Using fitness equipment to harvest human kinetic energy at the Dalplex

Rachael Nicholls
Rebecca Laporte
Stefanie Mandl
Elissa Christie
Ukelabuchi Egbe

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Executive Summary

The research project, Using Fitness Equipment to Harvest Human Kinetic Energy at the Dalplex explored the potential to offset fossil fuel energy dependency in the Dalplex. This was done through determining how much human energy members produced while exercising in the cardio room. Dependency on non-renewable energy is an issue that is going to need to be addressed at Dalhousie in the near future as the university grows and fossil fuels become more expensive and less available.

To determine the viability of producing a substantial amount of energy by using the cardio room, our research group used non-probabilistic purposive sampling within the Dalplex cardio room for a time span of 1.5 hours on Sunday, March 23 and surveyed 14 people and recorded their calories burned, the duration of their work out, and the type of machine they used. Our limitations and delimitations are included in the report. However our findings determined that based on the total annual Dalplex energy consumption and our study, human kinetic energy could offset 1% of the yearly energy required at the Dalplex. This is a total savings of $4, 737.70 annually. Although this may seem small it is important to remember that our results are being compared to the energy consumption of the entire Dalplex facility. As well, the yearly savings could potentially be put back into retrofitting more machines around the building that can also harness human energy.

Being a sustainable campus requires the cooperation and participation of not only the university community, but also that of the wider community. The Dalplex is a community hub where students and Haligonians come to exercise, play, and compete. By using human energy to offset electricity people will become more aware of the potential and future possibilities of alternative energies and a sustainable future for our school and community.

Introduction

Energy is in such large demand throughout the world and is currently being harvested in extremely harmful ways, impacting the planet. This energy production is coming from sources of non-renewable resources like fossil fuels and coal. These non-renewable sources are also seen to be used in our backyard, as Nova Scotia uses coal to power homes and Dalhousie University. Due to its large student body for an Atlantic school, Dalhousie requires large amounts of energy in order to successfully operate its residences, labs, classrooms and athletic facilities. The current energy costs each year for the school total at $14 million (Dalhousie University Appendix, 2010). However with this being said, energy demand will continue to rise, forcing prices to increase, along with the expansions that the school wants to make. This will add $9 million (Dalhousie University Appendix, 2010) to the already growing costs.

The Dalplex is home to a range of athletic facilities including the university pool, basketball and volleyball courts, a track and a cardio room. Many people come through the doors each day to work out, but the area that is seen to be in constant use is the cardio room. The workout culture is becoming larger each year with increased use seen in this room, which introduces the possibility to make a sustainable change in energy consumption. This encourages the energy harnessing of human kinetic power, which could be very beneficial due to the increasing number of people working out.

Gyms are trying to be more sustainable, and one way to do this is to harness the kinetic energy that is being used. This human power can be converted from mechanical to electrical power by using pedaling bikes, stair climbers and running on a treadmill. Though with this being said, the more people that use these machines to work out, the more energy can be harnessed and used. The power can be either sent back into the grid or used to power the Dalplex lights or other energy demanding devices. A person with average athletic ability has been seen to be able to produce about 100-1500 watts of energy, which can charge a battery of 50mA current and power a small electronic device, like an Iphone (Yildiz and Fahmy, 2009). In order to make the Dalplex even more sustainable they have begun to use treadmills that require no electricity. This is a great idea, for they are entirely human powered. But to make these machines even more suitable for this project, devices can be added to harness the human power that is being used.

In this project, what is trying to be found is how much can the harvest of electrical energy from exercise machines offset energy use at the Dalplex? We predicted that, when in use, fitness machines in the Dalplex can harness enough energy to decrease part of the building's energy emissions dependence on unsustainable energy sources like coal. It may not create a substantial difference at first, but once this method is constantly practiced and enforced, Dalhousie can create a more sustainable campus by just simply allowing people to continue their normal routine of working out. This has proved successful in other places, which is why we believe that it can also make a positive change on the campus.

