



**University
of Victoria**

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**THE IMPACT OF STUDENT LED TUTORIALS
ON FIRST YEAR STUDENTS' LEARNING
OUTCOMES**

Department of
Mechanical
Engineering

The Impact of Student Led Tutorials on First Year Students' Learning Outcomes

MEng Project Report

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Author: Sohad Kadhum

Advisor: Dr. Brad Buckham

Table of Contents

1. INTRODUCTION	3
1.1. Historical Instructional Approach	3
1.2. Problem Statement.....	4
1.3. Objectives.....	6
1.3.1. Curriculum Development Objectives	6
1.3.2. Curriculum evaluation and review Objectives.....	6
2. CURRICULUM DEVELOPMENT.....	7
2.1. Student-Led Tutorial	8
2.2. Assignments and Examinations	9
2.3. Seminars (Help Centre)	10
2.4. Formative and Summative Assessments.....	11
3. RESULTS and DISCUSSION.....	12
3.1. Student Feedback	12
3.2. Instructor Observations	16
3.2.1. Instructor Observations for the year 2014	16
3.3.2. Instructor Observations for the year 2015-2019	17
3.3 Student Led-Tutorial Preparing Students for Exams.....	25
4. CONCLUSIONS	27
Acknowledgments.....	28
References	29
Appendices	30
Appendix 1: Application Form for Ethics Approval for Human Participant Research	31
Appendix 2: Recruitment Script	53
Appendix 3: Participant Informed Consent Form.....	55
Appendix 4: Application Form for a Learning and Teaching Grant	58
Appendix 5: Starting and Final Questionnaires.....	64
Appendix 6: The Code's Matrix	77
Appendix 7: ENGR 141 Student's Led Group Tutorials Survey- Final Questionnaire pick up instruction	78
Appendix 8: Rod-Collar Problem- Tutorial #2	79

Executive Summary

ENGR 141 Engineering Mechanics is a first-year course that is common to all of the University of Victoria engineering degree programs. Between 2013 and 2014, the course population grew by ~50% necessitating changes in the methods of assessment; adjustments included introducing multiple choice exam components for the first time and replacing instructor evaluated handwritten assignments with machine graded on-line problems. Over concern that these logistically motivated changes would exacerbate negative trends in student work and study habits and detract from the course's emphasis on solution procedures and best practices, a pedagogically motivated change was also introduced.

The tutorial periods were repurposed to create student driven exploration, analysis and solution of customized mechanics problems lying just beyond the scope of typical coursework. The current report outlines the motivations, implementation details and findings made over the duration of the first offering of the revised course in 2014 and the curriculum evaluation and review in the following years 2015-2019. A close-up observation was made to find out how students retain knowledge developed on midterms and tutorials. This was measured by looking at exam questions that were repeats of questions seen earlier in the year in these two activities.

One of the major objectives was to make sure the students gain competency in tackling and solving complex statics problems into their simple constituents, it can generate confidence in best practices, their ability to apply these practices and their ability to attack complex problems. In the UVic Engineering Faculty, it was felt that the work habits acquired in ENGR 141 affect student performance in subsequent years of the program.

The change of the curriculum addresses the concern of the sudden growth in the student population and the risk of not addressing more of the learners' need. The student led tutorials, involving presentation of group work and discussions, facilitate the students' abilities to apply the fundamentals engineering concepts and theories in complex, but practical, applications while also increasing their retention of basic solution processes. The success rates were seen to be higher than the previous years 2008-2013. I observed that the number of failing grades in 2014 was the lowest since 2008, and that there was significant growth in the A+ and B letter grade brackets – approaching and eclipsing, respectively, the maximum number recorded over the previous 5 years. I feel we were able to help students who would otherwise finish in the D to E brackets to improve into the C bracket, and many students to elevate from the B- bracket into the B to B+ range.

The work at the ENGR 141 was a good environment to introduce the learners to the skills needed to embark on their engineering journey. Group work, quality of work, confidence, and professional practice were the skills improved through the curriculum changes.

1. INTRODUCTION

Engineering 141 (ENGR 141), Engineering Mechanics, is an introduction to mechanics that deals exclusively with the method of statics. Similar courses are found in all Canadian mechanical engineering programs, but ENGR 141 has some distinguishing characteristics; it includes structural analysis (trusses and beam shear and bending moment diagrams, and it is a core component across the UVic biomedical, civil, computer, electrical, mechanical and software engineering programs. The students' personal interests in the course material vary wildly [1].

The pedagogical challenge in ENGR 141 is not in the dissemination of mechanical principles – the focal points are the physical definition of force and moment and the execution of the method of statics over a variety of real-world scenarios. Rather, the challenge is developing confidence in solution procedures and convincing students to habitually apply these procedures, however time consuming, in order to transform seemingly difficult problems into straightforward, deterministic calculations.

If students learn to systematically decompose seemingly complex statics problems into their simple constituents, it can generate confidence in best practices, their ability to apply these practices and their ability to attack complex problems. In the UVic Engineering Faculty, it is felt that the work habits acquired in ENGR 141 affect student performance in subsequent years of the program.

1.1. Historical Instructional Approach

Through 2013, ENGR 141 was composed of 3 hours of instructor-led lecture (1 section) and 1 hour of instructor led tutorial (4 sections) each week. Lectures introduce basic theory (Cartesian vector notation, vector operations, internal force sign conventions, etc), but a large proportion of lecture time is devoted to solving example problems. Through the example problems, the creative process of generating Free Body Diagrams (FBDs) that lead to useful, equations of equilibrium are emphasized. Four tutorial periods were used as an opportunity to address more sample problems in a setting of ~60 students rather than ~240 as in lecture period. In addition to lecture and tutorial contact hours, a help centre was established in 2007 to provide opportunity for drop-in assistance on a one-to-one basis. The help centre hours replaced instructor office hours: the help centre was typically open for 8-9 hours per week and was staffed by a teaching assistant (TA) or one of the course instructors.

For the past decade, the course has been well thought of by students yet classified as one of the hardest courses in UVic Engineering common first year.

1.2. Problem Statement

Several disturbing trends in ENGR 141 student behaviours and study habits were observed between 2008 and 2013:

1. Widespread dependence on non-refereed materials as a primary source of knowledge; these materials are mostly worked assignment and test problem solutions.
2. Very low uptake of the help centre in 2012 and 2013.
3. Dramatically decreasing attendance at the tutorial sessions (~30-50% absentee rate).
4. With the exception of the 2013 final exam, poor averages on course testing components (quizzes, midterms and final exam) - see Table 1.
5. Low-quality assignment submissions that ignore the notations and procedures championed in the lecture and tutorial periods.

Of the above, the drop off in attendance at the ENGR 141 help centre was most concerning. For example, in 2012, most days saw only 3-5 people show up in a class of over 250 people. From assignment submissions, it was readily apparent that students were turning to immediately available on-line solutions and worked examples rather than working with an instructor at the help centre to develop their own solution strategies. By foregoing the opportunity to practice the execution of solution procedures independently, students were tending, I believe, to compartmentalize mechanics problems; students could solve problems of a very particular type using a particular procedure but could not extend the components and tools of such solutions to other types of problems. In 2014, these poor practices were augmented by a sudden increase in course population – shown in Figure 1.

Table 1: Class average grades for individual testing components of ENGR 141 for 2008 through 2019. As ENGR 141 switched between fall and spring terms in 2010, there was no 2010 calendar year course offering.

	2008	2009	2011	2012	2013	2014	2015	2016	2017	2018	2019
Quiz (%)	60.2	57.0	NA	69.5	NA						
St. Led T(%)	NA	NA	NA	NA	NA	92.2	91.9	88.9	93.0	93.1	90.2
Midterm(%)	60.1	59.7	44.5	59.0	58.0	61.9	62.6	60.4	51.1	54.8	63.1
Final(%)	52.2	59.0	58.2	58.1	70.1	71.1	75.5	68.1	69.0	66.5	64.9

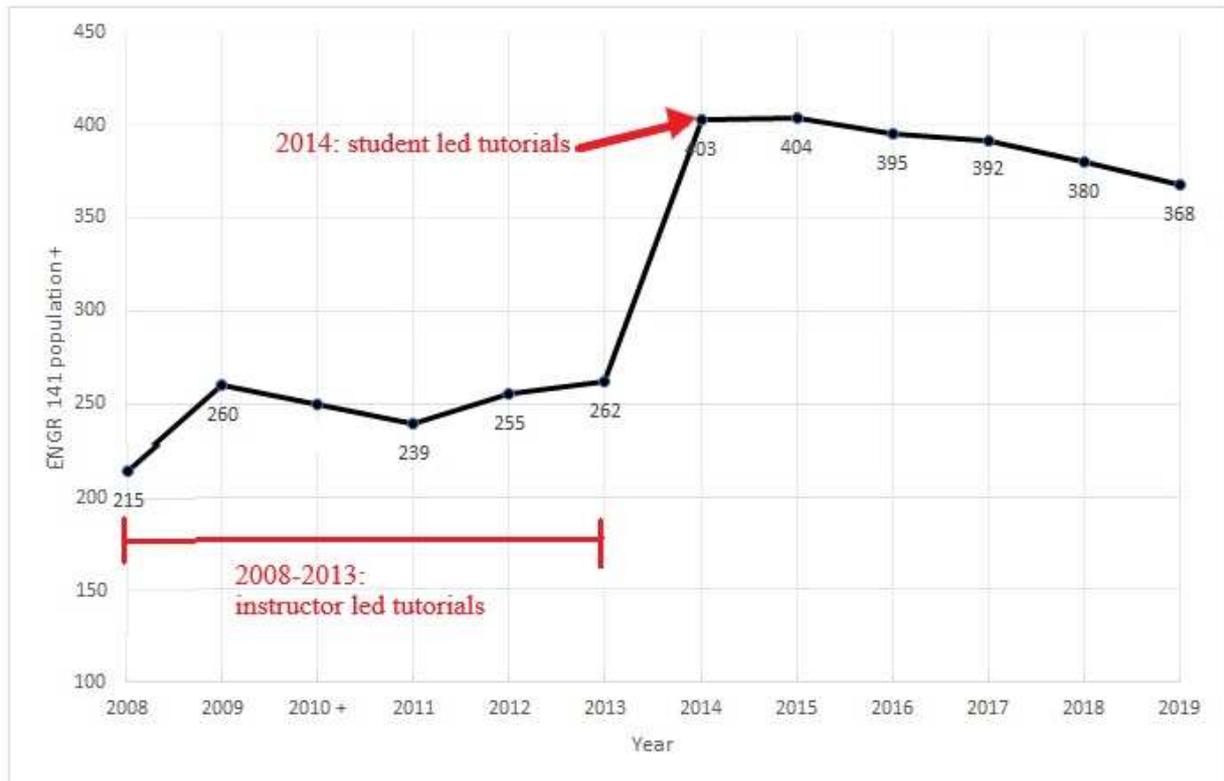


Figure 1: ENGR 141 population between 2008 and 2019(inclusive). Numbers given are for term end (final exam attendees).

Prior to the 2014 course offering, there was significant concern that the growth of the lecture session to >400 students and the 4 scheduled tutorial sessions to >100 students would intensify student anonymity and detachment, and drive students towards on-line materials due to real and perceived barriers to timely instructor interaction.

In 2013, I conducted an informal investigation of the ENGR 141 course components. The attendance of the lectures, the tutorial session, and the help center were observed. There was very low uptake of the help centre in 2012 and 2013 and decreasing attendance at the tutorial sessions (~30-50% absentee rate).

The students' success rate was 35% which is an alarming rate. It was clear a change to the curriculum that address the learners' need was needed.

There has been a steady degradation of the “checks and balances” in BC high schools. The problems are in the attitudes and habits being developed and not the high school curriculum. Interpersonal communication skills are being replaced with “on-line” personalities. Professional life requires face-to-face accountability, cannot hide behind an obscure username. Students need to be able to execute problem solving strategies independent of online resources.

Engineers, by definition, are required to carry through for example an enterprise by skillful or artful contrivance. The sole of engineering work is team work, and so the idea of having student led tutorials drive development of team work abilities was of paramount interest. The question was then how that this be done? How can I measure the impact of the tutorial changes on the students learning outcome. The formal research study was needed. I listed the questions that associated with the students' performance, the questions the instructors has, the tools to promote students driven approach, and lifelong learners skills . Lifelong learners demonstrate the ability to independently summarize, analyze, synthesize and evaluate information from a wide variety of sources, develop a strategy to identify and address gaps in knowledge, and are confident, independent, critical thinkers.

