceived learning benefit, and suggestions for future initiatives (i.e., “What other topics/activities would you like to see included in the study session?”). The Study Session Satisfaction Survey included one ranking question on the usefulness of different study session components (i.e., practice questions, guest lecturers from Learning Services). The Lab Satisfaction Survey was administered at the end of the lab visit. The Study Session Satisfaction Survey was administered in the lab when participants returned to the lab to submit their assignment.

4.5 Data Analysis

Quantitative data were analyzed using PASW Statistics version 18.0 for Windows (SPSS Inc., Chicago, IL). A $p$ value $\leq 0.05$ was considered significant. CLASSE data and participant
%tile rankings were normally distributed. The mean score for each dimension (ACL, LAC, and SFI) was calculated. Paired-samples t-tests were conducted to examine the change mean score for ACL, SFI, and LAC from baseline to follow-up. An independent samples t-test was conducted to examine the difference in %tile rank change in participants versus non-participants.

Data from satisfaction surveys were summarized as frequencies and percentages. In the case of the ranking question, data were summarized in two ways: the frequency with which the statement was ranked first, second or third; and, the mode response (the statements that were chosen most often by participants). Qualitative data from the open-ended questions were analyzed using thematic analysis (Braun & Clarke, 2006). Survey responses for each question were transcribed onto a single document. Following familiarization through examination of responses, responses were coded, grouped, and finally, themes were identified.
5.0 Results

5.1 Participants and Study Flow

As shown in Figure 1, a total of 172 participants (n=75 from NUTR*2050; n=97 from NUTR*1010) enrolled in this study. Although there was a 100 participant cap in NUTR*1010, 3 withdrew from the course after participating in the learning initiative and were excluded. Complete sets of CLASSE surveys were available for 58 participants in NUTR*2050, and 77 participants in NUTR*1010. In both courses, %tile rank data for grades on mid-term and final exams were available for all participants.

Descriptive statistics of participants are presented in Table 5.1. Demographic data were not available for 6 participants; 5 from NUTR*2050 and 1 from NUTR*1010, as these participants did not complete CLASSE surveys. The majority of NUTR*2050 participants were enrolled in an Applied Science program (i.e., Applied Human Nutrition, Adult Development, Child, Youth, and Family) (71%), and more specifically, in the program of Applied Human Nutrition (46%). In contrast, the majority of NUTR*1010 participants were enrolled in an Arts program (i.e., English, History, Psychology, etc.) (72%). In the overall sample, the majority of participants were female (87%), 18 to 19 years of age (89%), and Caucasian (84%).

5.2 Impact of Learning Initiative

5.2.1 Student Engagement

On a 100-point scale (0 = lowest score; 100 = highest score), baseline means (SD) in NUTR*2050 for Active and Collaborative Learning (ACL), Student-Faculty Interaction (SFI), and Level of Academic Challenge (LAC) were 30.6 (17.5), 28.5 (18.5), and 31.3 (15.0), respectively. Baseline means in NUTR*1010 for ACL, SFI, and LAC were 32.8 (16.8), 33.9 (19.4), and 37.6 (15.3).
From baseline to follow-up, there was a statistically significant increase in LAC in both NUTR*2050 \((M = 5.83; p = .003)\) and NUTR*1010 \((M = 5.67; p = .002)\). SFI increased significantly in NUTR*2050 \((M = 4.79; p = .017)\) but not NUTR*1010 \((M = 2.30; p = .335)\). ACL increased significantly in NUTR*1010 \((M = 10.24; p < .001)\), but not NUTR*2050 \((M = 3.06; p = .131)\). Results are summarized in Table 5.2.

**Figure 1** Study flow. ¹To be enrolled, students submitted a consent form and signed up for a lab visit at the information session. ²Enrollment was capped at 100 in NUTR*1010.
Table 5.1 Descriptive characteristics of NUTR*2050 and NUTR*1010 participants.

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<th>NUTR*1010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>141</td>
<td>60</td>
<td>81</td>
</tr>
<tr>
<td>Other</td>
<td>25</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

*Note. Data were missing from 5 from NUTR*2050 and 1 NUTR*1010 participants.*

*Programs in Arts include: English, Sociology, Psychology, etc.  bApplied Science: Applied Human Nutrition, Adult Development, Child, Youth, and Family.  cScience: Biology, Human Kinetics, Biomedical Sciences, etc.  dCommerce: Marketing Management, Hotel and Food Administration, Accounting, etc.*

### 5.2.2 Academic Performance

At baseline (first midterm), the mean %tile rank of participants in NUTR*2050 and NUTR*1010 were 49.8 (SD = 27.7) and 33.8 (SD = 24.1) respectively.

Participants from both courses experienced a significantly greater increase in %tile rank ($M = 4.70; M = 9.89$) than non-participants ($M = .387, M = .125$) from the midterm to final exam; $p = .032; p <.001$. Results are summarized in Table 5.3

33
Table 5.2 Baseline, follow-up, and mean change in engagement score.

<table>
<thead>
<tr>
<th></th>
<th>Whole Group 136 (n)</th>
<th>NUTR*2050 58 (n)</th>
<th>NUTR*1010 78 (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (SD)</td>
<td>Follow-up (SD)</td>
<td>ΔM (SD)</td>
</tr>
<tr>
<td>Active and Collaborative</td>
<td>31.8 (17.1)</td>
<td>38.9 (18.1)</td>
<td>7.03 (15.8)</td>
</tr>
<tr>
<td>Learning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student-Faculty Interaction</td>
<td>30.3 (16.5)</td>
<td>33.7 (19.1)</td>
<td>3.39 (18.8)</td>
</tr>
<tr>
<td>Level of Academic Challenge</td>
<td>34.9 (15.4)</td>
<td>40.3 (16.2)</td>
<td>5.44 (14.0)</td>
</tr>
</tbody>
</table>

Note. Minimum score = 0; maximum score = 100. Variations for n may exist in each dimension due to missing data.

Table 5.3 Mean %tile rank of participants at baseline (midterm 1) and follow-up (final exam), and comparison of mean change in %tile rank in participants versus non-participants.

<table>
<thead>
<tr>
<th></th>
<th>Participants Whole group n=172a</th>
<th>Non-participants Whole group n=808b</th>
<th>(^c p)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline (SD)</td>
<td>Follow-up (SD)</td>
<td>ΔM (SD)</td>
</tr>
<tr>
<td>Whole group</td>
<td>40.8 (26.8)</td>
<td>48.4 (28.2)</td>
<td>7.63</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>49.8 (27.7)</td>
<td>54.4 (28.1)</td>
<td>4.70</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>33.8 (24.1)</td>
<td>43.7 (27.5)</td>
<td>9.89</td>
</tr>
</tbody>
</table>

\(^a\)NUTR*2050 n=75; NUTR*1010 n=97. \(^b\)NUTR*2050 n=253; NUTR*1010 n=555. \(^c\)Comparison of mean change in participants versus non-participants.
5.3 Feasibility of Experiential Learning Activity

5.3.1 Reach

As shown in Figure 1, 83 students in NUTR*2050 enrolled in the experiential learning activity. Two students withdrew from the course and 6 were no longer interested and cancelled their visit in advance, resulting in a final participant count of 75 (29% class participation rate). In NUTR*1010, 100 students enrolled (maximum allowed for practical reasons including scheduling and availability of research assistants) in the experiential learning activity, and an additional 55 were put on the wait-list. Of the 100 initially enrolled, 4 students withdrew from the course, 1 was no longer interested and cancelled their visit in advance, and 5 did not show up. Ten students from the wait-list were subsequently enrolled. Three participants withdrew from the course after participating in the experiential learning activity, resulting in a final participant count of 97 (20% class participation rate).

As shown in Figure 2, the greatest number of NUTR*1010 participants had a baseline %tile rank in the bottom quartile of the class, and the smallest number in the top quartile. In NUTR*2050, there was a similar number of participants in each quartile.

![Figure 2 Percentile rank distribution of participants at baseline.](image-url)
5.3.2 Acceptability

In NUTR*2050, all 75 participants submitted a Lab Satisfaction Survey. Five surveys were incomplete (i.e., participants only completed one of two sides of the printed survey) and were therefore excluded from analyses. In NUTR*1010, 94 of the 97 participants submitted a Lab Satisfaction Survey. Three surveys were incomplete and were therefore excluded from analyses. Thus the number of completed Lab Satisfaction Surveys submitted in NUTR*2050 was 70 (93%), and 91 (94%) in NUTR*1010.

Greater than 80% of participants in both courses agreed or strongly agreed that additional learning activities would enhance their learning in the course, and disagreed or strongly disagreed that reading about the material instead would have been more useful. Seventy percent or more agreed or strongly agreed that the learning activities helped them make connections between concepts learned in class, and that they would consider themselves a “hands-on” learner. Sixty-one percent and 72% of participants in NUTR*2050 and NUTR*1010, respectively, agreed or strongly agreed that learning about the lab methods would be too theoretical without the activities. Finally, 77% and 87% of NUTR*2050 and NUTR*1010 participants, respectively, agreed or strongly agreed that they became more interested in their nutritional health after completing the learning activities. Results are summarized in Table 5.4.

In response to the yes/no question, “If given the opportunity, would you take part in other learning activities like this?”, 100% of respondents indicated yes.

The remaining questions in the Lab Satisfaction Survey were open-ended questions. In response to the question, “How could the learning activities be improved?”, the majority of respondents in both courses indicated no improvements were necessary and provided positive feedback.
“I think opening the optional assignment up to the class was the perfect way to get students involved and shows which individuals are interested. These activities are hard to come by, so I’m surprised I had the opportunity to participate.” [L018, NUTR*2050]

“More optional credit assignments provide motivation to join educational activities and enhance learning outside of the classroom.” [L053, NUTR*2050]

“No improvement. I loved the opportunity and learning about all the equipment.” [L133, NUTR*2050]

Secondly, many respondents wanted more learning activities. Specific to NUTR*1010, many suggested providing the experiential learning opportunity to more students:

“The only improvement I can think of would be more spaces available so more people in the class can experience this learning activity.” [L082, NUTR*1010]

“I think the activities were fine the way they were. For improvement, I think it would be helpful for students if there were more outside of class activities (such as the 3 day food guide) that didn’t feel like homework because I felt it helps keep me engaged in course material outside of lectures.” [L124, NUTR*1010]

In both courses, some respondents also indicated the activities could be improved by making them more relevant to course material:

“Discussion during class to make connections to course material rather than as a supplementary task.” [L044, NUTR*2050]

Also, a few respondents suggested providing further explanation of how the BOD POD works, and interpretation of their BOD POD results.

In response to the question “Overall, how have these learning activities (if at all) affected your learning and interest in this course?”, there were three common themes in both NUTR*2050 and NUTR*1010. The first was the activities increased attention to personal health:

“It has allowed me to see my own body composition so I can become aware of changes I should make in my own diet, activity levels, sleeping patterns, etc.” [L026, NUTR*2050]
“These activities make me more conscious about how I treat my body and I can take information from this course and apply it to myself to hopefully benefit from.” [L061, NUTR*2050]

Secondly, many respondents indicated the learning activities increased interest and engagement in the course:

“Gaining an interest in personal health is motivating for engaging in nutrition class.” [L100, NUTR*1010]

“Definitely furthered my interest in the course as well as my interest in my own personal health.” [L087, NUTR*1010]

“Increases attention in lectures.” [L092, NUTR*1010]

Thirdly, many respondents also indicated the learning activities increased real-life application of course concepts:

“Increased interest and increased ability to make connections between class concepts and real life.” [L152, NUTR*1010]

“When you do the bod pod and learn about your own body and your own nutrition, it just makes everything seem more real. All of the concepts learned in class can be applied to life.” [L036, NUTR*2050]
Table 5.4 Participant responses to: “Using the 5 point scale below, circle the number which best reflects your agreement with the various statements about the learning activity(ies) in which you participated” (Whole group $n=161$; NUTR*2050 $n=70$; NUTR*1010 $n=90$).