This idea of creating gyms that are sustainable was created by Lucien Gambarota, an Italian inventor, who worked with a number of people to successfully open the first sustainable gym in 2008. The gym, California Fitness, is based in Hong Kong. (Cho, 2012). This idea spread throughout the world and sustainable gyms are now seen in Australia and the USA. And not only can we work out to harness energy. In the Netherlands, a club called WATT uses their dance floor harnesses the kinetic energy of people moving around and stepping on it. This kinetic energy is then re-routed to power all the lights above (Staff, 2009). Other universities have begun to see the benefits of this as well; studies are being completed at the University of Toronto, in partnership with a Victoria-based company called Ecofit, which aim to determine the best way to harness human energy during a workout using time, distance and calories (Author Unknown, 2014).

Data can be collected based on the amount of energy created by each piece of gym equipment, along with how many people are using each piece of equipment. There are three machines that have been found to be the most successfully at the conversion of energy harvested from humans into electricity. A gym in Hong Kong uses a stationary bike that can produce 50 Watts of energy if someone were to pedal at a constant speed for one hour (Horton and Kiger, 2014). Also, a Stairmaster machine creates 50 Watts for one hour operation, which could lead to the elimination of 12 liters of carbon dioxide from entering the atmosphere (Cho, 2012). The most effective machine however is the treadmill, which is able to produce 18.2 Kilowatts over an hour, eliminating an impressive 4,380 litres of carbon dioxide (Cho, 2012). It is important to study the potential of collecting alternative energy on campus and determining the feasibility of it being a worthwhile investment, as well as how we can use this collected energy. The Dalplex is a large, energy intensive building, and therefore is a primary target on campus to find ways to use more alternative energy sources.

Methods

Sampling

Type of Sampling

For our research we will be collecting a non-probabilistic purposive sample. Due to the time constrictions and scope of our research non-probabilistic sampling is the most efficient method to provide us with the best estimate (Guarte & Barrios, 2007). Non-probabilistic sampling is created when respondents are chosen because they are easily accessible and the researchers have justification that they are a good representation of the population (Guarte & Barrios, 2007). By choosing the cardio room as our setting we have easy access to participants in which we can survey whom have already volunteered themselves to be at the location.

More specifically, we will be doing a purposive sample. Purposive sampling is when units within a population are selected specifically to be studied (Teddilie & Yu, 2007). Purposive sampling is used to either reach a consensus of representation of a large population or to compare scenarios (Teddilie & Yu, 2007). Due to the smaller sampling used in purposive sampling the quality of the data which includes, reliability is even more important than in a random sample (Tongco & Dolores, 2007).

Choosing Participants

Our research team conducted our sample within the Dalplex's cardio room. We chose to survey every person in the room in the 1.5 hour time span in which we conducted the survey, due to time constraints within our project. We have chosen to visit our setting at its busiest times of day to collect as much data as possible within our limited time there. We chose the time 4:00pm until 5:30pm which is generally after work hours for adult members. These times are what the class text refers to as, "richest possible data sites"(Kirby,Greaves,& Reid, 2010, p.185).

Research tools

Tools and methods used in this study:

The primary research method used in this study is observation and fieldwork, as described by Kirby, Greaves, and Reid (Kirby, Greaves, & Reid, 2006, p.147). Researchers will be present in the Dalplex cardio room (the research 'field'), and collect data on exercisers' calorie output using a pre-configured data-collection table (appendix A). The use of this table will allow for the standardized collection of data so that it may be meaningfully compared and analyzed later. Because "it is impossible for a researcher to be a total non-participant and...still be in the field of study," we will be "participant observers" (Kirby et al, 2006, p.149). There are varying degrees of participation however, and ours will be mostly limited to explaining the scope and importance of our research to potential subjects, and to requesting permission to use potential subjects' information in our study. The majority of our research will be comprised of unobtrusive observation and data recording.

A content analysis research method will also be employed via our examination of the Dalplex's powerbill record. This primary source document will allow us to gain a somewhat objective insight into the current situation of power usage at the Dalplex. (Kirby et al, 2006, p.154-5).