1.3. Objectives

1.3.1. Curriculum Development Objectives

In 2014 significant changes were made to the structure of ENGR 141 to:

1. Re-engage students with course material, the course instructors and, most importantly, their peers;
2. Improve the ability of students to manipulate basic mechanics principles to solve a variety of equilibrium problems;
3. Provide a forum for the students to demonstrate their own capabilities and witness the capabilities of their peers;
4. Enforce the value of independent critical analysis over guided execution of problem solutions.

At the core of these changes, was the repurposing of the tutorial periods to create student driven exploration, analysis and solution of customized mechanics problems for which no published solutions existed on-line.

1.3.2. Curriculum evaluation and review Objectives

In addition to the original curriculum development objective, we started repeating tutorial problems on midterm and the final exam.

I am trying to find out by looking more closely at grade data taken from several years at how students perform on questions seen before – on tutorials or midterms.

The repeated questions from the tutorial were focused on addressing the two initials and challenging concepts that the learners find difficult to understand, Force system resultants:

moment of a force, cross product, principle of moments, reduction to equivalent loads, and Shear and bending moment diagrams.

2. CURRICULUM DEVELOPMENT

Prior to 2014, I had observed that the traditional delivery of tutorials (students act as passive learners and the instructor determines the selection and application of methods) was experiencing low attendance. This was likely in part due to increased tutorial section sizes. However, the prevalence of on-line learning materials, both regulated and unregulated, was also believed to drive low tutorial turnouts. These materials are perceived by the students to be equivalent to the instruction delivered in the tutorials, and they offer immediate gratification. Unfortunately, the use of on-line learning material (especially unregulated materials) is a one way flow of information; the student takes direction from the on-line source without questioning or challenging the source –there is little to no critical assessment of the source’s suggestions.

It is important to note that while the introduction of student-led tutorials was the most dramatic change made in 2014, several other logistical changes were also mandated by the course population growth. Given the number of changes that were made to the course execution, it is difficult to isolate the impact of the student-led tutorials. In this section, a description of the student-led tutorials is provided along with a summary of the ancillary changes to provide context to the assessment results provided in the next section.

Since the curriculum development researched is to evaluate the change of the curriculum on the students' learning outcome, an application for Ethics Approval for Human Participant Research was developed, Appendix 1.

In order to invite students to participate in the research, the Recruitment Script was created to invite students to participate in questionnaires entitled the Student’s led Group Tutorials Development that has been developed for the ENGR 141- Engineering Fundamentals I course, Appendix 2.

To ensure the use of the students feedback at the research analysis, a consent form was created to be signed by the students at the beginning of the research study and at the end.

the students can withdraw from participation in this study at any time up to the moment that they hand in their completed questionnaire at the end of the term, Appendix 3.

In 2013, I applied for the curriculum development fund from the Learning and Teaching Centre at the University of Victoria and I was granted the fund, Appendix 4.

It was quite the process to develop since there are no similar research done before at the UVic Faculty of Engineering before, I included the forms with details so it can be used by future researchers as a guideline. To receive an formative feedback from the students, I designed the starting and final questionnaires, Appendix 5. Great thoughts were given into the type of the questions to gather as much feedback as we can. I also designed the Code Matrix to be used

with the Starting and Final Questionnaires to ensure the anonymous feedback of the students, Appendix 6.

This project focuses on the students as the main learners. By promoting and modeling the student led seminars I believe there is an increase the students' motivation and capacity for learning. Using this approach encouraged the students to engage in different short-form mechanical projects, derived from situations on campus and in the community, to explore the practical application of fundamental mechanics concepts and theories introduced in the regular lecture and tutorial periods. By extending the learning time outside of the existing course venues, I think a contribution was made into the students professional growth and helped creating lifelong learners.

The starting and final questionnaires, the projects that was used through this project and the self reflection journals that the students were encouraged to use helped the students to identify their learning needs. This approach guided the reallocation of appropriate resources during the ENGR 141 term to ensure the students' learning process was positively affected.

The students led tutorial approach provided connecting paths to the students future careers through the involvement in the development stages. They walked away with an enriched experience that will help them in setting their future career paths.

2.1. Student-Led Tutorial

The existing four tutorial sections were subdivided into nine sections of ~40-50 students. Each section met 12 times – once in each instructional week of the academic term. The first week of tutorials was used to establish 11 student teams within each section (ideally with 4 students per team). Teams were maintained throughout the term. Student teams were formed using the spectrum of difference approach: students self reported their experience and affinity for working in groups, and teams were made by drawing from both ends of the spectrum of reported answers. While not a precise exercise, the process introduced randomness (and some levity) in the selection of the teams and ensured most of each team's members were meeting for the first time. In addition to team formation, the ground rules of working in the groups and Tuckman's Team Development Model were discussed [2].

In 2014 and 2015, at the subsequent weeks of tutorial offerings, a series of 22 challenging mechanics problems, lying just slightly outside the knowledge domain of the assignments, were addressed - two problems per tutorial session. Student groups needed to review the two tutorials problems before their scheduled tutorial sessions. As these problems were custom developed, there was no opportunity for the students to draw upon web based resources (existing solutions, prior student work). In the tutorial session, two teams were selected and assigned a problem to work on and present their solution on the blackboard. The rest of the groups could choose a problem and generate a draft solution. At the end of each session, the two selected groups had 10 minutes present their thought processes to their colleagues and field questions from the class. Draft solutions were collected from all teams at the end of class before the start of the presentations. Each student team presented a problem solution in

session on two occasions. To allow each team a chance for reflection and to consider ideas presented by other teams, a final draft hardcopy solution of the tutorial problem they selected was submitted at the start of the next tutorial session.

Two teaching assistants TAs facilitated team discussions and solution generation (both hardcopy and blackboard work) in each tutorial session. The role of the TAs was to “debug” the teams’ work: they tried to identify showstopper issues in each group’s solutions and suggest possible alternatives to incorrect approaches. At no time did the TAs, explicitly show how a problem was to be solved.

The weekly ENGR 141 tutorials were a mandatory course component and the graded group work completed for the tutorial periods contributed to each student’s final grade in the course. The value of the tutorial component is shown in Table 2. The value assigned to the tutorials was drawn from the midterm and final exam components.

Table 2: *grading schemes applied in 2013 (instructor-led tutorials) and 2014-2019 (student-led tutorials).*

	<i>2013</i>	<i>2014</i>	<i>2015-2019</i>
<i>Assignment(%)</i>	<i>20</i>	<i>15</i>	<i>17.5</i>
<i>Tutorials(%)</i>	<i>NA</i>	<i>15</i>	<i>15</i>
<i>Midterm(s)(%)</i>	<i>25</i>	<i>15</i>	<i>15</i>
<i>Seminars (or Help Centre)(%)</i>	<i>NA</i>	<i>5</i>	<i>2.5</i>
<i>Final (%)</i>	<i>55</i>	<i>50</i>	<i>50</i>

By placing significant value on the tutorial component, I hoped to clearly communicate the expected effort and quality of work. The tutorial grades were assigned based on the final draft submission with a portion of the submission’s mark being based on the team’s ability to note and justify changes from the draft submission made in session. Students were responsible for ensuring that identification were provided for only those individuals who contributed to the final submission [3].

The majority of the assigned tutorial problems could not be completely solved inside the tutorial sessions. Rather student teams would work on the strategy to solve the problem (FBD generation, establishing equations of equilibrium) and proceed as far into the equation manipulation as possible.

2.2. Assignments and Examinations

During 2014 and 2015, nine problem sets were assigned over the course of the term. For each problem set, only 1 of the assigned questions was submitted in hardcopy due to constraints on

available TA time for grading. The remaining 4 assignment problems were completed using the Mastering Engineering on-line system that accompanies the course's required textbook. The on-line problems were "end-of section" problems. To compensate for difficulties students have in interpreting and using the Mastering Engineering interface and the score deductions that resulted from these complications, 1-2 additional "tutorial" style problems were added to each on-line assignment for a small amount extra credit (~5% of the assignment value).

In the course of 2016 to 2019, few changes were made to address the learners' performance and feedback. The nine problem sets were assigned over the course of the term and similar procedure was followed. One midterm was administered at 1/3 of the way through the term with a similar structure to the 2014 year.

In 2014, two midterms were administered at 1/3 and 2/3 of the way through the term. The midterm exams were composed entirely of multiple choice questions – 13-14 questions total. The final exam was a mix of 12 multiple choice problems and three conventional handwritten problems.

Throughout 2015 to 2019, one midterm was administered at 1/3 of the way through the term with a similar structure to the 2014 year.

2.3. Seminars (Help Centre)

Each week, 8 hours of drop in seminar time was provided. The seminar series provide the same function as the "help centre" that was offered between 2008-2013: the seminars were a forum to engage the course instructors, on a one-to-one basis, and to collaborate with peers on assignment and tutorial work. Students were encouraged to work in groups, and instructors would address common questions at the board with several students at once. Participation in the seminar series did constitute a small portion of each student's overall grade– 2.5% as shown in Table 2. A half hour of work (discussion with instructors, individual work, group work, etc) at a single seminar counted as an "attended session." For each attended session, students earned 0.5% towards their final grade to a maximum of 2.5%.

Of a population of 403 students only 7 did not earn the full 2.5%. At the end of the term, students requested that the seminars be extended beyond the end of scheduled classes to facilitate final exam review. The maximum grade can be earned from attending the seminar session is 2.5% with exception of the year 2014 were they earned 5%.

The seminar was staffed by the instructors and the teaching assistant (TA) team. For the course instructors, scheduled time providing assistance in the seminars replaced office hours. Whenever possible, we responded to student queries by decomposing their problem into constituents and challenged them to address the smaller components before providing more help. Studies concerning human cognitive abilities and learning and teaching practices are in favour of this approach. Lieberman integrates learning, retention, behavior, and cognitive to the encouragement of the students to critical thinking[4]. Brockbank, A. & I. McGill, in their Facilitating Reflective Learning in Higher Education book outline the importance of group work

and to taking into account factors such as group size, physical space, and technology in group setting [5].

2.4. Formative and Summative Assessments

The Principle Investigator, Dr. Brad Buckham, and RA, myself presented the research to students enrolled in ENGR 141- Engineering Fundamentals course (Spring 2014) during the first week of classes in January 2014. The presentation included a brief overview of the Research Project, an overview of the starting and final questionnaires, the projects that I will use through this project, and the self reflection journals, and the research consent form. Participation in this research is entirely voluntary. Students who are interested in participating will be led through the consent form and asked to sign it. Students who do not choose to participate in this research will have the option to leave the classroom for fifteen minutes while the survey is being administrated or remain in the classroom.

At the end of the term to present the research for a second time and return the starting questionnaires at the beginning of the term. The students filled the final questionnaires. Participants' anonymity was kept protected by a code outlined in Appendix 5 that students filled before completing the starting questionnaires. Students was asked to sign the consent form a second time in order for the researchers to obtain proper on-going consent for the research. The course instructor was not present during recruitment or administration of the starting and final questionnaires.

During 2014 and throughout the term, formative assessment of the impact of the student-led tutorials was completed through careful observation of the tutorial and assignment submissions, and the quality of the team presentations in the tutorial periods. The instructional team met each week to grade tutorial problems and discuss events of the previous week's sessions. These observations are discussed in the next section [6].

Three separate surveys were also conducted. The first was a questionnaire specific to the course was completed by the students at the start and end of the term, this can be found in Appendix 5. Using a symbol based identification system (to maintain anonymity), the code matrix at Appendix 6. In general, this questionnaire focused on measuring the students' changing valuation of the group work component of the course (the tutorials). Second, the final questionnaire. Between the starting and ending versions of the questionnaire, the students responses shift from being perception to experience based. Appendix 7 shows the ENGR 141 Student's Led Group Tutorials Survey- Final Questionnaire pick up instruction.

I was able to track each student's individual preliminary and final responses such that I could measure the change in the responses. Third, after the first midterm, we also solicited anonymous feedback through the tutorial sections. Lastly, the UVic Course experience survey allowed us to gather comments on the course structure and execution.

3. RESULTS and DISCUSSION

Here I present some of the information and data gathered in the formative and summative assessments. We have separated the content into observations made by the students and the instructors.