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
<td></td>
</tr>
<tr>
<td>Overall, I would consider myself a “hands-on” learner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>0</td>
<td>7 (4)</td>
<td>39 (24)</td>
<td>68 (42)</td>
<td>47 (29)</td>
<td></td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>0</td>
<td>1 (1)</td>
<td>20 (29)</td>
<td>31 (44)</td>
<td>18 (26)</td>
<td></td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>0</td>
<td>6 (7)</td>
<td>19 (21)</td>
<td>37 (41)</td>
<td>29 (32)</td>
<td></td>
</tr>
</tbody>
</table>

Rather than take part in this lab, it would have been more useful for my learning to have been given this time to read about the learning activities.

| Whole group | 91 (57) | 43 (27) | 22 (14) | 5 (3) | 0 |
| NUTR*2050 | 38 (54) | 22 (31) | 9 (13) | 1 (1) | 0 |
| NUTR*1010 | 53 (58) | 21 (23) | 13 (14) | 4 (4) | 0 |

Without these kinds of learning activities, learning about the methods would be too theoretical.

| Whole group | 2 (1) | 8 (5) | 53 (33) | 69 (43) | 29 (18) |
| NUTR*2050 | 2 (3) | 2 (3) | 16 (23) | 37 (53) | 13 (19) |
| NUTR*1010 | 0 | 6 (7) | 37 (41) | 32 (35) | 16 (18) |

These learning activities helped me make connections between concepts learned in class.

| Whole group | 1 (1) | 3 (2) | 34 (21) | 77 (48) | 46 (29) |
| NUTR*2050 | 1 (1) | 1 (1) | 12 (17) | 38 (54) | 18 (26) |
| NUTR*1010 | 0 | 2 (2) | 22 (24) | 39 (43) | 28 (31) |

Additional learning activities like these would enhance my learning in the course.

| Whole group | 0 | 0 | 26 (16) | 71 (44) | 64 (40) |
| NUTR*2050 | 0 | 0 | 11 (16) | 31 (44) | 28 (40) |
| NUTR*1010 | 0 | 0 | 15 (17) | 40 (44) | 36 (40) |

I became more interested in my nutritional health after completing these learning activities.

| Whole group | 1 (1) | 3 (2) | 24 (15) | 63 (39) | 71 (44) |
| NUTR*2050 | 1 (1) | 1 (1) | 14 (20) | 22 (31) | 32 (46) |
| NUTR*1010 | 0 | 2 (2) | 10 (11) | 41 (45) | 38 (42) |

*Note. Percents do not sum to 100 due to rounding.*
5.4 Feasibility of Study Sessions

5.4.1 Reach

As shown in Table 5.5, 33% and 12% of participants in NUTR*2050 and NUTR*1010, respectively, attended 3 or more study sessions. Instructor-reported attendance per study session ranged from 4 to 29 students in both courses.

Table 5.5 Participant response to “How many study sessions did you attend (check one)” (Whole group n= 172; NUTR*2050 n=75; NUTR*1010 n=97).

<table>
<thead>
<tr>
<th>Response</th>
<th>0</th>
<th>1 to 2</th>
<th>3 to 4</th>
<th>5 to 6</th>
<th>7 to 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole group</td>
<td>36(21)</td>
<td>106 (62)</td>
<td>23 (13)</td>
<td>7 (4)</td>
<td>0</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>12 (16)</td>
<td>42 (67)</td>
<td>15 (24)</td>
<td>6 (10)</td>
<td>0</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>24 (25)</td>
<td>64 (88)</td>
<td>8 (11)</td>
<td>1 (1)</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. Five study sessions were held in NUTR*2050, and 7 study sessions were held in NUTR*1010. Percents do not sum to 100 due to rounding.

Participants separately indicated they attended 0 sessions (i.e., ‘N/A’, ‘did not attend’) as 0 was not an available response option.

5.4.2 Acceptability

The number of completed Study Session Satisfaction Surveys submitted by participants who attended 1 or more study sessions was 63 (84%) in NUTR*2050, and 73 (75%) in NUTR*1010. Fifty-three percent and 46% of participants in NUTR*2050 and NUTR*1010, respectively, agreed or strongly agreed that they found the study sessions helped them learn the course material. Fifty-one percent of NUTR*2050, and 42% of NUTR*1010, participants agreed or strongly agreed that the study sessions increased their interest in the course. Also, 68% of NUTR*2050, and 75% of NUTR*1010, participants agreed or strongly agreed that they would recommend the study sessions to a classmate. Results are summarized in Table 5.6.
In response to the yes/no question, “If given the opportunity, I would participate in a similar study session for another course”, 98% and 97% of participants in NUTR*2050 and NUTR*1010, respectively, responded yes.

**Table 5.6** Participant response to: “Using the 5 point scale below, circle the number which best reflects your agreement with the various statements about the Step Up Club study sessions.” (Whole group n=136; NUTR*2050 n=63; NUTR*1010 n=73).

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Overall, I found the study sessions helped me to learn the course material.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>5 (4)</td>
<td>12 (9)</td>
<td>52 (4)</td>
<td>53 (4)</td>
<td>14 (10)</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>3 (5)</td>
<td>4 (6)</td>
<td>23 (37)</td>
<td>25 (40)</td>
<td>8 (13)</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>2 (3)</td>
<td>8 (11)</td>
<td>29 (40)</td>
<td>28 (38)</td>
<td>6 (8)</td>
</tr>
<tr>
<td>Attending the study sessions increased my interest in the course.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>5 (4)</td>
<td>14 (10)</td>
<td>54 (4)</td>
<td>50 (4)</td>
<td>13 (10)</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>3 (5)</td>
<td>7 (11)</td>
<td>21 (33)</td>
<td>22 (35)</td>
<td>10 (16)</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>2 (3)</td>
<td>7 (10)</td>
<td>33 (45)</td>
<td>28 (38)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>I would recommend these study sessions to a NUTR<em>2050/NUTR</em>1010 classmate.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>4 (3)</td>
<td>4 (3)</td>
<td>30 (22)</td>
<td>65 (48)</td>
<td>33 (24)</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>2 (3)</td>
<td>2 (3)</td>
<td>16 (25)</td>
<td>30 (48)</td>
<td>13 (21)</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>2 (3)</td>
<td>2 (3)</td>
<td>14 (19)</td>
<td>35 (48)</td>
<td>20 (27)</td>
</tr>
</tbody>
</table>

*Note.* Percents do not sum to 100 due to rounding.

Of the participants who completed the Study Session Satisfaction Survey, 34 (54%) participants in NUTR*2050, and 37 (51%) participants in NUTR*1010, correctly completed the question asking them to rank the components of study sessions according to their helpfulness. Remaining responses were invalid and were not included in the analysis. These participants did not give a rank to each component, or gave the same rank to more than one component. In both courses, “Practice questions”, followed by “Taking up midterm questions”, were most frequently ranked first or second (most helpful). In both courses, “Learning from other students’ questions in the study sessions” was least frequently ranked first or second. In NUTR*2050, “Guest
lectures from Learning Commons” was also least frequently ranked first or second. No participants provided a response for “Other”. Results are summarized in Table 5.7.

Table 5.7 Participant response to: “Rank the following components of the study sessions in terms of helpfulness/usefulness. 1 is most helpful/useful; 6 is least helpful/useful.”

<table>
<thead>
<tr>
<th>Component</th>
<th>Ranked 1$^{st}$</th>
<th>Ranked 2$^{nd}$</th>
<th>Ranked 1$^{st}$ or 2$^{nd}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice questions</td>
<td>Frequency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>39</td>
<td>20</td>
<td>59</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>21</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>18</td>
<td>11</td>
<td>29</td>
</tr>
<tr>
<td>Taking up midterm questions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>14</td>
<td>23</td>
<td>37</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>4</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>10</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Additional instruction on course content by course instructor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>10</td>
<td>7</td>
<td>17</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Guest lectures from Learning Commons (e.g., study skills, taking multiple choice tests, managing test anxiety)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>7</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>5</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Learning from other students’ questions in the study sessions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>1</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Other (please identify)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole group</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NUTR*2050</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NUTR*1010</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Note. NUTR*2050 n = 34; NUTR*1010 n = 37. Responses from 29 and 36 participants in NUTR*2050 and NUTR*1010, respectively, were invalid. These participants did not give a rank to each component, or gave the same rank to more than one component. Data from these participants were therefore excluded from this analysis.
The remaining questions in the Study Satisfaction Survey were open-ended questions. In response to the question, “Did the time and location of the study sessions work for you? Please explain”, all NUTR*2050 respondents found the location convenient, and the majority also found the time convenient. Some further explained the time and location were convenient because the study sessions were held directly after class and in the same room. Participants who did not find the time convenient had another class. Some participants commented on making alternative times available. In NUTR*1010, all participants found the location of study sessions convenient. Some further explained it was because they were held in a building central to campus. The majority of students also found the time convenient, however some had conflicting class or work schedules.

In response to the question, “How could the study session be improved?”, the majority of respondents in both NUTR*2050 and NUTR*1010 indicated there were no improvements necessary, and many also provided positive feedback. Some respondents suggested providing more time on course content, more practice questions, and alternative time slots. In NUTR*2050, a few respondents also suggested increasing interaction:

“Overall, I enjoyed the study sessions; however, it was a huge class. If, perhaps, we worked in groups, as opposed to one big group, then it would have encouraged the shy ones to speak up. It would have also been more interactive. Sometimes, I felt like it was a lecture, rather than a study session.” [L004, NUTR*2050]

“The study sessions might be improved if interactive games were involved to help students remember the material.” [L068, NUTR*2050]

In response to the question, “What other topics/activities would you like to see included in the study sessions?”, the majority of respondents in both courses wanted either more test preparation (i.e., practice questions, mock exams), more time on course content, or indicated that
no additional topics/activities were required. In NUTR*2050, some respondents also wanted more interactive group work:

“Group work so ideas can be heard from the student. Group work could also create friendships for people who don’t know anyone in the class and is looking for a study buddy.” [L070, NUTR*2050]

In NUTR*1010, some also wanted additional content on study strategies:

“How to take class notes.” [L157, NUTR*1010]

“How to prepare for short answer questions, exam preparation, how to apply what we learn to our lives (the perfect diet, exercise, etc.).” [L124, NUTR*1010]

In both courses, the majority of response fields under “Additional comments” were either left blank, or were positive comments. Of the responses provided, many related to the helpfulness of both the study sessions and the experiential lab activity. The helpfulness was related to increasing course engagement, learning, and performance:

“Study sessions motivated me to play a more active role in my education by wrestling in the content and changing my reflective study habits.” [L156, NUTR*1010]

“It was helpful in keeping the information clear and understanding it better.” [L015, NUTR*2050]

“I enjoyed them. My midterm #2 mark increased a lot from my first one!” [L154, NUTR*1010]

Many responses from both NUTR*2050 and NUTR*1010 also expressed enjoyment and appreciation of the study sessions, experiential learning activity, professor, and the course as a whole:

“I really enjoyed this class. The professor and content really engaged my interest in nutrition. One of my favourite classes.” [L030, NUTR*1010]

“I enjoyed the layout of this course, including the additional assignment and the step up sessions being made available to benefit us. Thank you!” [L110, NUTR*1010]
“I think the Step Up Club is a great program... Having the professors dedicate extra time to their students is very generous and I couldn’t be more thankful...” [L120, NUTR*1010]

“This course and extra help was awesome! Thank you.” [L060, NUTR*2050]
6.0 Discussion

The overall purpose of this research was to examine the impact and feasibility of an experiential learning activity and study sessions on student engagement and academic performance in two large introductory undergraduate nutrition courses. We hypothesized that the experiential learning activity and study sessions would result in an increase in student engagement and performance, participation would be high, and students would find the learning initiatives both helpful and enjoyable. In analyses where courses were combined, there was an increase from baseline to follow-up in both student engagement (Active and Collaborative Learning 22.1% increase, \( p < .001 \); Student-Faculty Interaction 11.2%, \( p = .038 \); Level of Academic Challenge 15.6%, \( p < .001 \)) and performance (%tile rank \( \Delta M = 7.63 \)). Participation in the experiential learning activity was higher (75 and 83 students in NUTR*2050 and NUTR*1010, respectively) compared to study sessions (4 to 29 students per session in both NUTR*2050 and NUTR*1010). Qualitative results indicate the experiential learning activity made students more aware of and interested in their personal health. Responses from both the experiential learning activity and study sessions indicate students enjoyed their overall learning experience, and appreciated the instructors’ support.