The data collected will be of both a quantitative nature that can be used in a numerical analysis (duration of exercise, calories burned, powerbill findings), and also a qualitative nature that can be used to support and explain quantitative findings (age, gender, type of machine used).

A calorie to Watt formula will be the final tool used to interpret and process the raw data (described above) collected in this study.

Validity and reliability of this method:

Validity refers to how accurately a method measures what it is intended to. Reliability refers to the replicability of test results. (Prof. Van Wilgenburg, 2014). Many studies performed and documented that concern harvesting biomechanical energy from humans are performed by high-level researchers who have access to funding and materials which our research group does not have the capital to replicate. Alternatively, many non-academic sources (e.g. "green" fitness centres) document fitness equipment being used to generate electricity, but have no formal scientific studies available on the effectiveness of this phenomenon. Nonetheless, these studies (academic) and scenarios (non-academic) are relevant enough to our research project that they lend some validity and reliability to our methods.

1. Validity

In their paper *Development of a biomechanical energy harvester*, Donelan et al. describe how "human muscle is the origin of the mechanical power available for energy harvesting" which can be translated into electrical power (Donelan et al, 2000). While the researchers are studying a technologically specialized contraption/method that directly measures power generated (cutting out the step where one must convert calories to Watts), their data is collected from people who are exercising (in this case, walking) as the data in our study will be (granted a more intense exercise).

In his thesis investigation, *Analysis of a Treadmill Based Human Power Electricity Generator*, Mankodi retrofits and old manual treadmill to be hooked up to an electricity generator. Thus the treadmill will produce electricity when someone expends calories to use it. While still technologically more advanced than the method we will be able to employ (again, he does not directly measure calories, but uses a generator), this scenario also indicates that our group is justified in observing the use of fitness equipment to measure the potential of human biomechanical energy output to be transformed into electricity.

Finally, the research project *The Effectiveness of Energy Generating Exercise Equipment for Energy Conservation Education* funded by the US Environmental Protection Agency which was conducted at Albion College, is the formal study most similar in method to the research our group is proposing. Old fitness machines were converted into devices attached to generators and batteries. In this study however, although the machines automatically showed how much electricity was produced from a person exercising, the researchers also compared this output to the actual energy expended by the person. The caloric expenditure was manually converted into Watts, and then compared with the amount of electricity that the machines had managed to capture. Through this, it was discovered that the machines captured only between 6-8% of the caloric output. (Cawood et al, 2008).

The first two of the above studies provide more external, rather than internal, validity support to our methods (Prof. Van Wilgenburg, 2014). The methods used in both studies to measure how human kinetic energy from exercise can be translated into electrical energy can be somewhat generalized to apply (to some extent) to our study. Ultimately, both of the above studies are measuring human calorie expenditure during exercise, but simply using a generator to immediately translate the caloric energy into electrical energy. Our method, being less technological, necessarily requires that we add the extra step of recording calories and then manually converting them into electrical energy. The intent and hope is that our method is similar enough to the aforementioned methods to result in valid findings.

The final study lends the most validity to our proposed methods, illustrating that by converting calories to Watts we are indeed measuring what we were intending to (potential amount of electrical energy that could be saved by harvesting human energy). It also points out a potential flaw however, showing that were the Dalplex to implement a program of harvesting human biomechanical energy, the actual percentage of the caloric output that could be captured for use depends on the quality of the machinery/generator. This study also indicated that there may be catalytic validity (Van Wilgenburg, 2014) attached to this research method, as the paper reported that participants came away with an increased understanding and appreciation for renewable energy sources (Cawood et al, 2008).