3.1. Student Feedback

Figure 2 shows the preliminary and final student responses to the question number 11 at the starting questionnaire and question number 9 at the final questionnaire, Appendix 5, “ Circle the number on the scale below, 1 to 100, and to your best of knowledge, to estimate the impact of student led seminars (group tutorials) on student learning outcome.”

The plot shows that, for all of the students who submitted the complete questionnaire, that there was a positive change in student’s attitudes towards the group work component. Interestingly, no student reported a more negative response to the question after completing the tutorials. The data of Figure 2 were supported by personal accounts conveyed in the seminars. Many students indicated that they learned more in the student led format and wished other courses used the approach.

As expected, there were also several constructive criticisms raised by the students. Repeated student comments, and steps taken to address these issues, are listed here in the form of representative individual student comments.

1. “I had to stay after tutorial to discuss the problem with the tutorial instructor as the peer presentations on the board were sometimes confusing.”

The team presentations served two roles: they ensured students were held accountable for their in-class work, and they also served to generate critical peer assessment. We wanted students to examine whether or not they agreed with peer work. To ensure that poor organization of the team presentations didn’t preclude this second benefit, after the midterm we redirected one of the TA facilitator's attention to be solely on the two groups making the presentations.

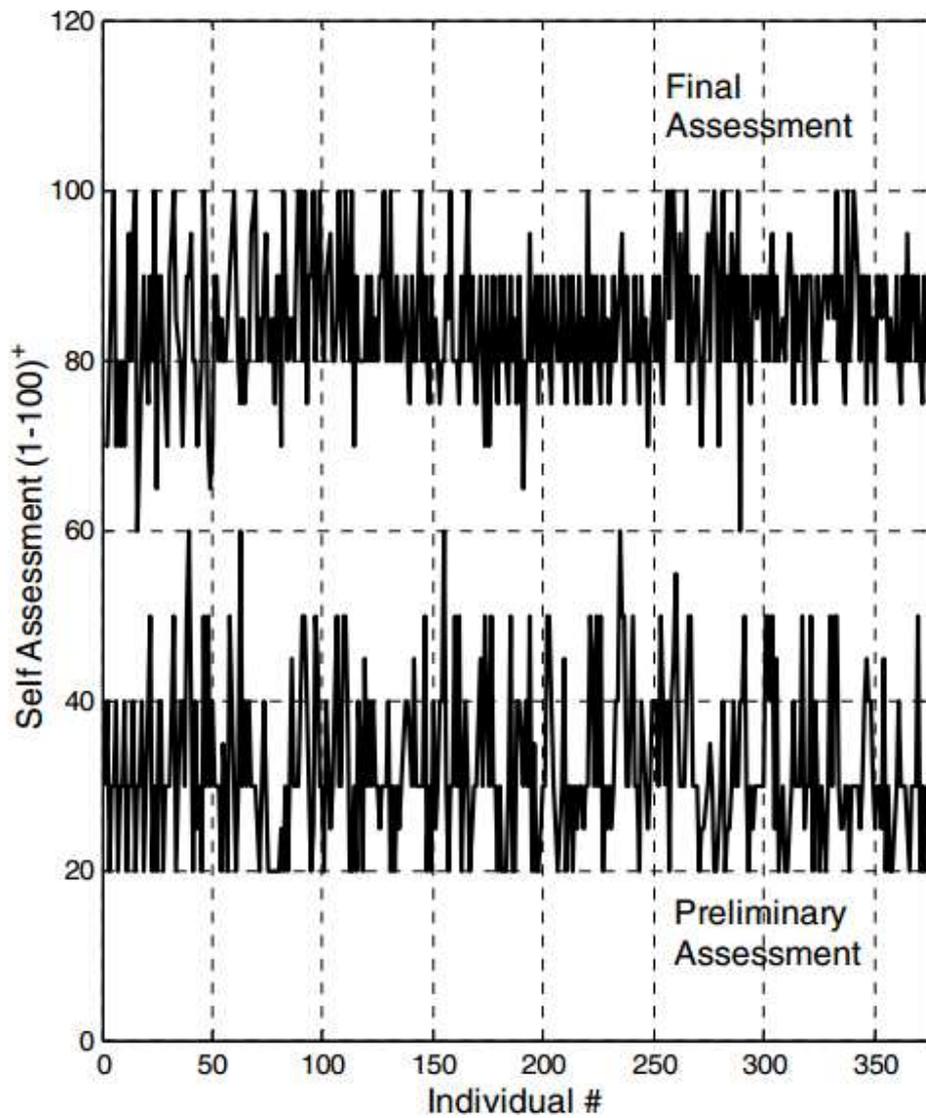


Figure 2: Student response to the question number 11 at the starting questionnaire and question number 9 at the final questionnaire, Appendix 5, “ Circle the number on the scale below, 1 to 100, and to your best of knowledge, to estimate the impact of student led seminars (group tutorials) on student learning outcome.” 100 – absolute “yes”, 0 –absolute “no”.

2. “The seminar room was too crowded for me to work comfortably and I couldn’t get enough of the instructor’s time.”

Figure 3 shows the student attendance at the seminar series over the course of the term. Attendance data has been aggregated over the A, B, C and D letter grades. Referencing comment 1 above, it was important to have the seminars in place so that students could resolve questions regarding not only the assignments but also the tutorial problems. Students made good use of the seminars: the seminar room accommodated 40 people and many days the room was above capacity.

3. “Please introduce a peer evaluation into the tutorial component of the course.”

We are currently working to introduce a formalized peer evaluation into future offerings of the course. In 2014, we relied on TA observations made in class, particularly when groups were presenting, but this did not capture any inequities that developed in the team work when preparing the final problem submissions.

4. “The multiple choice questions on the midterm don’t give me a chance to show how I can draw free body diagrams and generate the equilibrium equations.”

In order to place two TA’s in each of the nine tutorial sessions and staff the 8 hours of weekly seminar time, we decreased the TA marking load by moving to multiple choice midterm exams. For many students, the use of multiple choice exams detracted from the message delivered in lecture period that stressed the importance of best practices in the solution process. For the final exam we allocated more time to grading and included three handwritten problems. Extra TA time was facilitated through a grant from the UVic Teaching and Learning Centre.

Of a population of 403 students only 7 did not earn the full 2.5% allotted to seminar attendance. At the end of the term, students requested that the seminars be extended beyond the end of scheduled classes to facilitate final exam review. Students made good use of the seminars: the seminar room accommodated 40 people and many days the room was above capacity.

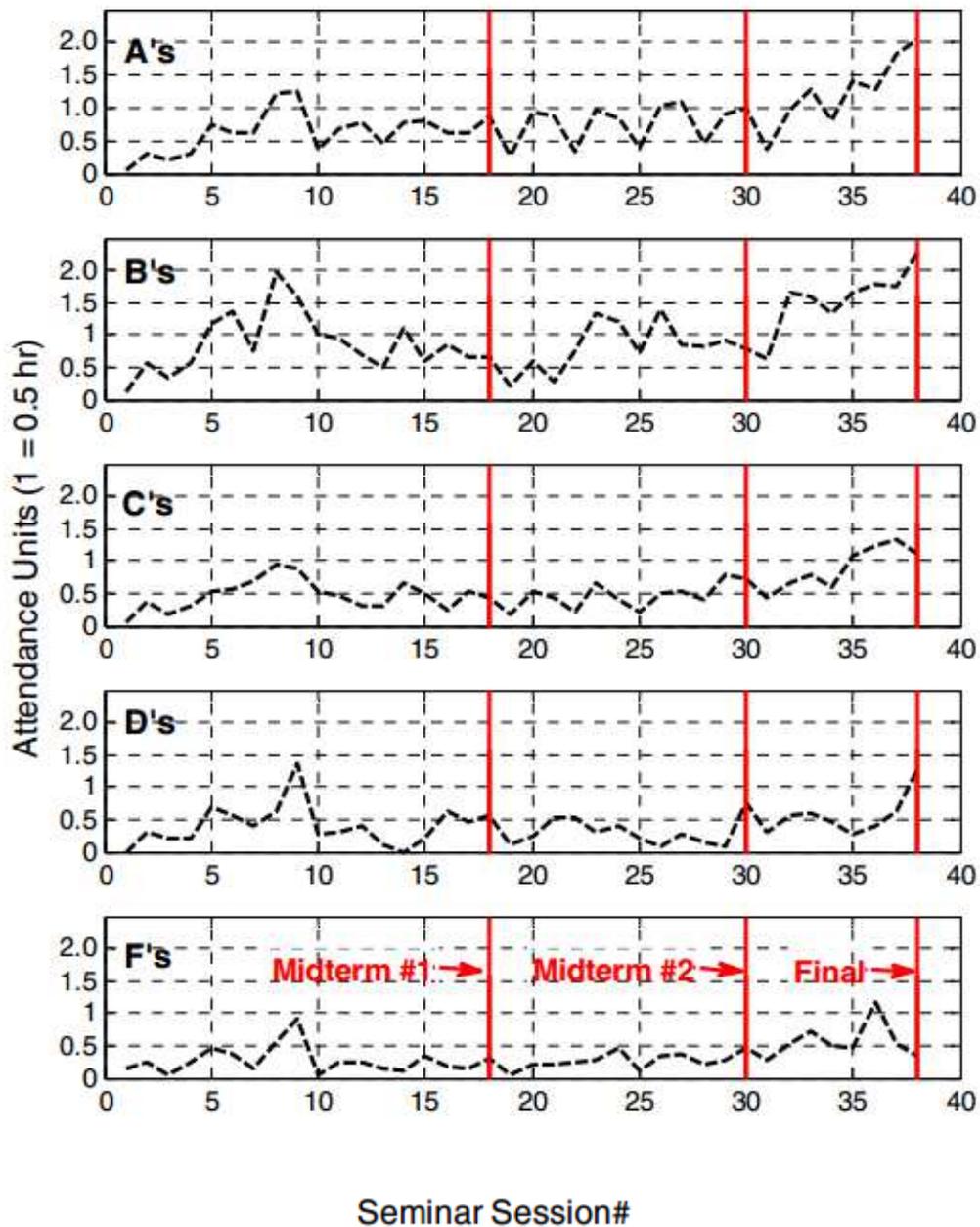


Figure 3: Student attendance at the drop-in seminar series grouped by the students' final letter grade. For example, the top plot shows the average attendance profile for A students. Horizontal axis is the seminar number – there were 38 seminar sessions.

3.2. Instructor Observations

3.2.1. Instructor Observations for the year 2014

Figure 4 provides a comparison of the letter grade distribution in ENGR 141 with instructor-led (2008-2013) and student-led (2014) tutorial components.

The grade distributions are presented in discrete probability density format. Two additional curves have been provided that show the upper and lower bounds for the grade distributions for 2008-2013 period. The upper and lower bounds are the sets of the highest/lowest values for any single bin seen across the 2008-2013 period.

I noticed that the number of failing grades in 2014 was the lowest since 2008, and that there was significant growth in the A+ and B letter grade brackets – approaching and eclipsing, respectively, the maximum number recorded over the previous 5 years. I feel we were able to help students who would otherwise finish in the D to E brackets to improve into the C bracket, and many students to elevate from the B- bracket into the B to B+ range.