6.1 Experiential Learning Activity

The learning initiatives of this study were developed to address the four underlying predictors of engagement identified in the literature: interest, autonomy, self-efficacy, and belonging. Specifically, the experiential learning activity was developed to increase students’ personal interest in the course, and study sessions were developed to increase students’ self-efficacy and belonging. To promote an autonomy-supportive learning environment, participation in each component of the learning initiative was voluntary.
First, with respect to the impact of the experiential learning activity on interest and engagement, findings are congruent with The Four Phase Model of Interest Development and Kolb’s Theory of Experiential Learning. Our qualitative results from the Lab Satisfaction Survey suggest the experiential learning activity increased students’ personal interest and thus engagement in the course, as demonstrated by the improved CLASSE scores. The experiential learning activity successfully addressed all four stages of the experiential learning process outlined by Kolb (1984). Participants underwent BOD POD testing to assess their body composition, and completed a 3 day food record (concrete experience). Participants reflected on their overall experience as part of the take-home assignment (reflective observation), integrated course theories to interpret their BOD POD and food record results (abstract conceptualization), and then made physical activity and diet recommendations to improve their health (active experimentation). Thus, the experiential learning activity was effective in making students aware of their own health and enabled them to apply course content to improve their health. Ultimately, this made them more personally interested in the course. Also as previously described, according to The Four Phase Model of Interest Development (Hidi & Renninger, 2006), personal interest, in contrast to situational interest, occurs in later phases of interest development and is associated with a predisposition to re-engage particular content over time. Personal interest is characterized by positive feelings, stored knowledge and stored value whereby students not only value but actively pursue additional learning opportunities, ask questions, and seek out answers (Hidi & Renninger, 2006). Results from the Lab Satisfaction Survey indicate participants enjoyed the experiential learning activity and wanted to participate in more opportunities. Thus, findings are congruent with theory and indicate the experiential learning activity effectively increased students’ personal interest and engagement in the course.
In addition to theory, results of this study are similar to experiential learning initiatives in the literature. Bohn and Schmidt (2008) examined the effect of an in-class diet analysis assignment in a first-year undergraduate Food Science and Human Nutrition course of 643 students. Students determined the nutritional value of their diet, and interpreted their results. The majority of students indicated the assignment made them more aware of their nutritional health, and helped them apply the material to their own life/real world situations. (i.e., “Yes, it was fun. I enjoyed calculating and learning more about what I am putting into my body and what it means [nutritionally]”). Similar to our study, Bohn and Schmidt (2008) concluded the experiential learning activity was an enjoyable activity that allowed students to complete all four stages of Kolb’s experiential learning process, starting with “concrete experience” (i.e., conducting their personal diet assessment), and ending with “active experimentation” (i.e., intended food behaviour change). Unlike our study however, one limitation is that Bohn and Schmidt (2008) did not assess impact on engagement or performance.

While, to the best of our knowledge, there is no literature on lab-based experiential learning activities in large undergraduate nutrition courses, researchers have examined the effect of similar lab-based experiential learning activities in physiology and health sciences courses, especially among health professional students. In these studies, students conducted diet, anthropometric (i.e., skinfold thickness, waist circumference, impedance analysis) and/or biochemical assessments (i.e., insulin response, leptin levels), and became more aware of and engaged in their health and course (Chow & Phoon, 2003; Martin, Watkins & Ramsey, 2004; Nickel, 1982; Tarnus & Bourdon, 2006; Tarnus & Bourdon, 2008; Yar, 2008). For example, Nickel (1982) examined the effectiveness of a 10-day diet inventory activity completed prior to a nutrition lecture series among pharmacy students. Similar to our findings from our Lab
Satisfaction Survey, Nickel (1982) reported that, based on students’ reflective written reports, the assignment “spurred” interest. Similarly, among 106 second year medical students, Yar (2008) found that according to student responses to a feedback survey, an anthropometric lab exercise motivated students to engage in more physical activity (74%), adopt healthier eating habits (63%), and increased their interest in physiology (89%) and obesity (67%). In another study, 35 first-year medical students examined the association between their blood pressure, lipid profile (i.e., cholesterol, triglycerides), and body fatness (Martin et al., 2004). From the responses of students’ written lab reports, the authors concluded that stimulating student involvement and personal interest is essential to any successful teaching laboratory, which can be done by using students themselves as subjects (Martin et al., 2004). Altogether, results from the Lab Satisfaction Survey and CLASSE are congruent with both pedagogical theory and findings of similar learning initiatives. Students in our study likewise reported increased awareness, interest, and motivation. A key limitation of these existing studies is that they did not examine impact on engagement and performance, making direct comparisons with our study difficult.

With respect to the high participation rate, students may have more willingly participated due to bonus marks. Though minimal (up to an additional 5% added to their midterm exam grade), the addition of bonus marks may have been sufficient to attract students’ participation. However, in the Lab Satisfaction Survey, no students commented on the potential gain in their grade by participating, rather, students commented on their learning gains and enjoyability of the experience itself. Students indicated they wanted more learning opportunities, and that they should be offered to all students, with no reference to grades.

Thus, high situational interest, that is, interest that is context-dependent, short-lived, and based on spontaneous attraction (Renninger et al., 1992; Schraw & Lehman, 2001), may further
explain the high participation, and also the acceptability of the experiential learning activity. Contextual factors that trigger situational interest include novelty, exclusivity, or salient informational content (Wade, 1992). The experiential lab activity exhibited these factors, hence its high appeal and participation. For almost all students, it was their first time visiting Body Composition and Metabolism Lab. Many students had never seen the laboratory equipment discussed in class, and it was the first time students had their body composition assessed by the lab’s BOD POD (novelty). Due to its high cost and ongoing maintenance, public access to the BOD POD is rare. Outside of this learning activity, students would have little opportunity to use the BOD POD (exclusivity). In comparison with more commonly used body composition assessment tools (i.e., skin calipers, bioelectrical impedance analysers), the BOD POD also provides a more accurate body composition measure (Lohmen, Houtkooper, & Going, 1997) (salient information).

In addition to situational interest, providing students a choice to participate as a means of being autonomy supportive, can further explain enjoyment in the experiential lab activity. As indicated by Lab Satisfaction Survey results, students perceived the experiential learning activity as an opportunity versus obligation. Proponents of positive psychology argue that choice is beneficial because it increases positive affect (Buss, 2000; Kohn, 1998; Myers, 2000; Ryan & Deci, 2000). Studies have found that choice improves students’ attitude towards, and increases engagement in, the content or learning activity (Hannafin & Sullivan, 1996; Morrison, Ross, & Baldwin, 1992; Pollack & Sullivan, 1990; Schraw, Flowerday, & Reisetter, 1998), and many students report greater task enjoyment when given choices (Parker & Lepper, 1992; Schraw et al., 1998; Sweet, Guthrie, & Ng, 1998).
Altogether, the experiential learning activity was feasible and effective in increasing student engagement. Congruent with the Four Phase Model of Interest Development (Hidi & Renninger, 2006) and Kolb’s Theory of Experiential Learning (Kolb, 1984), the experiential lab activity successfully triggered situational interest and enjoyment, deepened personal interest, and importantly, increased student engagement. The novelty, uniqueness, and informative nature of the learning activity attracted students to participate. Having a choice to participate made students perceive the experiential lab activity as an opportunity versus obligation, further increasing their enjoyment in the experience. Personal interest was deepened by the experiential component of the lab activity which increased the relevance of course material. With increased relevance and significance of course content, students became more engaged in the overall course.

6.1.1 Comparison of NUTR*1010 and NUTR*2050 Results

While students in both classes reported increased engagement, dimension-level differences exist between courses. First, Active and Collaborative Learning increased significantly in NUTR*1010 ($\Delta M = 10.24; p < .001$), but not NUTR*2050 ($\Delta M = 3.06; p < .001$). Item-level examination of CLASSE results within the Active and Collaborative Learning dimension (Appendix G) provide further detail into this difference. In response to the question, “How often have you tutored or taught other students in your NUTR*class?”, 21% more students in NUTR*1010 responded ‘one or more times’ in the second (52%) versus the first (31%) administration of the CLASSE survey. In NUTR*2050, only10% more students responded ‘one or more times’ in the second (36%) compared to the first (26%) administration of the CLASSE survey. Thus, there was a greater increase in the percentage of students who tutored or taught other students one or more times in NUTR*1010 compared to NUTR*2050. Similarly, in
response to the question, “How often have you participated in a study partnership with a classmate to prepare for a test?”, 17% more students responded ‘one or more times’ in the second administration of the CLASSE survey (93%) versus the first (76%) in NUTR*1010. In NUTR*2050, only 5% more students responded ‘one or more times’ in the second (64%) compared to the first (59%) administration of the CLASSE survey. Overall, a greater percentage of NUTR*1010 than NUTR*2050 students tutored or taught another classmate, and participated in a study partnership in the first, and particularly in the second administration of the CLASSE survey. One explanation for this is that more first year students live in residences on campus compared to second-year students. Research has found that residences support the development of learning communities among students (Pike, 1997; Pike, 1999; Wawrzynski & Jessup-Anger, 2010). Residences provide a shared space where students can conveniently convene and study (Pike, 1997; Pike, 1999; Wawrzynski & Jessup-Anger, 2010). As there were more first-year students among NUTR*1010 (94%) participants compared to NUTR*2050 (0%), it may have been more feasible for NUTR*1010 students to study with other classmates.

Second, Student-Faculty Interaction increased significantly in NUTR*2050 (ΔM = 4.70; p = .021) but not NUTR*1010 (ΔM = 2.30; p = 3.91). Item-level examination of CLASSE results within the Student-Faculty Interaction dimension can help explain this difference. In response to the question, “How comfortable are you talking with the instructor of your NUTR* class?”, 10% more students in NUTR*2050 responded ‘comfortable’ or ‘very comfortable’ in the second (77%) versus the first (67%) administration of the CLASSE survey. In NUTR*1010, 3% fewer students responded ‘comfortable’ or ‘very comfortable’ in the second (76%) versus the first (79%) administration of the CLASSE survey. Thus, more NUTR*2050 than NUTR*1010 students indicated they felt more comfortable with the instructor as the course progressed.
However, it is important to note that while there was a greater increase in NUTR*2050, final results between courses were similar. This is because at baseline, a greater percentage of NUTR*1010 students indicated ‘comfortable’ or ‘very comfortable’. The difference in class size may further explain the significant increase in Student-Faculty Interaction in NUTR*2050 but not NUTR*1010. While 555 students were enrolled in NUTR*1010, 253 students were enrolled in NUTR*2050. Large class size is frequently associated with low student-faculty interaction and decreased opportunity to build meaningful relationships with the instructor (Cuseo, 2007). Thus, more NUTR*2050 versus NUTR*1010 students may have found opportunity to speak with the instructor throughout the course.

In addition to differences in dimensions of engagement, there was a greater increase in %tile rank among NUTR*1010 versus NUTR*2050 students (ΔM = 9.89, SD = 21.8 vs. ΔM = 4.70, SD = 21.8, respectively). Mean baseline %tile rank of NUTR*1010 students (33.8) was also lower compared to NUTR*2050 students (49.8). NUTR*1010 students who were initially less familiar with course content may have benefitted more from the experiential learning activity and study sessions. Also, the majority of NUTR*1010 participants were enrolled in an Arts program (i.e., English, Sociology, Psychology, etc.) (72%), while the majority of NUTR*2050 participants were enrolled in an Applied Science program (71%), specifically, the Applied Human Nutrition program (46%). An experiential learning activity may have been more beneficial for non Applied Science, or more specifically, non Applied Human Nutrition majors, in contextualizing science-based nutrition concepts discussed in class to real-life health applications. Various learning styles exist, and different approaches to learning benefit some more than others (Kolb & Kolb, 2005). Thus, a greater proportion of NUTR*1010 students may have been hands-on learners, benefitting more from an experiential learning activity rather than
in-class lectures. Students in Arts-based programs may also be less familiar with multiple-choice exam formats of assessment. They may have benefitted further from study sessions that provided practice questions and advice on answering multiple-choice questions. Altogether, while dimension-level differences in engagement and performance exist between NUTR*2050 and NUTR*1010, of greater importance is that qualitative and overall quantitative results indicate that in both courses, there was an increase in overall student engagement and performance.

6.2 Study Sessions

Study sessions were developed to increase students’ sense of belonging and self-efficacy. Participation was also voluntary to promote an autonomy-supportive learning environment. Study sessions were developed to provide students the opportunity to build relationships with the instructors and peers, review difficult course content, and learn effective study strategies. Two important findings arose. The first is that attendance at study sessions was lower than we anticipated and hypothesized. Thirty-three percent of participants in NUTR*2050 and 12% of participants in NUTR*1010 indicated they attended 3 or more study sessions. However, the second finding, arising from the Study Session Satisfaction Survey, suggests that students still appreciated the opportunity and valued the instructors’ support in making the study sessions available. This second finding was somewhat curious since many of the students who responded positively to having the sessions available on the Study Session Satisfaction Survey did not actually attend the study sessions.