2. Reliability

Many sources that indicate the reliability of our proposed research method are not of an academic/scholarly nature. They frequently take the form of empirical and informal reports from “green” gyms and recreation centres that have invested in fitness machines that harvest the energy from users and convert it into electricity. Across the board gyms have reported lowering their power consumption by converting human caloric expenditure into electricity, albeit to varying degrees. For example, the Cadbury House Club (in Congresbury) claims that it has reduced its energy consumption by 30% (Atkin, 2013), while the Green Microgym in Portland, Oregon, has purportedly reduced it’s carbon emissions by 60% (Cho, 2012). While these reports do indicate some level of repeatability with regards to the potential of using human caloric output to reduce energy consumption, it must be noted that these reports are neither peer-reviewed literature, related to a university, or even confirmed.

Procedure description

a) Find out the Dalplex’s total energy use per year. Find out the average number of people who use the cardio room per day. These tasks will be achieved by speaking with a manager at the Dalplex, or relevant University administrative staff.

b) Request permission from the Dalplex to use the cardio-room as a space to gather research data for the span of one week (see schedule section of the proposal for exact dates). Provide the Dalplex with information about the study and the data collection table (see Appendix B).

c) In pairs, researchers will go to the cardio room throughout the week to collect data. Individual data collection sessions may range anywhere upwards of one hour, depending on the schedules of the researchers.

d) During these data collection times, random samples from users of the cardio room (see explanation of sampling section above) will be taken, with as many samples as possible being collected (ideally a minimum of 20). Researchers will respectfully approach cardio room users, briefly explain the scope and purpose of the study, and request permission to collect the user's information as data in the study. Relevant information provided by the user includes: the length of time he/she used the machine; and the calories burned at the end of his/her workout. The results will be recorded in Table 1 (see Appendix C).

Results

Table 1: Kilowatt usage and cost at the Dalplex

Timeframe	Kilowatts	Cost (CAD $)
Per year	2, 628, 470.93 *Information supplied by Kathie Wheadon, Dalplex employee	295, 426.66 *Information supplied by Kathie Wheadon, Dalplex employee
Average per day	7, 201.29 (2, 628, 470.93/365)	792.14 (**0.11*7, 201.29)

**Average cost per kilowatt is $0.11 (kilowatts per year/cost per year).

Table 2: Calories burned by participants on various cardio room equipment, and during workouts of varying lengths

Participant	Calories burned	Duration of workout (minutes)	Equipment
1	400	40	Treadmill and elliptical
2	185	20	Treadmill
3	300	30	Body Arcz
4	111	10	Rower
5	59	10	Bike
6	107	10	Stepper
7	77	10	EFX
8	205	15	Elliptical
9	330	30	AMT 1
10	469	30	ARC Trainer
11	400	45	Treadmill
12	260	17	ARC Trainer
13	137	15	Octane Lateral
14	350	50	Treadmill and elliptical

The calories burned by each participant during their workouts of varying lengths are standardized by calculating how many calories each participant would have burned in an hour if she maintained her pace. The calculations we done using cross multiplication.

Ex. Participant #1: 400 calories/40 minutes = X calories/60 minutes

X = 600 calories

Table 3: Calories burned per hour on various equipment in the Dalplex cardio room

Participant	Calories/hour	Equipment
1	600	Treadmill and elliptical
2	555	Treadmill
3	600	Body Arcz
4	666	Rower
5	354	Bike
6	642	Stepper
7	462	EFX
8	820	Elliptical
9	660	AMT 1
10	938	ARC Trainer
11	533	Treadmill
12	917	ARC Trainer
13	548	Octane Lateral
14	420	Treadmill and elliptical
Total	8,715	---

The cardio room is open 16 hours per day. The time the data was collected was neither a peak time for cardio room usage (lunch hour, 6-8pm), nor an exceptionally quite time (6-8am, late evening), so we (the researchers) believe that the number of participants we encountered is a good representation of the average number of people that would be using the cardio room in one hour, and therefore is also a good representation of the average number of calories that would be burned in the cardio room in one hour.

Average number of calories burned in the cardio room per day:

8,715 calories/hour * 16 hours (time the cardio room is open each day) = 139,440 calories

Now that the average number of calories burned in the cardio room per day has been ascertained, we can convert calories to Watts. One calorie is equivalent to approximately 0.85 Watts (How Stuff Works, 2001).