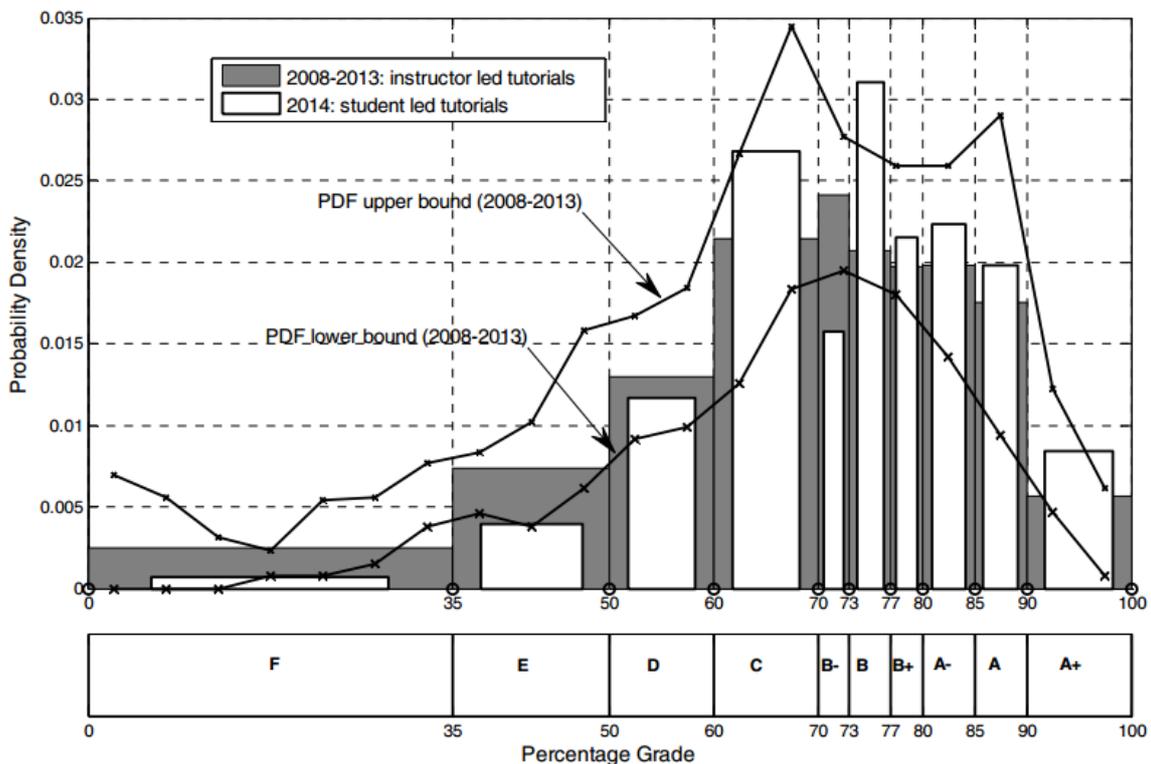


Figure 4: Comparison of the letter grade distributions (shown as discrete probability density functions) between the 2008-2013 (instructor led tutorials) and 2014 (student-led tutorials) offerings of the course. The two curves shown bound the individual PDF values extracted from the five years of final grades for the 2008 through 2013 offerings.

Referring to Table 2, it can be argued that significant value placed on the tutorial group work drives grade inflation; the tutorial value was drawn from the midterm and final exam components which have traditionally scored low. However, the seminar attendance data shown in Figure 1 supports instructor accounts that the students consistently engaged with the instructional team.

The relatively difficult tutorial problems were added motivation for the students to attend the seminars, but we feel that the benefits of the instructor and peer engagement at the seminars, which was not occurring in 2013, extended over the tutorial, assignment and testing components of the course.

3.3.2. Instructor Observations for the year 2015-2019

The following figures show how the grades look in the years that followed 2015-2019.

I observe that the number of failing grades in 2015-2019 are still the lowest since 2008, and that there was significant growth in the A+ and B letter grade brackets . There is a noticeable increase in B-and the C. There are a few noticeable changes across the years. The move from two midterm to one midterm due to heavy work load of the first year students' courses which could lowered the student chance to make up for the lower grades. This point can be observed at the future years of offering the course by inviting the students with lower grades to sit in a complementary midterm exam. To ensure fairness, this is step can be included in the course outline. The other change was made to ensure that the students had the chance to work on the tutorial question was lowering the number of the tutorial problems from 22 problem into 9 tutorials. These tutorial were selected to give a good practice of the concepts. This issue can be addressed by posting the removed tutorial problems as a handwritten problems at the assignments section. There is still a consistency of helping students who would otherwise finish in the D to E brackets to improve into the C bracket, and many students to elevate from the B-bracket into the B to B+ range.

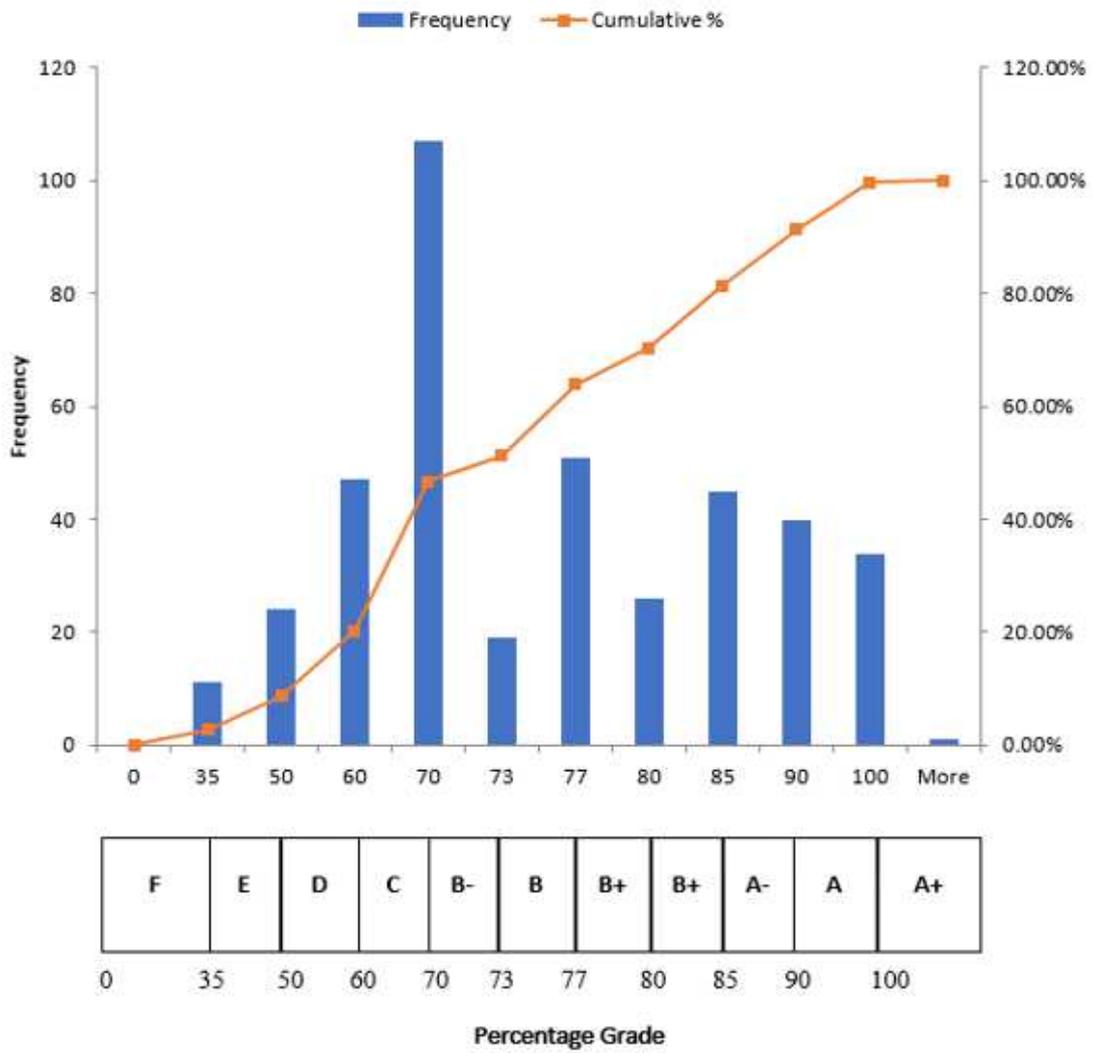


Figure 5: final letter grades distributions for 2015.

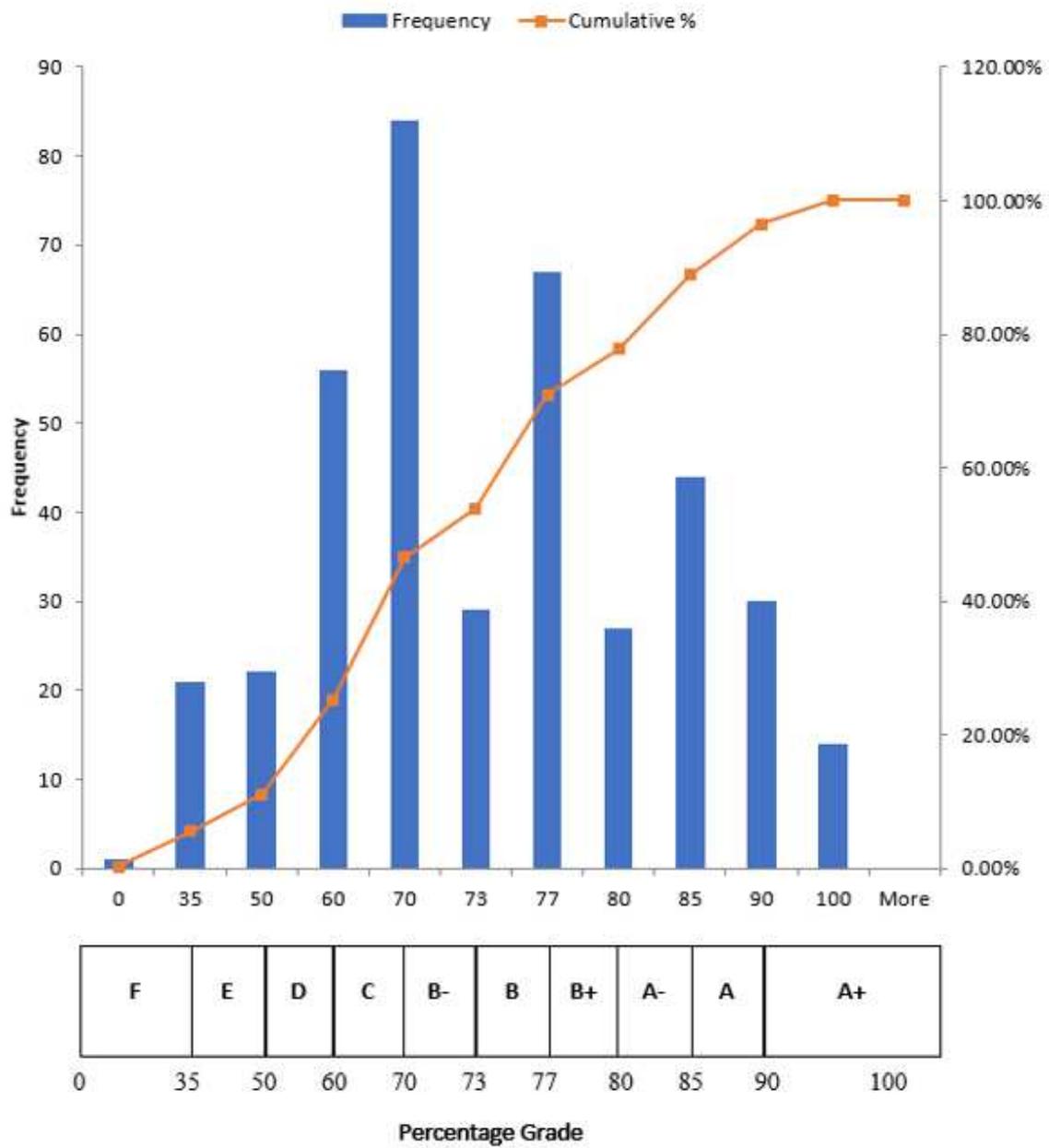


Figure 6: final letter grades distributions for 2016.