The reported enjoyment of study sessions is congruent with literature regarding the effect of perceived instructor support on student learning. In the current study, instructors aimed to demonstrate care and consideration for their students by offering and encouraging students to participate in the supplementary learning activities at the sessions. Extensive research has found
instructor affective support (i.e., caring, respect, concern for students) in university classrooms to be significantly associated with students’ functioning in learning environments (Crossman, 2007; Goodboy, Martin & Bolkan, 2009; Gorham & Christophel, 1992; Gorham & Millette, 1997; Horan, Chory, & Goodboy, 2010; Houser & Frymier, 2009; Teven & Gorham, 1998; Witt, Wheeless, & Allen, 2004). Turanli (2009) examined the association between perceived instructor support and perceived amount of learning. Findings showed that perceived instructor support such as caring, listening, encouragement and valuing ideas was positively associated with students’ perceived amount of learning. Qualitative analyses have also shown that respect, caring, interest in and concern for students, high expectations, fairness and encouragement, relate positively to student motivation (Chen, 2000; Gorham & Christophel, 1992; Gorham & Millette, 1997). Furthermore, Clifton, Perry, Stubbs, and Roberts (2004) administered a survey to examine the effect of instructors’ cognitive demands and social support on student achievement. Survey results from 854 undergraduate students suggest instructors’ social support, demonstrated through caring, interest in students, and recognition, significantly affects students’ cumulative GPA. One recent study by Sakiz (2012) examined the association between perceived instructor support, academic enjoyment, academic hopelessness, and behavioural engagement among 277 university students. Perceived instructor support was positively associated with academic enjoyment and behavioural engagement, and negatively associated with academic hopelessness (Sakiz, 2012). Likewise, Mullen and Tallent-Runnels (2006) found perceived instructor support to be significantly associated with student satisfaction (r = .49) and perceptions of learning (r = .32) among 94 university students. Thus, despite low attendance, students’ positive feedback regarding study sessions (i.e., their effectiveness) may be attributed to their perceived instructor support.
With respect to low study session attendance rates, one similar study on instructor-led study sessions presents similar findings (Drake, 2011). In Drake’s (2011) study, the instructor offered interactive, activity- and group-based supplementary study sessions for credit in a first-year undergraduate science class of 196 students. For the 34 instructor-led study sessions held throughout the 12-week course, mean attendance per session was 21 students (Drake, 2011). According to Drake (2011), one major challenge was encouraging students to participate. The instructor took extensive measures to encourage student participation in study sessions: every in-class lecture included a slide reminding students of the study sessions (as we did in our study); student performance data were announced in class after quizzes and exams, and for which the averages of those who attended study sessions regularly were compared to those who did not; students who attended were often called on to tell the class about their learning experience; letters and emails were sent out by the instructor to students who were underperforming in the course to encourage them to attend, and extra credit was given to students who attended (Drake, 2011). Also, a majority of students stated that extra credit was the most important reason why the first attended a study session (Drake, 2011). However, when asked why they continued to attend, 40% more students chose the “learning important course concepts” response over the extra credit response (Drake, 2011).

Furthermore, research on supplementary study sessions suggests that while these programs positively affect students who participate (Bednar & Weinberg, 1970; Kirschenbaum & Perri, 1982; Simpson, Hynd, Nist & Burrell, 1997), many students, especially low performing students, do not readily participate in these opportunities (Friedlander, 1980; Karabenick & Knapp, 1988). Rather, students resist these learning initiatives and do not change their study skills and habits (Dembo & Seli, 2004). Yuksel (2006) found that students resisted study sessions
because they did not want to change their study habits, did not feel they could change their study habits, and believed the new study skills to be meaningless and irrelevant to the course. Allan and Clarke (2007) included a learning skills module in their course and found that students lacked engagement in the module because they did not perceive the generic study skills as useful or relevant. Thus, students in our study may not have perceived the study sessions as useful, and therefore opted to not attend.

Finally, the low participation in our study may also have been due to the predominantly lecture-style format of study sessions in this study. In their Study Session Survey, students commented that study sessions could be improved by incorporating more collaborative group work and games. This also suggests that, in addition to instructor support, students may benefit from initiatives that develop sense of support and belonging among peers. Overall, in contrast to the experiential learning activity, our results suggest that study sessions were less effective in eliciting situational interest.

6.3 Strengths and Limitations

To the best of our knowledge, this is the first voluntary, out-of-class engagement initiative for large introductory-level university nutrition courses. Given that class sizes are increasing, identifying effective engagement strategies for large classes is important. This learning initiative addressed all four underlying predictors of engagement within large undergraduate classes. Also, while research studies on experiential learning or study sessions exist, the majority of these studies have been conducted in smaller-sized upper-year courses. Thus, this study may inform the development of more effective engagement initiatives for large undergraduate courses.
This study included both standardized quantitative and rich qualitative data. Quantitatively, student engagement was assessed via CLASSE, which includes items adapted from the widely-used, valid and reliable NSSE. CLASSE provides a global picture of overall classroom engagement and includes multiple dimensions of engagement (Ouimet & Smallwood, 2005). In contrast, many classroom-level learning initiatives develop intervention-specific questionnaires that primarily assess the desired outcomes. This also encourages use of inconsistent versus standardized assessment tools, making it difficult for researchers to track and compare effectiveness across subsequently designed initiatives. Also, to the best of our knowledge, no similar studies have formally assessed impact on student engagement. In this study, performance was assessed using change in %tile rank versus change in absolute grade. This controls for potential differences in the grading scheme/difficulty across tests. Percentile rank data were also available for non-participants, allowing us to compare performance among participants and non-participants. Qualitatively, participant responses to open-ended questions in the satisfaction surveys provided more in-depth data useful in explaining this study’s outcomes. Thus, qualitative data helped contextualize quantitative data.

The generalizability of results is another strength of this study. The experiential learning activity provides a model that can be used across courses of any discipline. The experiential lab activity attracted participants from various majors, and of all levels of academic performance. Thus, similar experiential initiatives may be designed to successfully engage students of various academic backgrounds, and both academically struggling and successful students.

While this study has many strengths, it also has some limitations. First, while there was a control group in this study for assessment of change in performance, there was no control group for assessment of change in student engagement. Comparing change in engagement between
participants and non-participants may provide insight into the effectiveness of the learning initiative, independent of other factors that may also affect engagement (i.e., varying course content, involvement in student clubs).

A second limitation is that although CLASSE was used as a standardized assessment of engagement, it primarily assesses behavioural engagement. Thus, changes in other forms of engagement were not measured. Relevant to this study’s findings, literature has identified a strong association between interest and psychological and cognitive engagement. Nonetheless, behavioural engagement is most commonly assessed in universities as it provides observable and actionable data.

Furthermore, CLASSE is designed for use once per semester (Ouimet & Smallwood, 2005). Questions ask students how many times they participated in the course so far, rather than within the past week or month (Ouimet & Smallwood, 2005). Therefore, cumulatively, the number of times students participated in the course may be higher by the end of the course, while the frequency of their participation, and thus level of engagement, remains unchanged. While CLASSE was administered twice in this study, this was not a major concern due to recency effect. Our CLASSE results suggest students recalled and reported the number of times they participated within most recent weeks only, rather than since the start of the course. This was demonstrated in our findings as some students indicated they participated less in certain activities at follow-up compared to baseline, and thus responses were not cumulative.

Fourth, due to high costs associated with using the BOD POD, it may be less feasible to replicate this study in subsequent years. Other courses may not have access to novel lab equipment. However, the experience can be repeated at a lower cost by replacing the BOD POD with other methods of measuring body composition (i.e., bioelectrical impedance analysis).
Implementing experiential learning activities and study sessions also requires planning, time, and personnel. However, the resultant gain in student engagement and academic success make learning initiatives a worthwhile investment.

In addition, participants in this study were predominantly female (91%). This is reflective of the gender distribution in University of Guelph’s nutrition program. In Food Science and Nutrition majors, there were 1,001 female (94%) versus 60 male (6%) students enrolled in fall 2011 (Council of Ontario Universities, 2013). However, the predominant female population may not be reflective of the gender distribution in other courses. Differences in male and female engagement and learning styles may exist and could not be explored in the current study due to the small number of male participants.

Finally, students in NUTR*1010 and NUTR*2050 expressed an initial interest in nutrition by choosing to enroll in either the nutrition program or course as an elective, thus baseline interest in the course may be higher compared to compulsory courses.

6.4 Implications for the Development of Future Learning Initiatives

Results of this study can be used to inform the development of future learning activities designed to increase student engagement. Learning initiatives should enable students to see the relevance and value of course content to personal life. Thus, initiatives should include a hands-on activity followed by self-reflection. While offering bonus marks may first attract students to participate in the activity, activities that are novel and incorporate choice more significantly impact interest, enjoyment, and engagement in the activity itself, and overall course. Future initiatives should also consider incorporating all four underlying predictors of engagement to further strengthen its effect. Study skills (self-efficacy) and interactive group work (belonging) can be incorporated in to the experiential learning activity, and less lecture-based, more hands-on
and novel activities (interest) can be incorporated into study sessions. Voluntary participation can promote self-regulated learning (autonomy). With respect to belonging, in addition to instructor support, incorporating more collaborative group work and encouraging the development of learning communities amongst students themselves, may further promote students’ sense of belonging and engagement. In situations in which out-of-class learning opportunities may not be feasible, developing in-class activities that still address the underlying predictors of engagement may be more effective than only targeting its behavioural indicators. Lastly, it is important to consider students’ learning styles and needs. Conducting a survey at the start of the course followed by a feedback form at the end, can help identify which areas to address the most, and how future learning initiatives can better address them.

6.5 Future Research

This was the first study, to our knowledge, to have assessed the impact of an experiential learning activity and study sessions on student engagement in introductory-level nutrition classes. Future research can explore assessing other constructs of engagement (i.e., psychological and cognitive engagement). Assessing engagement in subsequent years among the same cohort of participants can help determine the long-term effectiveness of the learning initiative. Future research can also include a control group and randomized design to control for variables such as age, sex, ethnicity, program, and university entrance average. Also, in-class administration of surveys may allow for higher return rates and more efficient data collection. Directly assessing barriers to attending study sessions would help tailor study sessions to the specific needs of students and help increase attendance. In addition, future research can explore other experiential learning activities that are lower in cost yet equally effective in increasing interest and engagement. Also, especially where out-of-class opportunities may not be feasible, future
research can also investigate ways in which instructors can incorporate the four underlying predictors of engagement inside the classroom. Finally, while literature suggests voluntary participation in the learning initiatives promoted students’ autonomy and encouraged more self-regulated learning, future research can further examine the difference in effect of presenting learning opportunities as mandatory versus optional in-class activities.
7.0 Conclusion

Undergraduate student enrollment and class sizes are ever-increasing. This is a concern as large class size is associated with low student engagement, and subsequently, poorer learning outcomes. To increase engagement, instructors can develop learning initiatives that address the four underlying predictors of engagement identified in the literature: interest, autonomy, self-efficacy, and belonging. In this study, we implemented an optional out-of-class experiential learning activity and study sessions in two large introductory-level undergraduate nutrition courses. The purpose of this study was to examine the impact and feasibility of the experiential learning activity and study sessions on student engagement. To the best of our knowledge, this was the first study to examine the impact of a learning initiative (experiential learning activity and study sessions) that addresses the four underlying predictors of engagement.

Altogether, there were significant increases in both student engagement and academic performance after participating in the experimental learning activity and study sessions. Results from our qualitative surveys suggest the experiential learning activity was an enjoyable opportunity, and that it successfully increased students’ interest in course material. With respect to study sessions, students appreciated the instructors’ support in providing additional study sessions. In addition, participation in the experiential learning activity was high while participation in study sessions was low.

Our findings suggest educators should provide autonomy-supportive initiatives that increase student interest and sense of instructor support. Future research can explore additional low-cost, collaborative, in-class activities, and examine long-term impact on student engagement. To conclude, by continuing to develop more feasible and effective learning
initiatives, educators can provide students with an engaging, enriching university experience regardless of class size.
8.0 References


Symposium on Postsecondary Student Success: Spearheading a Dialog on Student Success,


9.0 Appendices

Appendix A. Research Ethics Board Certification of Ethical Acceptability of Research Involving Human Participants

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<tr>
<th>UNIVERSITY OF GUELPH</th>
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<td>Certification of Ethical Acceptability of Research Involving Human Participants</td>
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**APPROVAL PERIOD:** September 7, 2012 to September 7, 2013

**REB NUMBER:** 12JL027

**TYPE OF REVIEW:** Full Board

**RESPONSIBLE FACULTY:** JESSICA HAINES

**DEPARTMENT:** Family Relations & Applied Nutrition

**SPONSOR:** N/A

**TITLE OF PROJECT:** Reaching Out Club (ROC): Support and Experiential Learning for Academically Struggling Students in Early-Year Nutrition Courses

The members of the University of Guelph Research Ethics Board have examined the protocol which describes the participation of the human subjects in the above-named research project and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement.