Average number of kilowatts that could be produced by the cardio room per day:

139,440 calories/day * 0.85 = 118, 524 Watts/day = 118 kilowatts/day

Average number of kilowatts that could be produced by the cardio room per year:

118 kW*365 days= 43,070 kW per year

Percentage of the Dalplex's energy use that could be supplied by harvesting the kinetic energy generated in the cardio room:

(118 kW per day/7, 201.29 kW per day)*100 = 1.6%

Money that could be saved per year by harvesting kinetic energy from machines in the cardio room:

$0.11/kW*43,070 kW per year = $4,737.7 per year

Limitations and Delimitations

Limitations

Limitations refer to areas in our research that we are unable to control that may possibly hinder the reliability and accuracy of our research results ("Develop a research proposal", 2010.)

1.The Sample Size: Due to time constraints of the project and receiving ethics approval we were only able to survey 14 people. We stayed for 1.5 hours and surveyed every person who was in the cardio room during that time. The cardio room was approximately 70% full therefore, we felt it was an accurate representation of an average population in the room despite our small sample size.

2. Distribution of Machine Use: We have chosen to sample every person who is in the cardio room at our designated observation times, this may mean more of one type of machine is being used than others (elliptical, stationary bike, rower etc.). Different machines burn more calories and therefore may contribute to a skewed average when totalled all as one.

3. Participant honesty: We have no way of knowing if the subjects recorded their number of calories burned correctly.

4. Participant Co-operation: One participant in our survey filled out the information that was needed but refused to sign the informed consent form writing, "NO!" on the signature line. Although we were not collecting any personal information we still had to include an informed consent form which may have caused the person to be upset without survey. We did not include their information.

Determining Energy Offsets: The power bill which was provided to us from the Dalplex only had information on energy consumption for the entire building, rather than the cardio room specifically. Therefore, although the energy offset for the entire building may be a very small percentage of the total Dalplex use, there is great potential that cardio users could be producing enough energy to offset the individual room itself.

Delimitations

Delimitations refer to choices our research team has consciously made that may have benefits or consequences to our research results ("Develop a research proposal", 2010.). These choices relate to the scope of our project and why we have chosen to include and exclude certain areas of research and information ("Develop a research proposal", 2010.).

1.Observation Times: We have chosen to record our data at the most commonly busiest times of day in the cardio room. We have chosen to do our surveys at this time so we can gather as many individual outputs as possible within a short time frame.

2.Setting Location: We have chosen our setting to be within the space of the cardio room despite the other exercise machines located in different areas of the Dalplex for efficiency purposes, and the convenience of the cardio room machines having calorie counters on them unlike some of the older machines located elsewhere.

3.Decision to have subjects: At first we debated on recording ourselves exercising on the different types of machines in the cardio room but we decided against it to avoid convenience sampling. Also, our research team contains five females all of similar age and size and would produce an inaccurate average and poor representation of cardio room members.

4.Length of Activity: Due to time constraints and efficiency for analyzing our data we converted all calories burned to a unit of calories burned per hour. The range of activity length varied from 10 minutes on a machine to 50 minutes. We chose to do this to make it easier to convert into energy units. This produces inaccuracy because it is assumed that a person would not be able to maintain the same pace they would for 10 minutes of activity for 1 hour of activity.

Budget

Due to the scope of our research project, a funding proposal and/or budget is not necessary. We do not require any extra materials as we used the existing environment of the Dalplex cardio room and our subjects were already present. We simply gathered quantitative data and did not proceed to purchase or install any types of technology as our goal was to investigate the feasibility of new technology in the future.