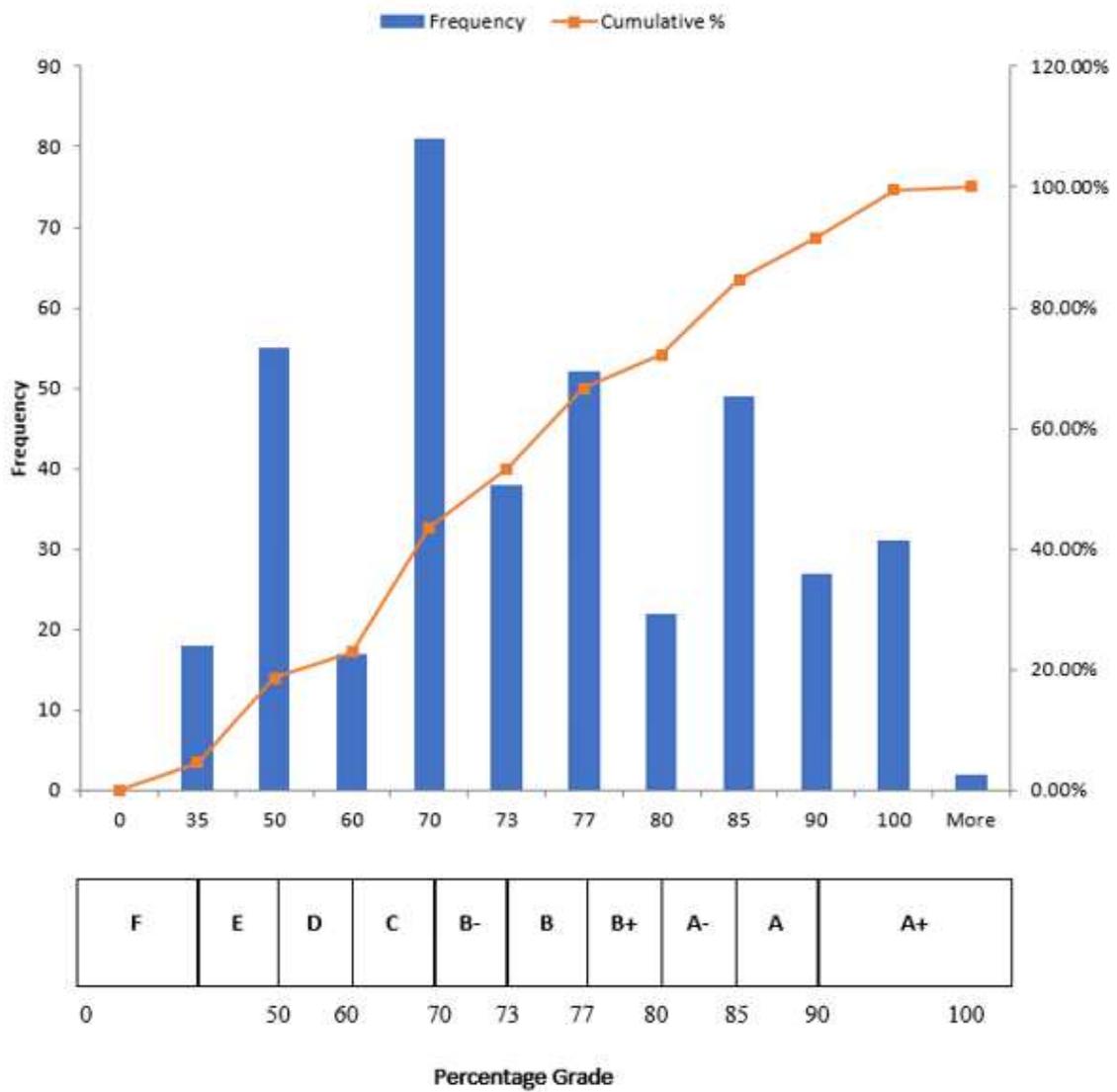


Figure 7: final letter grades distributions for 2017.

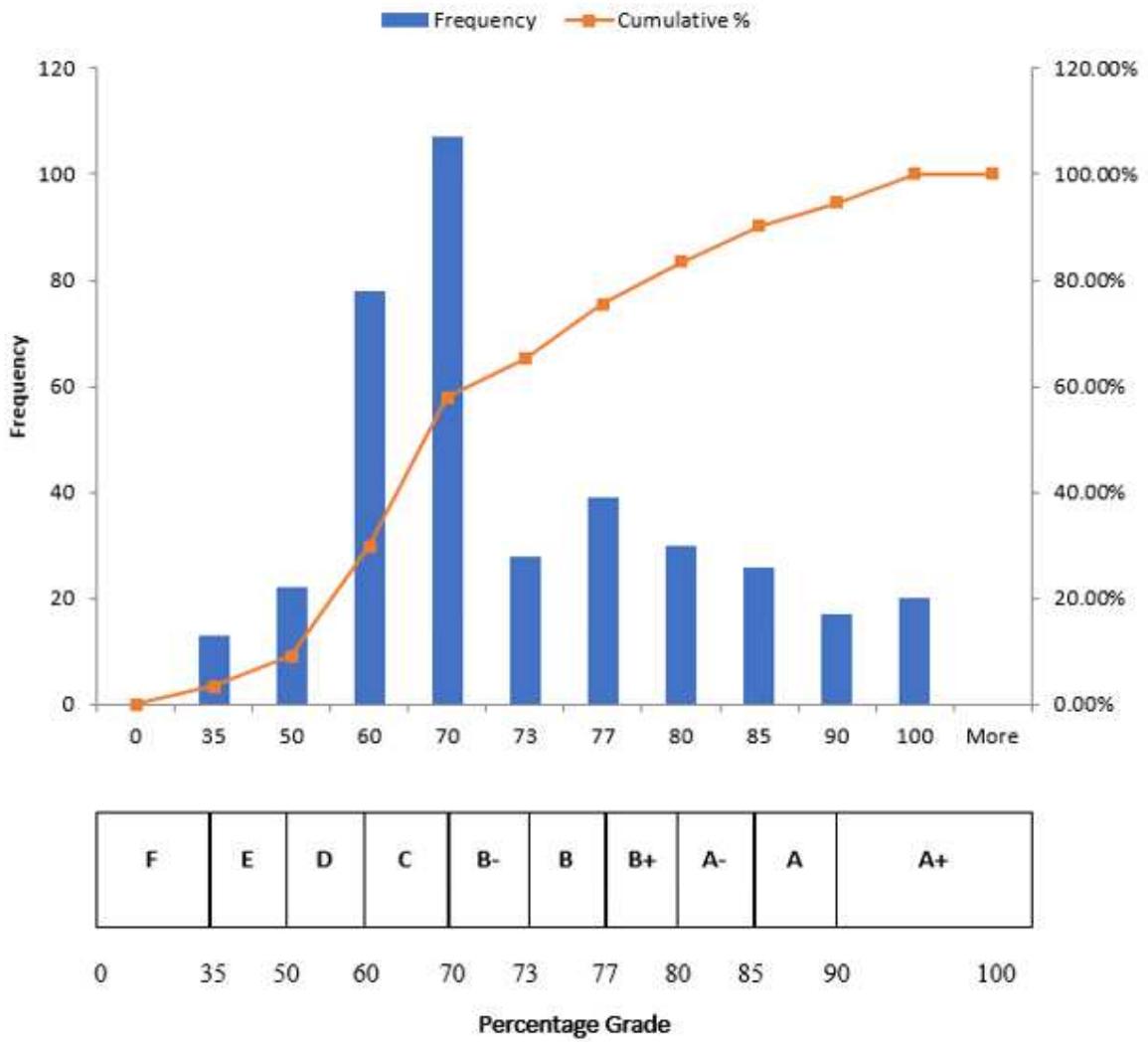


Figure 8: final letter grades distributions for 2018.

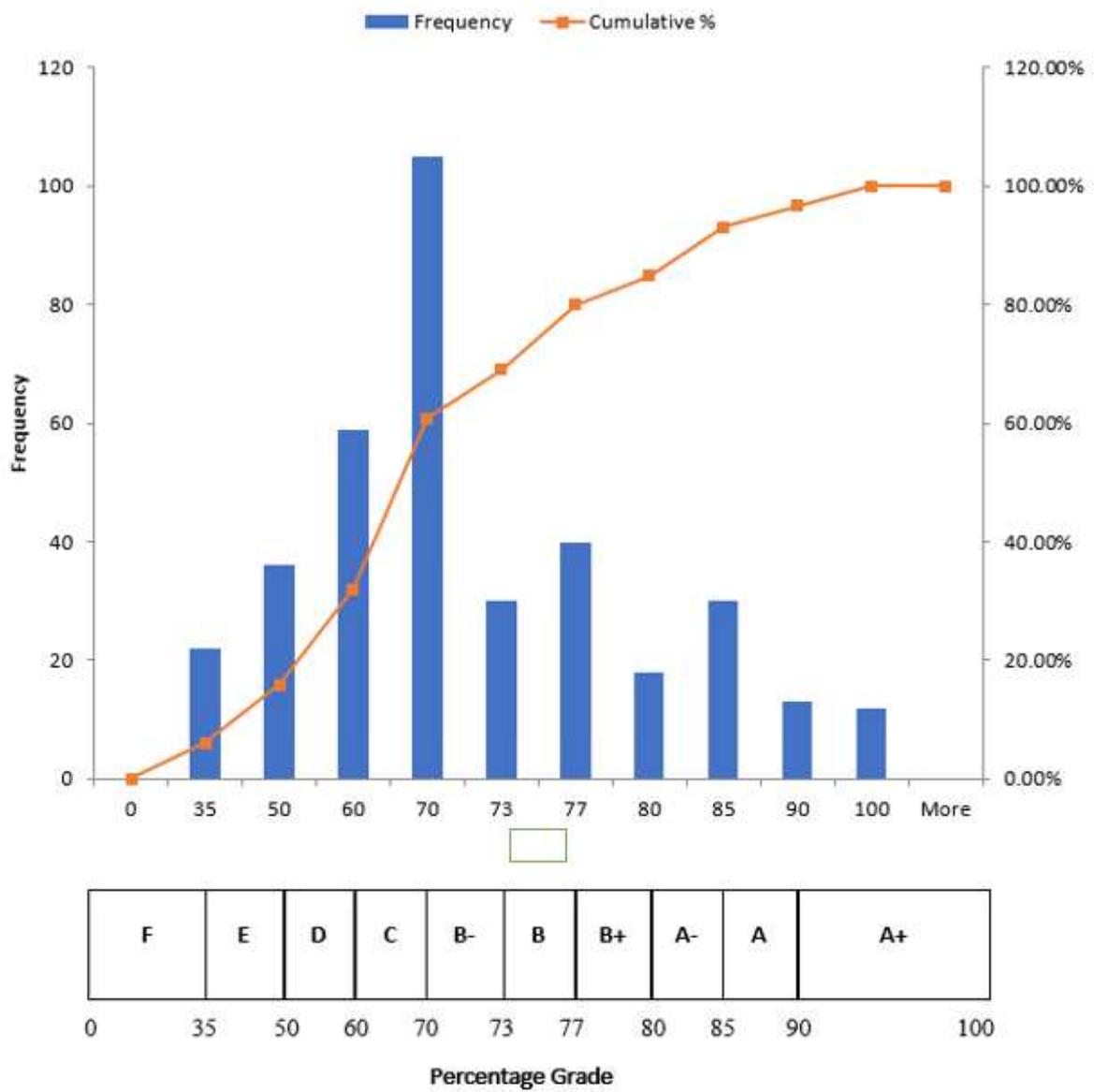
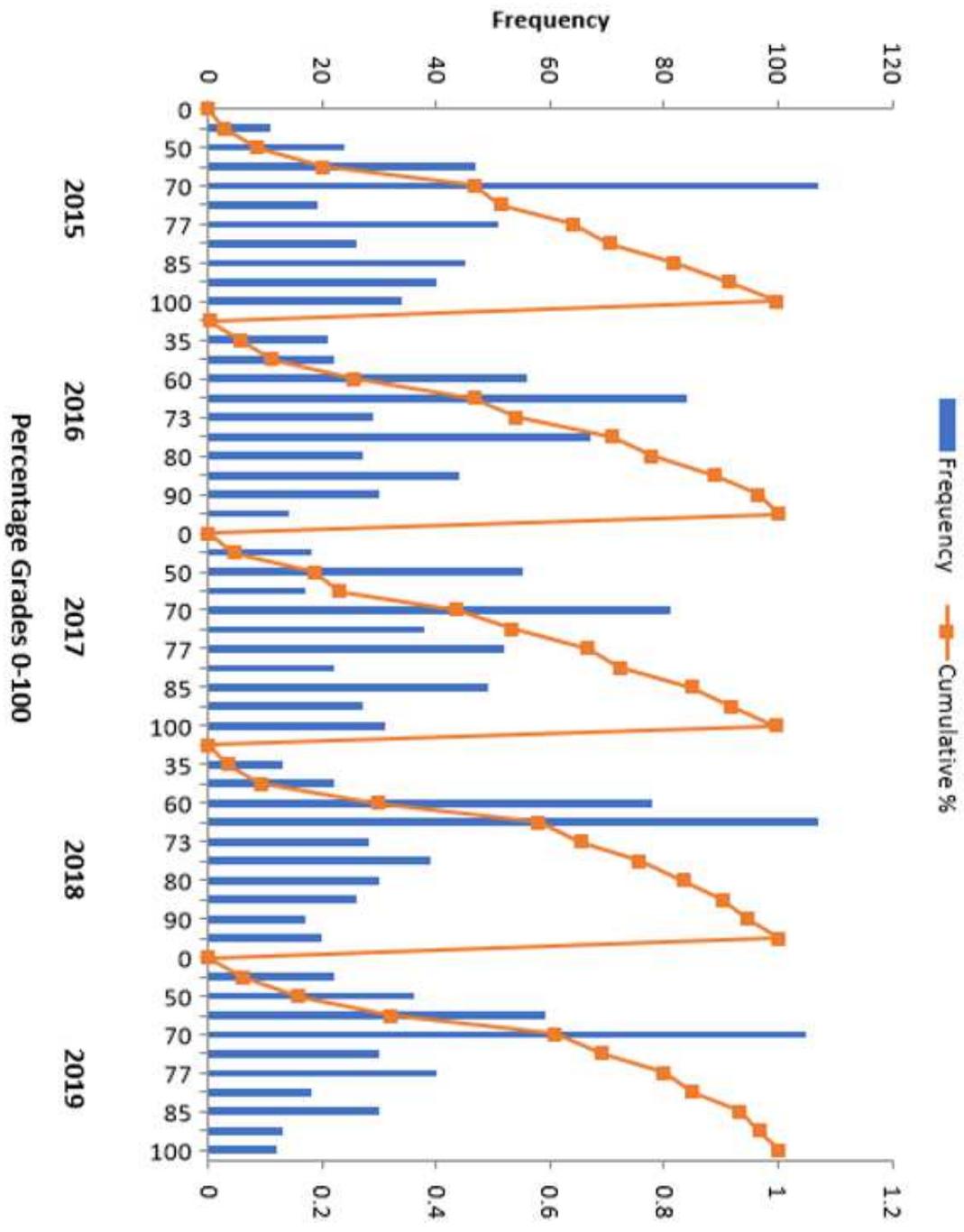