The REB requires that you adhere to the protocol as last reviewed and approved by the REB. The REB must approve any modifications before they can be implemented. If you wish to modify your research project, please complete the Change Request Form. If there is a change in your source of funding, or a previously unfunded project receives funding, you must report this as a change to the protocol.

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 Responsible Faculty, the safety of the participants, and the continuation of the protocol.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the
ethical guidelines and approvals of those facilities or institutions are obtained and filed with the REB prior to the initiation of any research protocols.

The Tri-council Policy Statement requires that ongoing research be monitored by, at a minimum, a final report and, if the approval period is longer than one year, annual reports. Continued approval is contingent on timely submission of reports.


Approved:  
Date:  

per 
Chair, Research Ethics Board
CONSENT TO PARTICIPATE IN A CLASS PROJECT AND RESEARCH

Step Up Study Sessions

You are asked to participate in a class project and research study conducted by Dr. Andrea Buchholz and Dr. Jess Haines of the Dept Family Relations and Applied Nutrition, University of Guelph. Funding is from the Learning Enhancement Fund, University of Guelph.

If you have any concerns about this research, please feel free to contact:

- Dr. Jess Haines, tel 519-824-4120 ext 53870, jhaines@uoguelph.ca
- Dr. Andrea Buchholz, tel 519-824-4120 ext 52347, abuchhol@uoguelph.ca
- Graduate Research Assistant: Anne Szeto, szetoa@uoguelph.ca
- Graduate Research Assistant: Caroline Fraser, cfrase07@uoguelph.ca

PURPOSE

The main purpose of this project is a learning opportunity for students to participate in optional study sessions (Step-Up Study Sessions and assignment for NUTR\[2050]\[1010]). It is also a research project because the investigators would like to publish the data collected.

PROCEDURES

There are three components of this project. You can volunteer to participate in none, one, two or all three components.

**Component 1: Optional Assignment**

This assignment will involve a tour of the University of Guelph Body Composition and Metabolism Lab (room 206 J.T. Powell Building), body composition testing (percent body fat) using the BOD POD, 3-day food records and diet analysis, a general health survey, and a physical activity survey. The optional assignment is described fully on the next page. You will also be asked to complete 1, 5-minute survey, during which you will be asked various questions on your experience with the assignment.

**Component 2: Use of Data from the Optional Assignment for Research Purposes**

If you choose to do the optional assignment above, we request your permission to use your data to explore the association between sleep, diet quality, and body composition in young adults.

**Component 3: Assessment of the Step-Up study sessions for Research Purposes**
You will be asked to complete two, 5-minute questionnaires to assess your study habits and approaches to learning; we will ask you to fill out these questionnaires during the first and final Step-Up study sessions of the semester. Also during the last Step-Up study session, you will also be asked to complete 1, 5-minute survey, during which you will be asked various questions on your experience in the study sessions, what you learned, etc. If you are not able to attend the last Step-Up study session, we will email you the surveys to complete and then email back to us.

**Full Description of the Optional Assignment**

If you volunteer to participate in the optional assignment, you will visit the Body Composition and Metabolism Lab once, for about 45 minutes. Approximately 1 week before your visit to the lab we will email you instructions and forms to complete a 3-day food record (a list of all the foods you ate over 3 days). We will ask you to bring the completed food record with you to your lab visit. At your lab visit, you will undergo a BOD POD test that will measure your body composition, pictured below.

![BOD POD](image)

The BOD POD™ measures the body’s per cent fat mass using air displacement. A test takes approx. 15 minutes.

The BOD POD, which will be operated by the Graduate Research Assistant, uses the displacement of air inside an enclosed chamber to determine your body volume. From the body volume measurements, whole-body density is determined and body fat is calculated. The procedure is simple and painless. The whole test takes approximately 15 minutes, but of these 15 minutes, you will sit in the BOD POD™ for only approximately 5 minutes. You will be asked to wear a bathing suit and bathing cap for this test to minimize the trapping of air between clothing, hair and your skin. **Please bring your bathing suit with you.** We will provide the bathing cap. You will also have your height measured using a wall mounted stadiometer. We will provide you with a copy of your results before you leave the lab.

We will ask to you to complete some questionnaires that will ask about your health behaviours, sleep habits, physical activity habits and your experience in the lab, what you learned, etc. The questionnaires will take approximately 20 to 25 minutes in total to complete.

You will have the opportunity to complete an optional assignment – worth up to 5 extra percent on your grade for midterm 1 - and for which you will interpret your laboratory data. The assignment will be marked by another professor in the Applied Human Nutrition program, who will communicate your assignment mark to a course Graduate Teaching Assistant (GTA). The GTA – and not the instructor teaching the course – will make the necessary adjustment to your midterm grade. You will be eligible to receive up to a 5 percent bonus on midterm 1. E.g., if you scored 53% on midterm 1, the optional assignment could raise your grade to a maximum of 58% (53% + 5%). Your marked assignment will be returned to you.
POTENTIAL RISKS AND DISCOMFORTS

Component 1: Optional Assignment
There is a small risk of claustrophobia while sitting in the BOD POD™. This risk is minimal, however you will be able to stop the test at any time by pressing a button under your left knee (and which will release the door), or by simply telling the Graduate Research Assistant that you would like the test to stop.

You may feel slightly embarrassed at having to wear a bathing suit, however, this will be minimized by wearing a hospital gown immediately before the test. You will be able to change back into your clothes immediately after the test. There is a film on the window of the lab, preventing passersby in the hall from seeing into the lab. We will also make sure that there will be very few people in the lab during your test.

If you do not feel comfortable completing the BOD POD™ test, you will be given a sample printout from the BOD POD, and so you will still be able to complete the optional assignment.

You may feel slightly embarrassed when filling out the questionnaires. You are free to omit any questions that may cause you some embarrassment.

Component 2 (Use of Data from the Optional Assignment for Research Purposes) and Component 3 (Assessment of the Step-Up Study Sessions for Research Purposes)
There is a small risk that someone other than the above mentioned researchers may see your completed survey data. To minimize this risk, your data will be coded immediately and stored in password-protected computer files. Thus, your individual data will not be identifiable with your name. Any results published or presented will be done using group data and/or coded (unidentifiable) results.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY
There are no direct benefits to you for participating in this class project and research study.

If you participate in the optional assignment, you will receive a data printout from the BOD POD and which will tell you your per cent body fat, and you will receive a personalized dietary analysis. In the community, body composition testing and dietary analysis can be expensive, but we will be providing this information free of charge. Data will be used for research purposes to advance the knowledge of body composition and dietary habits of young Canadian adults.

PAYMENT FOR PARTICIPATION
You will not receive any compensation, monetary or otherwise, for participating in this project.

CONFIDENTIALITY
Every effort will be made to ensure confidentiality of any identifying materials obtained during the study. Data will be coded immediately and stored in password-protected computer files. Thus your individual data will not be identified with your name. Any results published or presented will be done using group data and/or coded (unidentifiable) individual results. Data will be stored in the lab for seven years after which time paper records will be shredded and electronic records will be deleted from computers. We will not use any of your data for anything other than what is indicated in this document.
PARTICIPATION AND WITHDRAWAL
You can choose whether to be in this class project and research, or not. If you volunteer to be in this class project and research study, you may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don’t want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise that warrant doing so.

If you decide not to participate in this research study, you can still complete the optional assignment.

RIGHTS OF RESEARCH PARTICIPANTS
You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. This study has been reviewed and received ethics clearance through the University of Guelph Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

Research Ethics Coordinator       Telephone: (519) 824-4120, ext. 56606
University of Guelph        E-mail: sauld@uoguelph.ca
437 University Centre   Fax: (519) 821-5236
Guelph, ON   N1G 2W1
CONSENT AND SIGNATURE OF RESEARCH PARTICIPANT

I have read the information provided for the Step-Up Study Sessions and research study. My questions have been answered to my satisfaction, and I agree to participate. I have been given a copy of this form.

I have read this Consent Form. The components of the class project and research study, including the 3-day food record and the BOD POD™, have been explained to my satisfaction. I understand that I am free to stop participating in testing at any time, even after signing this consent form.

I agree to participate in the following components: (please check boxes for components in which you consent to participate):

☐ Component 1: Optional Assignment. I agree to visit the Body Composition and Metabolism Lab, undergo BOD POD testing, and complete a 3-day food record and some short questionnaires.

☐ Component 2: Use of Data from the Optional Assignment for Research Purposes. I give permission to the investigators to use my data from the optional assignment in a published manuscript and/or presentation at a conference. I understand that in order to do Component 2, I must also do Component 1.

☐ Component 3: Assessment of the Step-Up Study Sessions for Research Purposes. I agree to complete two, 5-minute surveys that will ask about my study habits and approaches to learning, and one, 5-minute survey that will ask my opinions about the study sessions. I give permission to the investigators to use my survey data and my [NUTR*2050][NUTR*1010] course marks in a published manuscript and/or presentation at a conference.

PARTICIPANT

____________________________________________________________________

(Participant name) (Signature) (Date)

(University address)

(Permanent address)

(E-mail address)

WITNESS

____________________________________________________________________

(Printed name) (Signature) (Date)
Appendix C. Optional Assignment

Optional Assignment

This optional assignment involves visiting the University’s Body Composition and Metabolism Lab (www.uoguelph.ca/bodycomp), room 206 JT Powell Building. The lab is in the same building as Student Health Services; it is on the second floor, beside the Health and Performance Centre.

Approximately 1 week before your lab visit, we will email you instructions on how to complete a 3-day food record. Please bring your completed 3-day food record with you to the lab.

At the lab, you will have the opportunity to have your body fat measured using the BOD POD. Use your results to complete the assignment on the following pages.

The grade for this assignment (out of 5) will be added to the grade for midterm 1.

- For example: if you scored 52% on the midterm and you score 14/15 (93.3%, or 4.7/5) on this assignment, then your new grade for the midterm will be (52 + 4.7) = 56.7%.

- The assignment will be graded by [Dr. Jess Haines/Dr. Andrea Buchholz], a professor in the Department in Family Relations and Applied Nutrition

If you would like to complete this optional assignment, but do not wish to undergo body composition testing, you are still required to visit the lab for a tour, and to submit your 3-day food record. At this time, we will provide you with a set of ‘dummy’ BOD POD results to complete the assignment.
Optional Assignment

Date: ______________________________________________________

Student ID: ________________________________________________

Age: ___________________                Gender (circle one):        M         F

1. Using information in the Appendix, calculate your Body Mass Index (BMI) in kg/m². Show your calculations.

   /2

2. Using Table 11.1 in the Appendix, what is your BMI classification?

   /1
3. Using **Table 2 in the Appendix**, how does your percent body fat (measured by BOD POD) compare to the relative “Percent Body Fat Standards for Health” for your age and gender? Is your percent body fat consistent with the Standard? **Why or why not?** *(for example, do you consider yourself to be more or less physically active than the “average” person of your age and gender?)*

My percent body fat: ______________
Percent Body Fat Standard for my age and gender: ________________

4. How does your answer for Question 2 (your BMI Classification) compare with your answer for Question 3 (your percent body fat relative to the Percent Body Fat Standards for Health)? Do the two agree? **Why or why not?** *(for example, do you feel body fat and BMI measure the same thing?)*
As part of this assignment, you completed a three-day food record. We will email you the results once they have been analyzed, but in the meantime, we would like you to reflect on your experience in completing the food record. Please answer the following two questions.

5. Identify TWO (2) things you learned in completing the food record? [e.g. it was difficult to estimate portion sizes.]

1.

2.

6. What TWO (2) pieces of advice would you give a friend who decides to complete a food record?

1.