Discussion

Rising costs in energy suggest it is only rational that institutions take the necessary steps to reduce consumption of non-renewable resources for the sake of financial savings. Considering the Dalplex is a highly energy intensive building, such a reduction in energy expenditure could decrease overhead costs. It has been estimated in other studies that that with 45 retrofitted exercise bikes running for 18 hours a day; a gym could save up to $3,200 a year (Blechman et al, 2009). Our findings yielded a significantly higher prediction at $4,737.70 per year. However, it is important to note that this is compared to the Dalplex's total energy requirements and it would only offset 1% of the yearly energy required at the Dalplex. The goal of the research was focused on using inductive reasoning to establish the amount of renewable energy that can be harvested by Dalplex machine users, which can significantly reduce the buildings overall emissions. Given this, by examining our findings, we can conclude it does not support our hypothesis that retrofitting could create a significant reduction in the buildings emissions.

Yet even if the gym cannot create substantial profit margins, any profits that come from retrofitting could be redistributed into retrofitting more machines in the Dalplex. If we start small, by implementing harvesting devices in a small percentage of machines, the profits of doing such could be redistributed towards other renewable energy initiatives like solar or wind power. For example, the 'Green Microgym' in Portland, Ore. Adam Boesel opened the facility in 2008 with Human Dynamo machines inside and solar panels on the roof. Boesel reports that his gym generates about 36 percent of its own electricity, saving nearly 40 000 kWh per year (Gibson, 2011). Comparatively, our findings suggest the Dalplex would achieve similar results with approximately 43,070 kW per year. With effective management, any money that is saved through harvesting the kinetic energy,will have a catalytic effect on the further reduction of energy intake at the Dalplex. Even if actual financial output of retrofitting remains small when put into practice, it could contribute to increasing LEED points for the building.

Beyond the financial implications of implementing our project, there remains a potential social impact. If the Dalplex achieved the results predicted in our findings, it could create a noteworthy display of environmental responsibility. The environmental movement has arisen out of inherent need and because of that, has influenced all aspects of society. In an increasingly energy conscious society, adapting different forms of technology to become more eco-friendly is a worthwhile goal. Dalhousie can bring itself one step closer to becoming a foreword thinking university that actively invests in the sustainability of its self in the future. If Dalhousie's small gym could achieve successful retrofitting, it possesses the inherent worth that could spark interest in other gyms off campus. The scope of our proposal could expand to the wider community.

Furthermore, looking at the micro implications of the implementation of our project, it could increase the interest of renewable energy and sustainability in the individuals using the cardio room. It can educate those who are involved, and create a discourse of renewable energy on campus. Not only does it not require a change of lifestyle on the part of cardio room patrons, but if they were made aware of the energy they are producing while working out, it could result in increased rate of calories being burned, and ultimately initiate a healthier lifestyle for participants. If interest were created by implementing this project, it could also bring in more customers who want to try the equipment for themselves, and ultimately create more energy and revenue for the cardio room. It could get people thinking about adopting a more energy efficient lifestyle. It is intuitively beneficial to incorporate human health and energy needs within the same scope to increase overall human health.

Conclusion

In summary, biomechanical energy harvesting constitutes a clean, portable energy alternative to the fossil fuels currently being used. Biomechanical energy harvesting technology is a novel approach for producing energy for small devices. Here we have been able to estimate the biomechanical power generating potential of the cardio room in the Dalplex. We have also presented estimates of harvestable potential power from different exercise equipment in the Dalplex cardio room.

Since the amount of energy that can be produced depends solely upon human effort, a very small amount of electricity can be produced compared to the actual energy requirements of the Dalplex. However, the aim of this research was to promote sustainability, and biomechanical power generation in no way takes away from that. We are focused on saving energy and saving the environment; therefore, when we look at the amount biomechanical power generated by one person in the cardio room for one hour, we do not just consider the amount of electricity generated. We pay more attention to the fact that each kilowatt of electricity generated from biomechanical power, is one less kilowatt from fossil fuels.