Figure 9: final letter grades distributions for 2019.

Figure 10: Final grade distributions for the 2015-2019 offerings



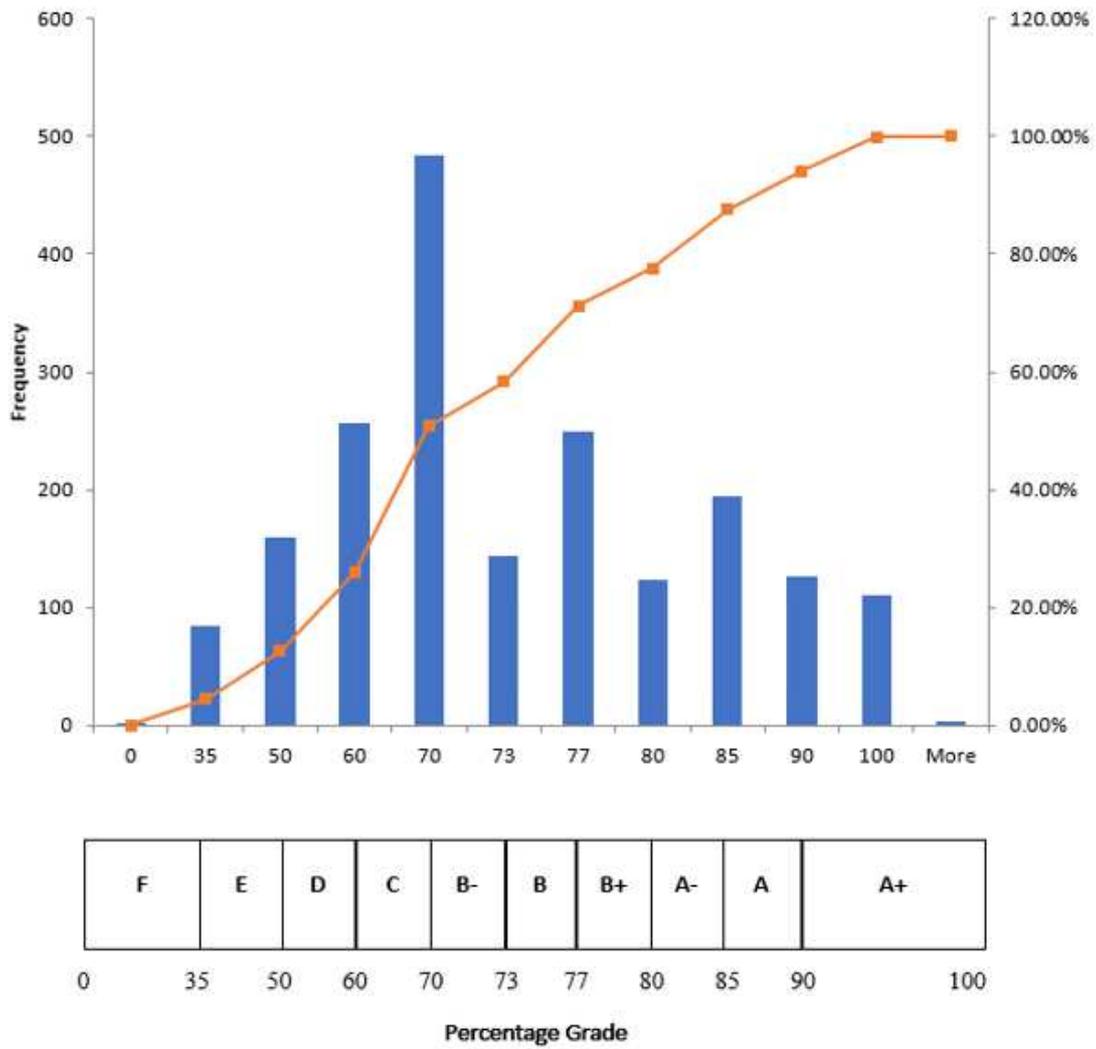


Figure 11: Accumulative final letter grades distributions for 2015-2019.

Figure 11 shows a accumulative of the letter grade distribution for the years 2015-2019

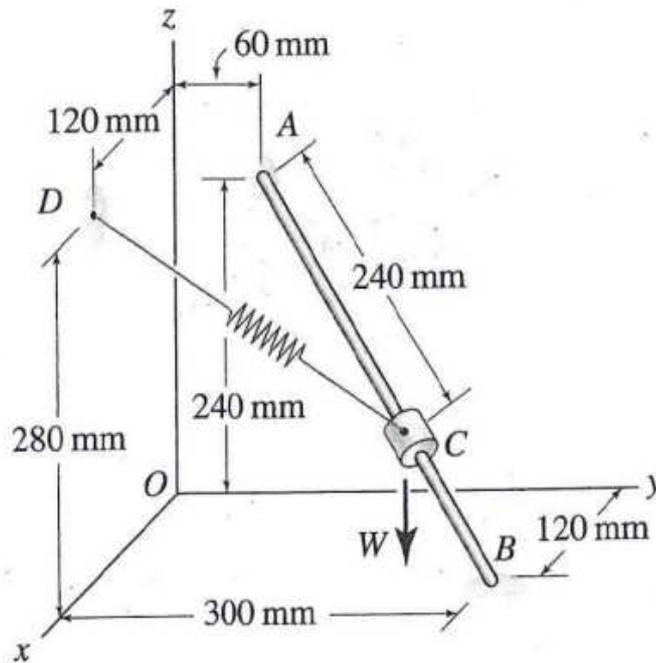
It was noted that the number of failing grades in 2015-2019 still the lowest since 2008, and that there was significant growth in the A+ and B letter grade brackets I feel we were able to help students who would otherwise finish in the D to E brackets to improve into the C bracket, and many students to elevate from the B- bracket into the B to B+ range. There is a shift from the B bracket into the C bracket. that could be due to the move from two midterm to one midterm, and the lowering of the tutorial problems from 22 problem to 9 problems (1 in each tutorial session).

3.3 Student Led-Tutorial Preparing Students for Exams

At the tutorials, the Force system resultants: moment of a force, cross product, principle of moments, reduction to equivalent loads concepts, Section 4.1-4.8 concepts were explored in depth. In particular, tutorial number 2:

Bar AB is straight and fixed in space. Spring CD has 4 N/mm stiffness and 200 mm unstretched length. If there is no friction between collar C and bar AB , determine:

- The weight W of the collar that produces the equilibrium configuration shown.
- The reaction between the collar and bar AB .



See Appendix 8 for the complete problem solution.

By repeating this difficult tutorial problem on the midterm, I was able to use the midterm marks to gauge how well the tutorial preparation prepared the students. Figures 12-13 show a comparison of students' score to question that was seen at the tutorial session to their score to a question not seen at the tutorial session.

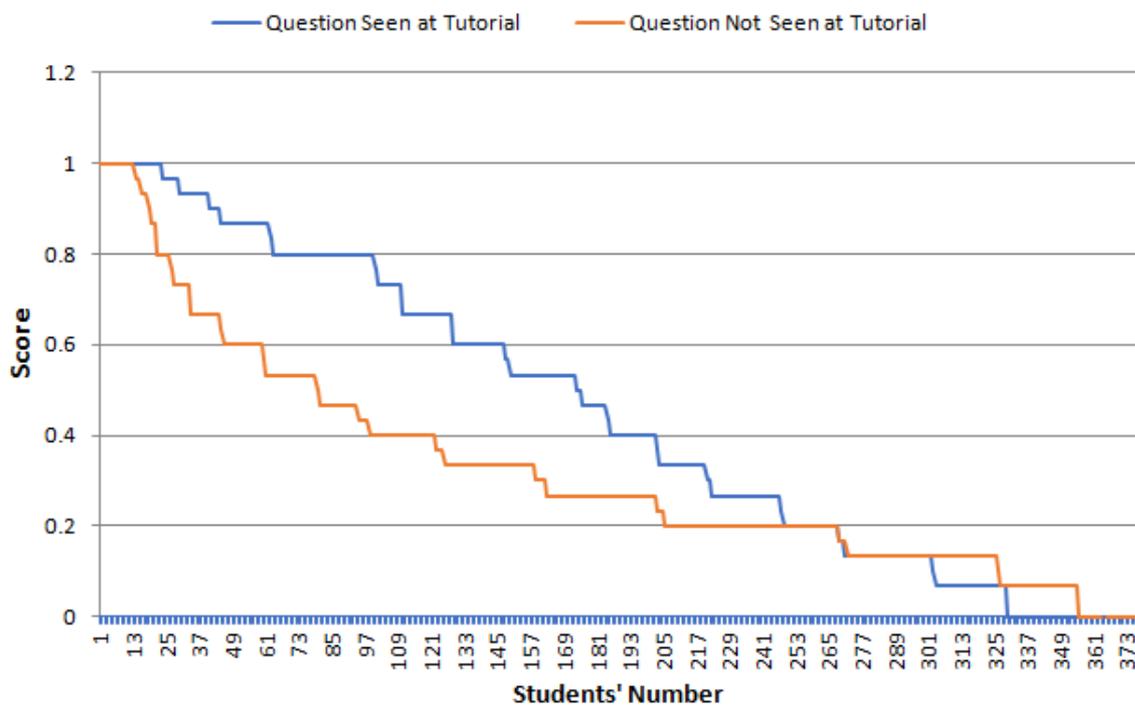


Figure 12: Comparison between Students score on Midterm Exam to a question seen at the Tutorial sessions, and question not seen at the tutorial for the year 2017 offering .