2.
Appendix

Calculating your Body Mass Index (in kg/m\(^2\))

\[ \text{BMI} = \frac{\text{weight in kg}}{\text{height in m}^2} \]

To convert lb to kg, divide lb by 2.2. For example, if you weighed 150 lb, you would divide 150/2.2 = 68.2 kg

To convert feet and inches to m\(^2\),
1. Convert ft and in to in. For example, if your height is 5 ft 8 in, then your height in inches is (5 ft x 12 in per ft) + 8 = 68 in
2. Convert inches to metres. Multiply height in inches by 0.0254 metres per inch. For example, 68 in x 0.0254 = 1.727 m
3. Convert metres to m\(^2\). For example, 1.727 x 1.727 = 2.98 m\(^2\)

BMI is therefore \(68.2 \text{ kg} / 2.98 \text{ m}^2 = 22.9 \text{ kg/m}^2\)

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI Category (kg/m(^2))</th>
<th>Risk of Developing Health Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
<td>Increased</td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5–24.9</td>
<td>Least</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0–29.9</td>
<td>Increased</td>
</tr>
<tr>
<td>Obese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td>30.0–34.9</td>
<td>High</td>
</tr>
<tr>
<td>Class II</td>
<td>35.0–39.9</td>
<td>Very high</td>
</tr>
<tr>
<td>Class III</td>
<td>&gt; 40.0</td>
<td>Extremely high</td>
</tr>
</tbody>
</table>

Note: For persons 65 years and older, the “normal” range may begin slightly above BMI 18.5 and extend into the “overweight” range.

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Table 2. Percent Body Fat Standards for Health

<table>
<thead>
<tr>
<th>Body Fat Levels (%)</th>
<th>Unhealthy low</th>
<th>Low</th>
<th>Mid</th>
<th>Upper</th>
<th>Obesity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young adult</td>
<td>&lt;8</td>
<td>8</td>
<td>13</td>
<td>22</td>
<td>&gt;22</td>
</tr>
<tr>
<td>Middle adult</td>
<td>&lt;10</td>
<td>10</td>
<td>18</td>
<td>25</td>
<td>&gt;25</td>
</tr>
<tr>
<td>Elderly</td>
<td>&lt;10</td>
<td>10</td>
<td>16</td>
<td>23</td>
<td>&gt;23</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young adult</td>
<td>&lt;20</td>
<td>20</td>
<td>28</td>
<td>35</td>
<td>&gt;35</td>
</tr>
<tr>
<td>Middle adult</td>
<td>&lt;25</td>
<td>25</td>
<td>32</td>
<td>38</td>
<td>&gt;38</td>
</tr>
<tr>
<td>Elderly</td>
<td>&lt;25</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>&gt;35</td>
</tr>
</tbody>
</table>

Classroom Survey of Student Engagement (CLASSE)

This survey includes items that ask about your participation in NUTR*1010 (Nutrition and Society) and about educational practices that occur in this class. Your honest and straightforward responses to these questions will help us identify targets for improvements and enable us to provide an even higher quality academic experience.

**PART I: ENGAGEMENT ACTIVITIES**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never ▼</th>
<th>1 or 2 times ▼</th>
<th>3 to 5 times ▼</th>
<th>More than 5 times ▼</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Asked questions during your NUTR*1010 class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Contributed to a class discussion that occurred during your NUTR*1010 class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Worked with classmates outside of your NUTR*1010 class to study or learn course material</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Put together ideas or concepts from different courses when learning course material or during class discussions in your NUTR*1010 class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Tutored or taught other students in your NUTR*1010 class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Used Courselink to discuss course materials in your NUTR*1010 class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Discussed grades or course material with the instructor of your NUTR*1010 class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Discussed ideas from your class with others outside of your NUTR*1010 class (students, family members, coworkers, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
9. Discussed ideas from your readings or classes with your NUTR*1010 instructor outside of class

10. Worked harder than you thought you could to meet your NUTR*1010 instructor’s standards and expectations

**PART II: OTHER EDUCATIONAL PRACTICES**

**So far this semester**

11. In a *typical week*, how often do you spend more than 3 hours preparing for your NUTR*1010 class (studying, reading, reviewing notes)?

12. How many times have you been absent so far this semester in your NUTR*1010 class?

13. How frequently do you take notes in your NUTR*1010 class?

14. How often do you review your notes prior to the next scheduled meeting in your NUTR*1010 class?

15. How often have you participated in a study partnership with a classmate in your NUTR*1010 class to prepare for a test?

16. How interested are you in learning the NUTR*1010 course material?

**PART III: CLASS ATMOSPHERE**

**So far this semester, what are your general impressions of the NUTR*1010 class atmosphere?**
17. How comfortable are you talking with the instructor of your NUTR*1010 class?

- Uncomfortable
- Somewhat comfortable
- Comfortable
- Very comfortable

18. How difficult is the course material in your NUTR*1010 class?

- Easy
- Somewhat difficult
- Difficult
- Very difficult

19. How easy is it to follow the lectures in your NUTR*1010 class?

- Difficult
- Somewhat easy
- Easy
- Very easy

PART IV: DEMOGRAPHICS

20. Gender:  

- Male
- Female

21. Year of Study:

- 1st year
- 2nd year
- 3rd year
- 4th year
- 5th year

22. Student Status:

- Full time student
- Part-time student

23. Age: _____ _______ years

24. How do you define yourself? *(Check all that apply)*

- White, Caucasian
- Black, African Canadian, African American
- Middle Eastern, Arabic
- South Asian (i.e., Indian, Pakistan)
- East Asian (i.e., China, Japan)
- Southeast Asian (i.e., Thailand, Philippines, Malaysia)
- Hispanic
- Native
- Other (specify):_____________________

25. What is your academic major? 

This survey is an adaptation of the National Survey of Student Engagement (NSSE) with permission from Indiana University. Items 1-25 used with permission from the College Student Report, National Survey of Student Engagement, Copyright 2001-13 The Trustees of Indiana University.
Appendix E. Lab Satisfaction Survey

Date: ________________

Step Up Study
Lab Exit Survey

Thank you for having participated in the Reaching Out Club lab. Please take a moment to complete an exit survey. This is NOT a test. You will NOT be graded. Your answers will be used for research and publication purposes ONLY.

1. In which learning activity(ies) did you participate? Check all that apply.

☐ BOD POD  ☐ 3-day food record

Using the 5 point scale below, circle the number which best reflects your agreement with the various statements about the learning activity(ies) in which you participated:

2. Overall, I would consider myself a “hands-on” learner.

1  2  3  4  5
Strongly disagree Neutral Strongly agree

3. Rather than take part in this lab, it would have been more useful for my learning to have been given this time to read about the learning activities.

1  2  3  4  5
Strongly disagree Neutral Strongly agree

4. Without these kinds of learning activities, learning about the methods would be too theoretical.

1  2  3  4  5
Strongly disagree Neutral Strongly agree
5. These learning activities helped me make connections between concepts learned in class.

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly disagree</th>
<th>2 Neutral</th>
<th>3 Strongly agree</th>
</tr>
</thead>
</table>

6. Additional learning activities like these would enhance my learning in the course.

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly disagree</th>
<th>2 Neutral</th>
<th>3 Strongly agree</th>
</tr>
</thead>
</table>

7. I became more interested in my nutritional health after completing these learning activities.

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly disagree</th>
<th>2 Neutral</th>
<th>3 Strongly agree</th>
</tr>
</thead>
</table>

8. If given the opportunity, would you participate in other learning activities like this?

- [ ] Yes
- [ ] No

9. How could the learning activities be improved?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

10. Overall, how have these learning activities (if at all) affected your learning and interest in this course?
Thank you for taking the time to provide us with your feedback!
Appendix F. Study Session Satisfaction Survey

Date: ________________

Step Up Study Sessions Exit Survey

Thank you for having participated in the Step Up study sessions! Please take a moment to complete this brief exit survey. This is NOT a test. You will NOT be graded. Your answers will be used for research purposes only, and to help us improve the Step Up sessions.

1. How many ROC study sessions did you attend (check one)?

- □ 1-2
- □ 3-4
- □ 5-6
- □ 7-8

Using the 5 point scale below, circle the number which best reflects your agreement with the various statements about the ROC study sessions:

11. Overall, I found the study sessions helped me to learn the course material.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>Neutral</td>
<td></td>
<td></td>
<td>Strongly agree</td>
</tr>
</tbody>
</table>

12. Attending the study sessions increased my interest in the course.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>Neutral</td>
<td></td>
<td></td>
<td>Strongly agree</td>
</tr>
</tbody>
</table>

13. I would recommend these study sessions to a NUTR*2050/NUTR*1010 classmate.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>Neutral</td>
<td></td>
<td></td>
<td>Strongly agree</td>
</tr>
</tbody>
</table>

110
14. If given the opportunity, I would participate in a similar study session for another course.

☐ Yes
☐ No

15. Rank the following components of the study sessions in terms of helpfulness/usefulness. 1 is most helpful/useful; 6 is least helpful/useful.

____ Taking up midterm questions
____ Guest lectures from Learning Commons (e.g., study skills, taking multiple choice tests, managing test anxiety)
____ Practice questions
____ Additional instruction on course content by course instructor
____ Learning from other students’ questions in the study sessions
____ Other (please identify) ______________________________________________

______________________________________________________________________

______________________________________________________________________

16. Did the time and location of the study sessions work for you? Please explain.

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

17. How could the study sessions be improved?

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________
18. What other topics/activities would you like to see included in the study sessions?

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

19. Additional comments.

__________________________________________________________________________________________

__________________________________________________________________________________________

__________________________________________________________________________________________

*Thank you for taking the time to provide us with your feedback!*
**Appendix G. CLASSE Item Frequencies.**

Table 9.1 Baseline and follow-up CLASSE item frequencies.

<table>
<thead>
<tr>
<th>Item #</th>
<th>Question</th>
<th>Baseline (%)</th>
<th>Follow-up (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Never</td>
<td>1 to 2 times</td>
</tr>
<tr>
<td><strong>Active and Collaborative Learning</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>asked questions during your NUTR* class</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole Group</td>
<td>76</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>NUTR*2050</td>
<td>68</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>NUTR*1010</td>
<td>92</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>contributed to a class discussion that occurred during your NUTR* class</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole Group</td>
<td>68</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>NUTR*2050</td>
<td>59</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>NUTR*1010</td>
<td>75</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>worked with classmates outside of your NUTR* class to study or learn course material</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole Group</td>
<td>23</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>NUTR*2050</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>NUTR*1010</td>
<td>18</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>tutored or taught other students in your NUTR* class</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole Group</td>
<td>72</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>NUTR*2050</td>
<td>75</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>NUTR*1010</td>
<td>69</td>
<td>18</td>
</tr>
<tr>
<td>8</td>
<td>discussed ideas from your class with others outside of your NUTR class (students, family members, coworkers, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole Group</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>NUTR*2050</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>NUTR*1010</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>13</td>
<td>how frequently do you take notes in your NUTR* class?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole Group</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>NUTR*2050</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>NUTR*1010</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 9.1. Baseline and post-intervention CLASSE item frequencies cont’d.

<table>
<thead>
<tr>
<th>Item #</th>
<th>Question</th>
<th>Baseline (%)</th>
<th>Follow-up (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Never</td>
<td>1 to 2 times</td>
</tr>
<tr>
<td>15</td>
<td>How often have you participated in a study partnership with a classmate in your NUTR* class to prepare for a test?</td>
<td>Whole Group</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NUTR*2050</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NUTR*1010</td>
<td>24</td>
</tr>
</tbody>
</table>

#### Student-Faculty Interaction

| 7     | Discussed grades or course material with the instructor of your NUTR* class | Whole Group | 76 | 17 | 4  | 4  | 69 | 23 | 4  | 3  |
|       |                                                                          | NUTR*2050   | 72 | 19 | 4  | 6  | 72 | 19 | 4  | 6  |
|       |                                                                          | NUTR*1010   | 80 | 15 | 4  | 2  | 72 | 19 | 4  | 6  |

| 9     | Discussed ideas from your readings or classes with your NUTR* instructor outside of class | Whole Group | 86 | 5  | 7  | 3  | 80 | 13 | 4  | 3  |
|       |                                                                          | NUTR*2050   | 85 | 6  | 8  | 2  | 77 | 11 | 8  | 4  |
|       |                                                                          | NUTR*1010   | 87 | 4  | 6  | 4  | 83 | 15 | 0  | 2  |

| 17    | How comfortable are you talking with the instructor of your NUTR* class? | Whole Group | 1  | 26 | 43 | 30 | 2  | 22 | 32 | 45 |
|       |                                                                          | NUTR*2050   | 0  | 34 | 42 | 25 | 2  | 21 | 30 | 47 |
|       |                                                                          | NUTR*1010   | 2  | 19 | 44 | 35 | 2  | 22 | 33 | 43 |