When you account for all the energy that goes into powering a huge structure like the Dalplex, and also take into account the total energy requirement for the University, biomechanical power may appear to be a somewhat inefficient way to make electricity. Yet, the fact remains that it is energy generated and not wasted. Furthermore, harvesting green energy while engaging in healthy activities, which are part of our normal routine, seems logical. The opportunity to play a key role in promoting sustainability at Dalhousie, will help a number of Dalplex users feel better about their workout, and give them an added incentive to workout more frequently and for a longer period of time. It will also improve enrolment rates at the Dalplex, as most people would want to identify with a gym that is actively involved in going green. Our recommendation to the University will be to begin utilization of biomechanical energy, as it will prove to be a worthwhile undertaking at Dalplex.

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The group of students working on this project; Stefanie Mandl, Elissa Christie, Rebecca Laporte, Rachael Nicholls and Ukelabuchi Edge, would like to thank and acknowledge the following people who have helped with the success of this project. We would first off like to thank the Collage of Sustainability for the support behind this project and our professor Hendricus Van Wilgenburg. We would also like to thank the staff at the Dalplex for allowing the use of its facilities and Kathie Wheadon-Hore, Director of Facility and Business Services for additional Dalplex energy information and ethics approval to work in the cardio room. Lastly we would like to acknowledge the numerous participants who were involved in the study and allowed us to collect the necessary information required in order to determine the energy usage in the cardio room of the Dalplex.

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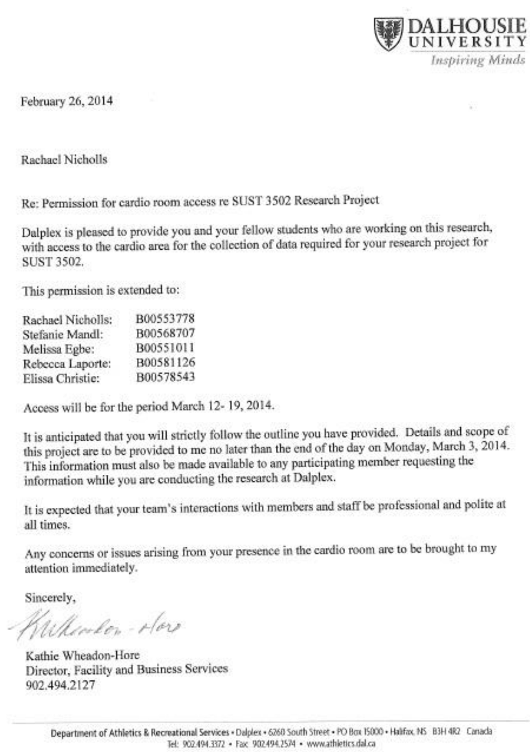
Appendices

Appendix A: Dalplex Letter of Permission



DALHOUSIE UNIVERSITY
Inspiring Minds

February 26, 2014

Rachael Nicholls

Re: Permission for cardio room access re SUST 3502 Research Project

Dalplex is pleased to provide you and your fellow students who are working on this research, with access to the cardio area for the collection of data required for your research project for SUST 3502.

This permission is extended to:

Rachael Nicholls:	B00553778
Stefanie Mandl:	B00568707
Melissa Egbe:	B00551011
Rebecca Laporte:	B00581126
Elissa Christie:	B00578543

Access will be for the period March 12- 19, 2014.

It is anticipated that you will strictly follow the outline you have provided. Details and scope of this project are to be provided to me no later than the end of the day on Monday, March 3, 2014. This information must also be made available to any participating member requesting the information while you are conducting the research at Dalplex.

It is expected that your team's interactions with members and staff be professional and polite at all times.

Any concerns or issues arising from your presence in the cardio room are to be brought to my attention immediately.

Sincerely,

Kathie Wheadon-Hore
Director, Facility and Business Services
902.494.2127

Department of Athletics & Recreational Services • Dalplex • 6260 South Street • PO Box 15000 • Halifax, NS B3H 4R2 Canada
Tel: 902.494.3372 • Fax: 902.494.2574 • www.athletics.dal.ca

Appendix B: Data Collection Table

Date:

Table 1: Calories burned by Dalplex cardio room users, taking into account the type of machine used.

Time of day	Machine type	Calories burned	Workout duration