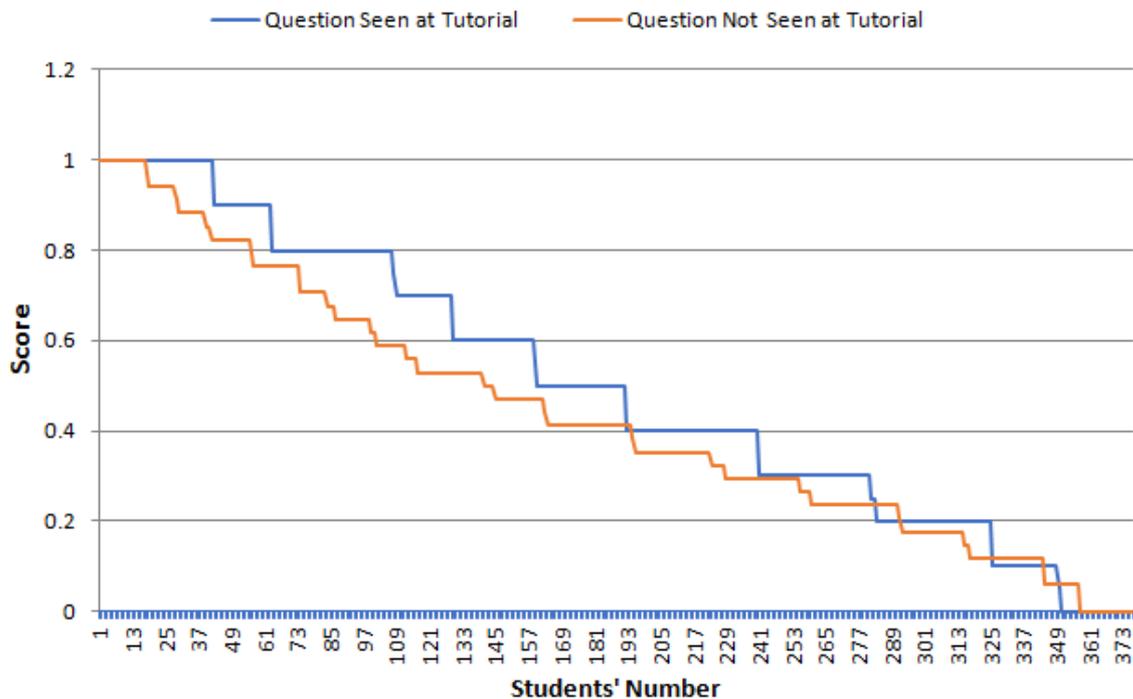


Figure 13: Comparison between Students score on Midterm Exam to a question seen at the Tutorial sessions, and question not seen at the tutorial, for the year 2018 offering.

Significant affect can be seen on the Learners performance having worked in depth at these concepts at the tutorial section, their scores are high, the average is higher than the score for the question that not seen in the tutorial session.

I could not pull out the individual question scores at the final exam, therefore, I was not able to do the same comparison. This is something to keep in mind for future observation.

4. CONCLUSIONS

The addition of the student-led tutorials provided a mechanism to mix highly motivated students with students who showed low interest in the subject. By addressing difficult problems with no available on-line solutions, the tutorial periods forced students to critically assess the work of their peers and work to resolve their concerns in the methods being suggested in tutorial session. Even in the criticisms of the tutorials, we found evidence that the new tutorial structure was having the intended effect; students were obviously reflecting on their draft solutions prior to submitting final copies.

However, maintaining the seminar contact hours in concert with the student-led tutorials is very important. Students demonstrated a need for that forum to engage with the instructors on a one-to-one basis and resolve questions raised in the tutorial sessions. The increased TA and

instructor time needed to adequately staff both the tutorials and the seminars may inhibit implementation of the approach [7].

I could not pull out the individual question scores at the final exam, therefore, I was not able to do the same comparison. This is something to keep in mind for future observation.

Significant affect can be seen on the Learners performance having worked in depth at these concepts at the tutorial section, their scores are high, the average was higher than the score for the question that not seen in the tutorial session. Also, the grade distribution was more linear for the question that has been seen at the tutorial session. In 2016 we demonstrated to Canadian Engineering Accreditation Board (CEAB) that we produce “Life-long learners”

I observe that the number of failing grades in 2014 was the lowest since 2008, and that there was significant growth in the A+ and B letter grade brackets – approaching and eclipsing, respectively, the maximum number recorded over the previous 5 years. I feel we were able to help students who would otherwise finish in the D to E brackets to improve into the C bracket, and many students to elevate from the B- bracket into the B to B+ range.

Observing the student performance on span of twelve years, the students feedback I think the students led tutorial approach should continue and more structure can be introduced to the other affective element of the course, the seminar series.

Significant affect can be seen on the Learners performance having worked in depth at these concepts at the tutorial section, their scores are high. By facilitating enough time and guidance, the leaners were able to master the ENGR 141 concepts.

Acknowledgments

I wish to thank the UVic Learning and Teaching Centre (LTC) at the University of Victoria for a Curriculum Development Grant in support of the tutorial and seminar components of the 2014 ENGR 141 course.

I extend my thanks to my supervisor Dr. Brad Buckham for his mentoring and support.

Many thanks go to Dr. Ben Nadler for his collaboration and support. I also would like to thank the ENGR 141 Cohort students of the implementation years of 2014 and 2015.

References

- [1] Biggs, J. & C. Tang, *Teaching for quality learning at university. Fourth edition. Berkshire, England: Open University Press. McGraw Hill, 2011, 382 pp.*
- [2] Day, R. & the ISW International Advisory Committee. (2005). "The Instructional Skills Workshop: The heart of an educator learning community in British Columbia and beyond." *Int. Soc. for the Scholarship of Teaching and Learning Conf.*, http://iswnetwork.ca/wpcontent/uploads/2012/07/Hand_ISW_ISSoTL1.pdf
- [3] Kolb, D. *Experiential learning: Experience as the source of learning and development. New Jersey: Prentice-Hall, 1984.*
- [4] Lieberman, D., *Human Learning and Memory. Cambridge University Press, 2011.*
- [5] Brockbank, A. & I. McGill, *Facilitating Reflective Learning in Higher Education, 2nd edition, McGraw Hill, 2007.*
- [6] Pratt, D., & J. Collins, *TPI: Teaching Perspectives Inventory. Retrieved from www.teachingperspectives.com*
- [7] Kadhun, S., Buckham, B., & Nadler, B., *MEASURING THE IMPACT OF STUDENT LED TUTORIALS ON FIRST YEAR STUDENTS' LEARNING OUTCOMES. Proc. 2015 Canadian Engineering Education Association (CEEA15) Conf., McMaster University, Hamilton, ON;2015, Article # 38.*

Appendices

Appendix 1: Application Form for Ethics Approval for Human Participant Research



Human Research Ethics Board
Application for Ethics Approval for
Human Participant Research

The following application form is an institutional protocol based on the
Tri-Council Policy Statement on the Ethical Conduct for Research Involving Humans

Instructions:

- 1. Download this application and complete it on your computer. Hand written applications will not be accepted. The ethical review process takes 4 - 6 weeks.
2. Use the Human Research Ethics Board Guidelines to complete this application: http://www.research.uvic.ca/Forms/. Note: This form is linked to the guidelines. Access links in blue text by hitting CTRL and clicking on the blue text.
3. Submit one (1) original and two (2) copies of this completed, signed application with all attachments to: Human Research Ethics, Administrative Services Building (ASB), Room B202, University of Victoria, PO Box 1700 STN CSC, Victoria BC V8W 2Y2 Canada
4. If you need assistance, contact the Human Research Ethics Assistant at (250) 472-4545 or ethics@uvic.ca
5. Please note that applications are screened and will be returned to the applicant if incomplete (e.g. missing required attachments, signatures, documents).
6. Once approved, a Request for Renewal must be completed annually for on-going projects for continuing Ethics approval.

A. Principal Investigator

If there is more than one Principal Investigator, provide their name(s) and contact information below in Section B, Other Investigator(s) & Research Team.

Last Name: Buckham First Name: Bradley
Department/Faculty: Mechanical Engineering Email: bbuckham@uvic.ca
Phone: (250) 721-6035 Fax: (250)721-6051

Mailing Address including Postal Code:
(if different from Dept/Faculty)

Title/Position:

- X Faculty Undergraduate Ph.D. Student
Staff Master's Student Post-Doctoral

Students: Provide your Supervisor's:

Name: Email:
Department/Faculty: Phone:

Graduate Students: Provide your Graduate Secretary's email address:

B. Project Information

Project Title: ENGR 141 - ENGINEERING FUNDAMENTALS I- Student's led Group Tutorials Development

Anticipated Start Date: January 2013 Anticipated End Date: December 2013

Geographic location(s) of study: University of Victoria

Keywords: 1. Student's led Tutorials 2. Student retention 3. Student performance 4. Curricular development

Is this application connected/associated/linked to one that has been recently submitted? Yes No

If yes, provide further information:

Other Investigator(s) and Research Team:

(Include co-investigators, students, employees, volunteers, community organizations. The form will expand.)

Contact Name	Role in Research Project	Institutional Affiliation	Email or Phone
Ben Nadler	Co-investigators	Mechanical Engineering	bnadler@uvic.ca
Sohad Kadhum	Research Assistant	Mechanical Engineering	skadhum@uvic.ca

For Faculty Only: Graduate Student/Research Assistant who will use this data to fulfill UVic thesis/ dissertation/ academic requirements.

Student/Research Assistant	Email or Phone
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C. [Agreement and Signatures](#)

Principal Investigator and Student Supervisor affirm that:

- *I have read this application and it is complete and accurate.*
- *The research will be conducted in accordance with the University of Victoria regulations, policies and procedures governing the ethical conduct of research involving human participants.*
- *The conduct of the research will not commence until Ethics approval has been granted.*
- *The researcher(s) will seek further HREB review if the research protocol is modified.*
- *Adequate supervision will be provided for students and/or staff.*

Principal Investigator

Student's Supervisor

Signature

Signature

Bradley Buckham

Print Name

Print Name

Date

Date

Chair, Director or Dean

I affirm that adequate research infrastructure is available for the conduct and completion of this research.

Signature

Zuomin Dong

Print Name

Date

D. [Project Funding](#)

Have you applied for funding for this project? Yes No
Has notice of award been received? Yes No

If yes, please complete the following:

Source(s) of Project Funding	Project Title used in Funding Application(s)
UVic- LTC- LTDG 2012	ENGR 141 - ENGINEERING FUNDAMENTALS I- Student's led Group Tutorials Development

Will this project receive funding from US Funders (*e.g. NIH*)? Yes No

If yes, provide further information:

E. [Level of Risk](#)

The [Tri-Council Policy Statement](#) (TCPS) definition of "minimal risk" is as follows:

The research can be regarded as within the range of minimal risk if potential participants can reasonably be expected to regard the probability and magnitude of possible harms implied by

participation in the research to be no greater than those encountered by the participant in those aspects of his or her everyday life that relate to the research. The designation of minimal or non-minimal risk affects the way the application is reviewed not the substance of the ethical review.”

Based on this definition, do you believe your research qualifies as “minimal risk” research?

Yes No

Explain your answer by referring to the level of risk stated in the TCPS definition:

With reference to the Tri-Council Policy Statement, the researchers have no reason to believe that the participation in this study will go beyond what a student might experience in his or her everyday life related to this research. The researchers believe this research qualifies as “minimal risk research” for the reason that all potential participants are adults who have the ability to be aware of “the probability and magnitude of possible harms” that could occur as a result of participation in the research. The topic of “Student’s led Group Tutorials” has the potential to elicit discomfort among some participants, yet through the planned activities prior to the tutorials we can help students to overcome the discomfort.

F. [Scholarly Review](#)

What type of scholarly review has this research project undergone?

External Peer Review (*e.g. granting agency*)

Supervisory Committee or Supervisor—required for all student research projects

None

Other, please explain:

G. [Other Approvals and Consultations](#)

Do you need to seek approval from other agencies, community groups, First Nations, local governments, etc?

Yes No

(Attach proof of having made request for permission or approval letter. Please forward approvals upon receiving them. Be assured that ethics approval may be granted prior to receipt of external approvals.)

If **Yes**, what types of other approval will you need?

- School District, Superintendent, Principal, Teacher**
- VIHA or other regional government authority.** If you are planning to conduct research (including recruitment via poster placement), in a VIHA facility you must use the [Joint UVic/VIHA application form](#) on the ORS website. Above minimal risk applications, please contact the Ethics Office.
- Community Group (e.g., formal organization, informal collective)**
- Indigenous Organization (e.g., Treaty Group, Tribal Council)**
- Indigenous Community**

Approval from an Indigenous community or organization may be required when the research involves Indigenous people in relation to their community or organizational affiliation (whether residing in urban or reserve areas), the cultural knowledge and/or resources of Indigenous people, or where individuals speak on behalf of an Indigenous community or nation.