#### Level of Academic Challenge

<p>| 4     | Put together ideas or concepts from different courses when learning course material or during class discussions in your NUTR* class | Whole Group | 15 | 46 | 26 | 14 | 11 | 35 | 32 | 23 |
|       |                                                                          | NUTR<em>2050   | 17 | 48 | 21 | 14 | 10 | 42 | 33 | 15 |
|       |                                                                          | NUTR</em>1010   | 12 | 45 | 29 | 14 | 12 | 28 | 31 | 29 |</p>
<table>
<thead>
<tr>
<th>Item #</th>
<th>Question</th>
<th>Baseline (%)</th>
<th>Follow-up (%)</th>
<th>Baseline (%)</th>
<th>Follow-up (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Never 1 to 2 times 3 to 5 times &gt; 5 times</td>
<td>Never 1 to 2 times 3 to 5 times &gt; 5 times</td>
<td>Never 1 to 2 times 3 to 5 times &gt; 5 times</td>
<td>Never 1 to 2 times 3 to 5 times &gt; 5 times</td>
</tr>
<tr>
<td>10</td>
<td>Worked harder than you thought you could to meet your NUTR* instructor’s standards and expectations</td>
<td>23 50 18 9</td>
<td>10 48 33 9</td>
<td>17 52 17 14</td>
<td>14 44 31 12</td>
</tr>
<tr>
<td>11</td>
<td>In a typical week, how often do you spend more than 3 hours preparing for your NUTR* class (studying, reading, reviewing notes)?</td>
<td>32 50 16 3</td>
<td>28 49 18 5</td>
<td>46 44 8 2</td>
<td>33 50 14 4</td>
</tr>
<tr>
<td>14</td>
<td>How often do you review your notes prior to the next scheduled meeting in your NUTR* class?</td>
<td>38 43 14 6</td>
<td>34 48 12 6</td>
<td>60 27 10 4</td>
<td>42 46 6 6</td>
</tr>
<tr>
<td>18</td>
<td>How difficult is the course material in your NUTR* class?</td>
<td>2 16 70 13</td>
<td>7 62 28 3</td>
<td>0 12 77 12</td>
<td>8 73 17 2</td>
</tr>
</tbody>
</table>

1. Uncomfortable; Somewhat comfortable; Comfortable; Very comfortable.
2. Never/Rarely; Sometimes; Often; Very often.
3. Very easy; Easy; Somewhat easy; Difficult.
Appendix H. Biologic Manuscript.

Secondary analyses were also conducted to fulfill the biologic component of this Master’s degree.

Association between Sleep and Body Composition in Young Adults

Abstract

Objective: To examine the association between sleep and body composition in young adults.

Method: This was a cross-sectional study of a convenience sample of 175 undergraduate students at University of Guelph, Ontario, Canada. Body composition was measured using a BOD POD™ air displacement plethysmograph (Cosmed), and participants completed questionnaires to collect demographics, sleep, depressive symptomatology, diet, and physical activity data. Multivariate linear regression models, controlled for gender, depressive symptomatology, and diet, were used to examine the association of sleep duration and quality, with % body fat and BMI. Independent samples t-tests were also conducted to examine difference in BMI and % body fat between short vs. adequate, and poor vs. good quality sleepers.

Results: There was no significant association between either sleep duration or quality, and % body fat or BMI. There was also no significant difference in % body fat or BMI between short vs. adequate, or poor vs. good quality sleepers.

Conclusion: Future studies examining the association between objectively measured sleep and body composition among young adults are required.

Introduction

Within the past decade, researchers have begun examining the association between sleep and overweight/obesity. While some studies have found no association between sleep and
overweight/obesity, many studies suggest short sleep duration is associated with increased BMI and risk of overweight/obesity (Davies, Lewis, Pekmezi, Evans & Baskin, 2014; Patel & Hu, 2008).

In addition to sleep quantity, a growing body of recent research further suggests poor sleep quality to be associated with overweight/obesity (Chen, Truong & Tsai, 2013; Resta et al., 2003; Yeh & Brown, 2014). The majority of larger-scale epidemiological studies use only one or few survey items to determine sleep quality (i.e., “In general, how is your sleep time”) (Pearson, Johnson & Nahim, 2006; Vale, Santos, Soares-Miranda, Moreira, Ruiz & Mota, 2010), standardized and validated sleep quality questionnaires, versus single survey items, should instead be used to provide a more extensive and reliable measure of sleep quality.

The majority of existing studies have also used self-reported body mass index (BMI). Thus, more studies are needed to examine the association of sleep with objectively measured body composition (% fat vs. fat-free mass) for a more accurate proxy of body fatness and overweight/obesity (Okorodudu et al., 2010).

Furthermore, while studies have been conducted among adults, children, and adolescents, to the best of our knowledge, only three studies have examined the association between sleep and overweight/obesity among young adults, and findings have thus far been mixed (Bailey et al., 2013; Meyer, Wall, Larson, Laska & Neumark-Sztainer, 2012; Quick et al., 2013). Young adulthood is a critical life stage for the development of health behaviour habits, and a period of transition and adjustment to university for many (Nelson, Story, Larson, Neumark-Sztainer & Lytle, 2008). Research has also found a high prevalence of poor sleep among university students (Buboltz, Jenkins, Soper, Woller, Johnson & Faes, 2009). Thus, the association of sleep...
and overweight/obesity among the young adult university student population requires further investigation.

In examining the association between sleep and overweight/obesity, it is also important to control for gender (Lauderdale et al., 2006; Tsai & Li, 2004), depressive symptomatology (Janson- Fröjmark & Lindbolm, 2005; Tsuno, Besset & Ritchie, 2005; Goodman & Whitaker, 2002; Luppino et al., 2010), diet (Swinburn, Caterson, Seidell & James, 2004), and physical activity (Peuhkuri, Sihvola & Korpela, 2012; Raumer, Mess & Woll, 2013; Yang, Ho, Chen & Chien, 2012), which have been identified as potential confounders of the association.

Altogether, the purpose of this research is to examine the association between sleep quantity and quality, with % body fat and BMI among young adults.

**Methods**

**Participants and Recruitment**

Participants for this cross-sectional study were recruited from the cohort of students enrolled in one of two undergraduate nutrition courses, NUTR*2050 (Family and Community Nutrition) and NUTR*1010 (Nutrition and Society), in the Applied Human Nutrition program at the University of Guelph in Ontario, Canada. Students were offered the opportunity to participate in the study through a brief presentation following a class session. The only inclusion criterion was that participants be enrolled in NUTR*2050 or NUTR*1010 in fall 2012 and winter 2013, respectively. Participation in the research was strictly voluntary. No monetary compensation was offered, however students received bonus marks for completing a related assignment. The study was approved by the University of Guelph’s Research Ethics Board, and all participants provided written informed consent.
Measures

**Body composition.** All testing took place at the University of Guelph Body Composition and Metabolism Lab between November 2012 and March 2013. Percent body fat was measured using a BOD POD™ Air Displacement Body Composition System (software version 4.5.1, Cosmed, Concord, CA). As per standard protocol for BOD POD testing, participants were instructed to avoid eating, drinking, or exercising, 2 hours prior to the test, and to wear appropriate attire (i.e., bathing suit, swim cap, no jewellery). The test involves four measures: height, weight, body volume, and thoracic gas volume. Height was measured to the nearest 0.1 cm using a wall-mounted stadiometer (Medical Scales and Measuring Devices; Seca Corp., Ontario, CA). Weight was measured to the nearest 0.1 kg using the digital scale accompanying the BOD POD. For measurement of raw body volume, participants entered the BOD POD chamber and were instructed to sit quietly, limit movement, and breathe normally. Finally, to adjust raw body volume, participants breathed through a disposable tube connected to the rear of the BOD POD to measure thoracic gas volume. If thoracic gas volume could not be measured by the third attempt, predicted thoracic gas volume from the BOD POD was used (n=40). The entire BOD POD procedure was undertaken by one of two trained research assistants.

Mean within-subject coefficient of variation for the BOD POD used in this study was determined by assessing 4 individuals (2 males, 2 females) 3 times each, and was found to be 6.4%. Also, one study among 45 female undergraduate students found the mean percent body fat assessed from BOD POD (26.1 ± 5.5) vs. dual x-ray absorptiometry (27.1 ± 4.8) to be strongly associated (correlation coefficient = 0.88, p < 0.01) (Edwards, Simpson & Buchholz, 2011).
Also, one study among 40 women found the mean percent body fat assessed from BOD POD vs. dual x-ray absorptiometry was 24.3 (standard error [SE] = 1.1) vs. 23.8 (SE = .8), respectively (Maddalozzo, Cardinal & Snow, 2002).

**Sleep quality.** The Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman & Kupfer, 1989) was used to assess sleep quality. The PSQI is a validated instrument with seven scales that assess the following dimensions of sleep over the last month: Subjective Sleep Quality (i.e., perception of one’s own quality), Sleep Latency (i.e., how long it usually takes to fall asleep per night), Habitual Sleep Efficiency (i.e., actual hours of sleep vs. hours spent in bed), Sleep Disturbances (i.e., factors that cause individuals to wake up in the middle of the night or early morning), Sleep Medication Use (i.e., prescribed or “over the counter”), and Daytime Dysfunction (i.e., difficulty staying awake during the day). Scores for each scale range from 0 to 3, generating a total score ranging from 0 to 21. A total score of 5 or higher is indicative of a poor-quality sleeper. The PSQI adequately differentiates between good and poor sleepers (Grandner, Kripke, Yoon & Youngstedt, 2006), and is also a reliable sleep quality measure among college students (Cronbach’s α = .73) (Lund, Reider, Whiting & Prichard, 2010).

**Sleep quantity.** Sleep quantity was assessed from the PSQI item, “During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed).”

**Confounders.** Gender, depressive symptomatology, diet quality, and physical activity have been identified as potential confounders of the association between sleep and body composition. Percent body fat is typically lower in males vs. females, and gender differences in sleep patterns may also exist (Lauderdale et al., 2006; Tsai & Li, 2004). With respect to depression, depressed vs. non-depressed individuals have been found to experience more sleep
difficulties (Janson-Fröjmark & Lindbolm, 2005; Tsuno et al., 2005), and have higher rates of overweight/obesity (Goodman & Whitaker, 2002; Luppino et al., 2010). It has also been well documented in the literature that a healthy diet and physical activity is associated with decreased BMI and % body fat (Rauner et al., 2013; Swinburn et al., 2004). Research further suggests specific dietary variables and increased physical activity is associated with improved sleep (Peuhkuri et al., 2012; Yang et al., 2012).

**Depressive symptomatology.** The Center for Epidemiological Studies Depression (CESD) scale (Radloff, 1977) was used to assess depressive symptomatology. The CESD scale, designed to measure depressive symptomatology in the general population, assesses frequency of depressive symptoms (i.e., appetite loss, feeling lonely) experienced during the past week. The scale includes 20 items scored on a 4-point Likert scale for a minimum and maximum total score of 0 and 60. A score of 16 or greater is used to identify individuals at risk for clinical depression. The CESD has been found to be a reliable measure of depressive symptomatology in a population of otherwise healthy young adult university students (Cronbach’s α = .87) (Radloff, 1991).

**Diet quality.** Participants completed 3 day food records (2 weekdays, 1 weekend day) to reflect their typical intake one week prior to their body composition assessment. Food records were analyzed using The Food Processor for Windows (version 10.12.0; ESHA Research, Salem, OR), and average daily intake of nutrients and food group servings were recorded by a trained research assistant. The Canadian Healthy Eating Index (HEIC-2009) (Woodruff & Hanning, 2010) was used to determine diet quality based on daily average intake. HEIC-2009 is Canada’s adaptation of the U.S. Healthy Eating Index that assesses diet quality based on having an adequate intake of Eating Well with Canada’s Food Guide servings (Katamay et al., 2007), as
well as a moderate intake of saturated fats, sodium, and other foods. Diet quality is scored on a scale of 0 to 100, and categorized as high (> 80), average (50 – 80), or low (< 50). While the HEIC-2009 has yet been validated, the American HEI, from which HEIC-2009 was adapted, has been evaluated (Guenther, Reedy, Krebs-Smith, Reeve & Basiotis, 2007).

**Physical activity.** The International Physical Activity Questionnaire – Short Form (IPAQ-SF) (Booth et al., 2003) was used to assess physical activity level. IPAQ-SF contains 9 items to record activity of four intensity levels: 1) vigorous (i.e., aerobics), 2) moderate (i.e., leisure cycling), 3) walking, and 4) sitting. Participants report the number of days over the last week, and average minutes per day, performing at each intensity level. The IPAQ has been found to be a reliable (compared with objectively measured physical activity, via accelerometer and pedometer, correlation coefficient = 0.15 to 0.26) and stable (intraclass correlation coefficient = 0.71 – 0.89) measure of physical activity among college students (Dinger & Behrens, 2013).

**Statistical Analysis**

Participant characteristics were summarized as means (± standard deviations) and ranges, or frequencies and percentages. Statistical analyses were conducted using version 21 of IBM SPSS Statistics for Windows (PASW, IBM, New York, USA). Normality of the data and assumptions necessary for performing each statistical test were checked. A $p$-value ≤ .05 was considered significant.

Bivariate linear regression was used to examine the association between sleep variables (explanatory variable: sleep duration or sleep quality) and % body fat (outcome variable). For comparison with the majority of similar studies, the association between sleep and BMI was also examined. Regression coefficients were calculated to examine how % body fat or BMI changed with each unit increase in the sleep variable. Standardized regression coefficients were also
determined to allow better comparison between sleep and weight variables by indicating how many standard deviations the weight variable changed per standard deviation increase in the sleep variable. Gender, depressive symptomatology, diet quality, and physical activity were added to statistical models to account for any potentially confounding influence on the relationships. Control variables were retained in the analysis if its regression coefficient $p$-value was less than .25 (approaching significance).

Independent samples t-tests were also conducted to examine difference in % body fat and BMI between short vs. adequate sleepers, and poor vs. good quality sleepers.

**Results**

A total of 175 (89% female) students from NUTR*1010 and NUTR*2050 participated in this study. All participants had complete body composition and sleep data, and thus 175 participants were included in independent samples t-tests. Of the 175 participants, 169 also had complete depressive symptomatology and diet quality data, and thus 169 participants were included in regression models.

Participant characteristics are summarized in Table 1. Based on BMI, 4.0% were classified as underweight (< 18.5 kg/m$^2$), 72.6% were normal weight (18.5 to 24.9 kg/m$^2$), 18.3% were overweight (25 to 29.9 kg/m$^2$), and 4.0% were obese (> 30 kg/m$^2$). Based on % body fat, 9.7% were classified as obese (females, > 35%; males, > 22%) (Lohman, Houtkooper & Going, 1997). In addition, 8.0% were short sleepers (< 7 hours), and 92.0% were adequate sleepers (>7 hours). Also, according to the PSQI, 53.1% were good quality sleepers (score ≤ 5), and 46.9% were poor quality sleepers (score > 5).

With respect to control variables, the majority of participants (76%) were not at risk for clinical depression (CESD score < 16), had average (59%) or above average (28%) diet quality
(HEI score 50-80, > 80, respectively), and were classified as having a moderate (32%) or vigorous (60%) physical activity level (IPAQ-short form score $\geq 600$ MET-min/wk, $\geq 1500 – 3000$ MET-min/wk, respectively).

Controlling for physical activity had a statistically negligible effect (regression coefficient $p$-value $> .25$) on the relationship between any sleep and weight variables. Thus, final adjusted regression models were only controlled for gender, depressive symptomatology, and diet quality.

As shown in Table 2, results of bivariate regression analyses revealed no association between sleep duration or sleep quality and % body fat. Similarly, there was no association between sleep duration or sleep quality and BMI. However, there was a negative association between sleep quality and BMI that approached significance (a 1 PSQI score increase, that is, poorer sleep quality was associated with a .214 unit decrease in BMI, $p = .085$). There was also a positive association between sleep duration and % body fat that approached significance (a 1 hour increase in sleep was associated with a .926 % increase in body fat, $p = .064$).

As summarized in Table 3, between sleep categories, there was no significant difference in % body fat between short vs. adequate sleepers ($p = .328$), or good vs. poor quality sleepers ($p = .608$). Similarly, there was no significant difference in BMI between short vs. adequate sleepers ($p = .130$), or good vs. poor quality sleepers ($p = .607$).
Table 1. Participant Characteristics.

<table>
<thead>
<tr>
<th></th>
<th>Whole Group (n=175)</th>
<th>Females (n=156)</th>
<th>Males (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>19 ± 1.5</td>
<td>18 – 28</td>
<td>19 ± 1.5</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>22.9 ± 3.6</td>
<td>14.6 – 38.1</td>
<td>22.7 ± 3.5</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>25.3 ± 8.1</td>
<td>4.1 – 47.9</td>
<td>26.6 ± 7.2</td>
</tr>
<tr>
<td>Sleep Quantity (hr)</td>
<td>7.6 ± 1.1</td>
<td>5 – 11</td>
<td>7.6 ± 1.0</td>
</tr>
<tr>
<td>Sleep Quality¹</td>
<td>5.9 ± 2.5</td>
<td>1 – 13</td>
<td>6.0 ± 2.5</td>
</tr>
<tr>
<td>Depressive Symptomatology²</td>
<td>11.7 ± 8.0</td>
<td>0 – 44</td>
<td>12.2 ± 8.1</td>
</tr>
<tr>
<td>Diet Quality³</td>
<td>70 ± 15</td>
<td>35 – 97</td>
<td>70 ± 14</td>
</tr>
<tr>
<td>Physical Activity (MET-min/wk)⁴</td>
<td>3407 ± 2484</td>
<td>132 – 13998</td>
<td>3163 ± 2239</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>%</th>
<th>Frequency</th>
<th>%</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity: Caucasian</td>
<td>147</td>
<td>84.0</td>
<td>133</td>
<td>85.3</td>
<td>14</td>
<td>73.7</td>
</tr>
<tr>
<td>Other</td>
<td>28</td>
<td>16.0</td>
<td>42</td>
<td>14.7</td>
<td>5</td>
<td>26.3</td>
</tr>
</tbody>
</table>

¹Pittsburgh Sleep Quality Index; minimum=0, maximum=21; a cut-off score of ≤ 5 is used to identify “good” quality sleepers; > 5 poor quality sleepers.
²Centre for Epidemiological Studies Depression scale; minimum=0, maximum=60; a cut-off score of ≥ 16 is used to identify individuals at risk for clinical depression. Whole group n=171; Females n=154; Males n=17.
³Canadian Adaptation of Health Eating Index; a score of > 80=good quality diet (high), 50 – 80=improvement required (average), < 50=poor diet (low). Whole group n = 173; Females n = 154; Males n = 19.
⁴International Physical Activity Questionnaire – Short Form; vigorous activity level is defined by ≥1500 – 3000 MET-min/wk; moderate activity level is defined by ≥ 600 MET-min/wk; low moderate activity level is defined by not meeting requirements for moderate or vigorous activity levels. Whole group n= 153; Females n= 134; Males n= 19.
Table 2. Bivariate and Multivariate Associations between Sleep (Duration and Quality) and Weight Variables (% Body Fat, and BMI)

<table>
<thead>
<tr>
<th>Sleep Duration (hours)</th>
<th>% Body Fat</th>
<th></th>
<th></th>
<th></th>
<th>BMI</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted</td>
<td>Adjusted</td>
<td>Unadjusted</td>
<td>Adjusted</td>
<td>Unadjusted</td>
<td>Adjusted</td>
<td>Adjusted</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>STβ</td>
<td>p</td>
<td>β</td>
<td>STβ</td>
<td>p</td>
<td>β</td>
</tr>
<tr>
<td>Sleep Duration (hours)</td>
<td>.740</td>
<td>.098</td>
<td>.195</td>
<td>.926</td>
<td>.124</td>
<td>.064</td>
<td>.430</td>
</tr>
<tr>
<td>Sleep Quality (PSQI score(^1))</td>
<td>-.256</td>
<td>-.079</td>
<td>.297</td>
<td>-.244</td>
<td>-.074</td>
<td>.325</td>
<td>-.249</td>
</tr>
</tbody>
</table>

\(^1\)Higher score indicative of poorer sleep quality.

Note. Adjusted for gender, depressive symptomatology, and diet quality.

Abbreviations. BMI, body mass index; β, regression coefficient; STβ, standardized regression coefficient.

Table 3. Comparison of BMI and % body fat between short vs. adequate sleepers, and poor vs. good quality sleepers (n=175)

<table>
<thead>
<tr>
<th>Sleep Quantity(^1)</th>
<th>Short sleepers (&lt;7 h/night, n=14)</th>
<th>Adequate sleepers (≥ 7 hr/night, n=161)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>---</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>24.3 ± 3.6</td>
<td>22.8 ± 3.5</td>
<td>.130</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>23.3 ± 12.7</td>
<td>25.5 ± 7.6</td>
<td>.328</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sleep Quality(^2)</th>
<th>Poor quality sleepers (PSQI score &gt; 5, n=14)</th>
<th>Good quality sleepers (PSQI score ≤, n=93)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>---</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>22.4 ± 2.9</td>
<td>23.4 ± 4.2</td>
<td>.063</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>25.0 ± 7.5</td>
<td>25.6 ± 8.8</td>
<td>.607</td>
</tr>
</tbody>
</table>
**Discussion**

The purpose of this study was to examine the association between sleep (duration and quality) and body composition (% body fat and BMI) variables. We found no significant association between sleep duration or quality and % body fat or BMI. We also found no significant difference in % body fat and BMI between short vs. adequate or poor vs. good quality sleepers.

Results of this study are congruent with some studies among older adults, children, and adolescents that have found no association between self-reported sleep duration and BMI. Specific to the young adult population, results are similar to one cross-sectional study which examined the association between self-reported sleep duration and BMI in young adults (Meyer et al., 2012). This study examined a demographically diverse (with respect to ethnicity, socioeconomic status [SES], family status, health-related behaviours) sample of 1051 young women (25.3 ± 1.7 years). Linear regression models adjusted for age, race, SES, family structure, depressive symptoms, physical activity, and sedentary and dietary behaviours found sleep duration was not associated with BMI, overweight, or obesity (Meyer et al., 2012). One longitudinal cohort study examined the association of sleep with BMI among children/adolescents assessed at three time points approximately 4 years apart: ages 8-11, 12-15 and 16-19. Sleep duration and BMI was reported by parents for children (8-15 years), while adolescents (16-19 years) self-reported their sleep duration (Storfer-Isser, Patel, Babineau & Redline, 2012). Regression analyses adjusted for age, race, birth rate and SES found sleep duration was not associated with BMI at any age among females. Among males, the strength of association between shorter sleep duration and increased BMI decreased as age increased, and was no longer significant in late adolescence (Storfer-Isser, et al., 2012). Furthermore, one recent
cross-sectional study examined the relationship between sleep patterns and % body fat in 330 predominantly normal-weight young adult women (20.2 ± 1.5 years) (Bailey et al., 2013). Sleep and % body fat were objectively measured via 7-day actigraphy and the BOD POD, respectively. Structural equation modelling found that neither sleep duration, wake time, nor sleep time were not significantly related to either % body fat or BMI.

However, in contrast with our study, this study found that sleep efficiency (amount of time participants were asleep over the amount of time they were in bed), sleep pattern inconsistency, and physical activity were significantly related to % body fat. When examining the structural equation model with BMI instead of % body fat, only sleep efficiency was significant. Also, one study among 1 252 college students (18-24 years) examined the association between sleep duration and quality, as assessed by the PQSI, and self-reported BMI (Quick et al., 2013). The study found a greater proportion of participants with short or poor quality sleep to be classified as overweight/obese. Difference in findings may be due to objectively measuring sleep (Bailey et al., 2013), or, from examining a larger, more diverse sample which increases the ability to identify statistically significant associations (Quick et al., 2013).

**Strengths and Limitations**

This study contributes to the limited body of literature on the association between sleep and body composition among the young adult population. One key strength of our study is that the BOD POD was used to reliably assess % body fat as most studies have used BMI as a proxy of body fatness.

One limitation is that neither sleep duration nor sleep quality was objectively measured (i.e., via actigraphy or polysomnography). While this study examined global sleep quality,
specific sleep quality variables (i.e., sleep efficiency) found to be associated with body composition in similar studies was not examined.

Another limitation is that the majority of participants were normal weight, had a healthy diet, moderate to vigorous activity level, and adequate sleep, with few depressive symptoms. Though representative of a healthy young university population, a more diverse population may have allowed for detection of a more statistically significant association between sleep and body composition. Participants were also self-selected undergraduate nutrition students, thus findings may not be generalizable to the greater young adult population.

**Conclusion**

Results of this study suggest there to be no significant association between sleep duration or overall sleep quality, and objectively measured % body fat and BMI among young adults. Similar to the older adult, child, and adolescent populations, existing sleep and weight association studies among young adults presents mixed results. Further research that objectively measures sleep duration and sleep quality are needed for more conclusive findings on the association between sleep and body composition among young adults. Future studies should also further examine specific sleep quality variables (i.e., sleep efficiency, sleep pattern inconsistency), which have been found to be associated with body composition. Nonetheless, the importance of sleep should continue to be promoted for greater overall health.

**References**