- a. Does your research specifically involve or include in the study's population sample individuals from an Indigenous community or organization?
 Yes No
- b. Will a particular Indigenous community, group of communities, or organization be a central focus of the research?
 Yes No
- c. Will the cultural knowledge, resources or heritage of an Indigenous community be a central focus of the research?
 Yes No
- d. If you answered "yes" to questions a), b), or c) have you consulted with the Indigenous community or communities for this study?
 Yes No
- e. If you answered "yes" to question d), describe the process that you have followed or will follow. Include any documentation of consultations and the role or position of those consulted, including their names if appropriate.
- f. If you answered "no" to question c), briefly justify your decision not to seek Indigenous community approval.

The researchers do not intend to seek Indigenous community approval for the reason that this research does not involve Indigenous Peoples specifically. Indigenous students may be enrolled in the ENGR 141. This research regards any and all students who are enrolled in the course as equally important to this study.

UVic Biosafety Committee Approval. Please attach Biosafety Human Materials Form to this application. Note that Ethics Approval is contingent on Biosafety Approval.

Other Approval, please explain:

H. Description of Research Project

1. Purpose and Rationale of Research

Briefly describe in non-technical language:

Please use 150 words or less. The form will expand to the length of your answers.

1a. The research objective(s) and question(s)

Student learning goals:

By the end of the ENGR 141- Engineering Fundamentals I, students will be able to:

- ***Apply the basic principles of mechanics and vector algebra that one re-uses throughout a professional engineering career, regardless of one's engineering discipline, to fundamental equilibrium problems,***
- ***Construct and analyze a free body diagram in order to solve complicated mechanics problems in a clear and concise manner in accord with industry standards, and***
- ***Apply a standard engineering methodology to calculate certain forces and moments acting on, or within, rigid bodies, structures and machines that are in equilibrium.***

These outcomes are attained through attendance and participating in lectures, tutorials, an ENGR 141 Help Centre, and student led seminars (group tutorials). Students apply the techniques disseminated in these venues by completing assignments derived directly from the course textbook (Engineering Mechanics by R.C. Hibbeler), participating in field studies that explore practical applications, and writing quizzes and examinations.

Teaching Goal(s):

To complement the existing lecture, tutorial and help centre contact hours with a student-led learning experience that helps prepare UVic engineering students for their professional journey by developing confidence in their ability to wield fundamental mechanical principles. This will occur through student driven exploration, analysis and solution design for a complex three dimensional mechanics problem in the new seminars sessions.

Specific inquiry question:

Will student led seminars(group tutorials) , involving presentation of group work and

discussions, facilitate the students' abilities to apply the fundamentals engineering concepts and theories in complex, but practical, applications while also increasing their retention of basic solution processes?

1b. The importance and contributions of the research

This project focuses on the students as the main learners. By promoting and modeling the student led seminars we believe we will be able to increase the students' motivation and capacity for learning. Using this approach we will engage the students in different short-form mechanical projects, derived from situations on campus and in the community, to explore the practical application of fundamental mechanics concepts and theories introduced in the regular lecture and tutorial periods. By extending the learning time outside of the existing course venues, we think we will be contributing into their professional growth and to help creating lifelong learners.

The starting and final questionnaires, the projects that we will use through this project and the self reflection journals that we will encourage them to use will help the students to identify their learning needs. We will be modeling, guiding, and reallocating appropriate resources during the ENGR 141 term to ensure the students' learning process is positively affected.

We will generate connecting paths to their future careers through the involvement in the development stages. They will walk away with an enriched experience that will help them in setting their future career paths.

1c. If applicable, provide background information or details that will enable the HREB to understand the context of the study when reviewing the application.

Stated above in 1a. and 1b.

1. Recruitment

2. Recruitment and Selection of Participants

2a. Briefly describe the target population(s) for recruitment. Ensure that all participant groups are identified (*e.g. group 1 - teachers, group 2 - administrators, group 3 - parents*).

The target population for this research includes all students enrolled in ENGR 141- Engineering Fundamentals I course - Winter 2013.

2b. Why is this population of interest?

Engineering Fundamentals I is foundational courses in the UVic Engineering Faculty with approximately 280 students in attendance. Skills and knowledge acquired in this course affect student retention and performance at subsequent years of the program. Our specific inquiry is to measure the impact of student led seminars (group tutorials) on the students' learning outcome.

2c. What is the desired number of participants?

The desired number of participants is approximately 280 students.

2d. What are the salient characteristics of the participants (*e.g. age, gender, race, ethnicity, class, position, etc.*):

The participants for this research are UVic students enrolled in first year engineering course ENGR 141- Engineering Fundamentals I. The researchers will make no distinction between age, gender, race, ethnicity or class when recruiting students to participate with this research. This research will ask all students registered in the course to participate.

2e. Provide a detailed description of your exact recruitment process. Explain:

i) Who will recruit/contact participants (*e.g. researcher, assistant, third party*)

Bradley Buckham (PI) and Sohad Kadhum (RA) will recruit/contact participants for this research.

ii) List and explain any relationship between the investigator(s) and participant(s) (*e.g. acquaintances, colleagues*). Complete item 3 if there is a [power over relationship](#) (*e.g. instructor-student, manager-employee*).

The PI, Dr. Buckham, Assistant professor at the Mechanical Engineering Department, does not hold a power-over position with any of the students who will be asked to participate. The Co-I, Dr. Ben Nadler, Assistant professor at the Mechanical Engineering Department, does not hold a power-over position with any of the students who will be asked to participate. The RA, Sohad Kadhum, is a graduate student in the Mechanical Engineering Department and also does not hold a power over relationship to any of the students who will be asked to participate.

iii) Describe how recruitment will be done (*e.g. in person, by telephone, letter, snowball sampling, word of mouth, advertisement*) and from what source(s) will the participants be recruited. If applicable, include how contact information for participants will be obtained.

Recruitment will take place, in person by the PI and the RA, at the beginning of the term. Dates will be arranged by the course instructors (PI and Co-I).

iv) Describe the steps in the recruitment process.

The PI and RA will present the research to students enrolled in ENGR 141- Engineering Fundamentals I course - Winter 2013 during the second week of classes in January 2013. The presentation will include a brief overview of the Research Project, an overview of the starting and final questionnaires, the projects that we will use through this project, and the self reflection journals, and the research consent form. Participation in this research is entirely voluntary. Students who are interested in participating *will be led through the consent form and asked to sign it. Students who do not choose to participate in this research will have the option to leave the classroom for fifteen minutes while the survey is being administrated or remain in the classroom.*

The PI and RA will return to the ENGR 141- Engineering Fundamentals I course at the end of the term to present the research for a second time and return the starting questionnaires at the beginning of the term. Then will conduct the final questionnaires. Participants' anonymity will be protected by a code (outlined

below) that students created before completing the starting questionnaires. Students will be asked to sign the consent form a second time in order for the researchers to obtain proper on-going consent for the research.

The course instructor will not be present during recruitment or administration of the starting and final questionnaires.

- v) Indicate whether the permission of other bodies is required for recruitment (*e.g. school boards*)

Permission of the other bodies is not required for recruitment.

3. [Power-Over](#)

If you are completing this section, please refer to the:

[Guidelines For Ethics in Dual-Role Research for Teachers and Other Practitioners](#)

Are you or any of your co-researchers in any way in a position of authority or power over participants? Examples of a “power-over” situation include teachers-students, therapists-clients, supervisors-employees and possibly researcher-relative or researcher-close friend.

- Yes No Varies

If yes or varies, describe below:

- i) The nature of the relationship.
- ii) Why it is necessary to conduct research with participants over whom you have power.
- iii) What safeguards (steps) will be taken to minimize inducement, coercion or potential harm.
- iv) How the dual-role relationship and the safeguards will be explained to potential participants.

Recruitment Materials Checklist:

Attach all documents referenced in this section (*check those that are appended*):

Script(s) – in-person, telephone, 3rd party, e-mail, etc.

Invitation to participate (*e.g. Psychology Research Participation System Posting*)

Advertisement, Poster, Flyer

None; please explain why (*e.g. consent form used as invitation/recruitment guide*)

J. Data Collection Methods

4. Data Collection

For community-based research, autobiographical or observational research, please see Appendix III of the Guidelines.

4a. Which of the following methods will be used to collect data? Check all that apply.

<input type="checkbox"/> Interviewing participants: <input type="checkbox"/> in-person <input type="checkbox"/> by telephone <input type="checkbox"/> using web-based technology (explain) <input type="checkbox"/> Conducting group interviews or discussions (including focus groups)	<input type="checkbox"/> Attach draft interview questions
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------

<p>X Administering a questionnaire or survey:</p> <p><input checked="" type="checkbox"/> In person <input type="checkbox"/> by telephone</p> <p><input type="checkbox"/> mail back <input type="checkbox"/> email</p> <p><input type="checkbox"/> web-based <input type="checkbox"/> Other, describe:</p>	<p>X Attach questionnaire or survey:</p> <p><input type="checkbox"/> standardized (one with established reliability and validity)</p> <p>X non-standardized (one that is untested, adapted or open-ended)</p>
<p><input type="checkbox"/> Administering a computerized task (<i>describe in 4b</i>)</p>	
<p><input type="checkbox"/> Observing participants</p> <p><i>[In 4b, describe who and what will be observed. Include where observations will take place.]</i></p>	
<p><input type="checkbox"/> Recording of participants using:</p> <p><input type="checkbox"/> audio <input type="checkbox"/> video <input type="checkbox"/> photos or slides</p>	<p><input type="checkbox"/> Images used for analysis</p> <p><input type="checkbox"/> Images used in disseminating results <i>[include release to use participant images in consent materials]</i></p>
<p>Analyzing secondary data or secondary use of data (Refers to information/data that was originally gathered for a purpose other than the proposed research and is now being considered for use in research., <i>e.g. patient or school records, personal writings, lesson plans</i>).</p> <p><input type="checkbox"/> Secondary data involving anonymized information (Information/data is stripped of identifiers by another researcher or institution before being shared with the applicant). May be eligible for Application for a Waiver from Full Ethical Review</p> <p><input type="checkbox"/> Secondary data with identifying information (Data contains names and other information that can be linked to individuals, <i>e.g., student report cards, employment records, meeting minutes, personal writings</i>).</p> <p><i>In item 4b describe the source of the data, and explain whether and how consent was obtained from the individuals for use of their data.</i></p>	
<p><input type="checkbox"/> Using human samples (<i>e.g., saliva, urine, blood, hair</i>)</p> <p><i>Ensure that you apply to the Biosafety Committee for the storage and use of biological materials. Also, complete the Human Materials Form, have it signed and attach it to your application. If using human tissue only, skip to 7g-8, 11-end.</i></p>	
<p><input type="checkbox"/> Other, specify:</p>	

4b. Provide a sequential description of the procedures/methods to be used in your research study. List all of the research instruments and interview/discussion questions, and in an appendix provide copies of all instruments. If not yet available, provide drafts or sample items/questions. For multi-method or other complex research, use the following sections in ways best suited to explain your project. If you have more than one participant group, be sure to explain which participant group(s) will be involved in which activity/activities.

The PI and RA will administer the starting questionnaires at the beginning of the term in January. As noted above the PI and RA will present the research to students enrolled in ENGR 141- Engineering Fundamentals I course as part of the recruitment process. The PI will store the collected data in a locked cabinet at the Mechanical Engineering Department. During the last week of classes, the PI and RA will return to the class to request ongoing consent and to administer the final questionnaires.

4c. Where will participation take place? (Provide specific location, e.g., UVic classroom, private residence, participant's workplace)

The participation for this research will take place inside the classroom of the ENGR 141- Engineering Fundamentals I course.

4d. How much time will be required of participants?

Approximately 60 minutes total will be required of participants. The starting questionnaire will require 25 minutes and the final questionnaire will require 35 minutes.

4e. Will participation take place during participants' office hours or instructional time? If so, indicate whether other permission (e.g. from workplace supervisor) is required.

Yes, participation will take place during participants' class time. ENGR 141- Engineering Fundamentals I course instructors have committed to allowing class time to be used for the project.

Data Collection Methods Checklist:

Attach all documents referenced in this section (*check those that are appended*):

- Standardized Instrument(s)
- Survey(s), Questionnaire(s)
- Interview and/or Focus Group Questions
- Observation Tools

K. Possible Inconveniences, Benefits, Risks and Harms to Participants

5. Benefits

Identify any potential or known benefits associated with participation and explain below. *Keep in mind that the anticipated benefits should outweigh any potential risks.*

To the participant To society To state of knowledge

The outcomes of this research may assist and prepare UVic engineering students for their professional journey by developing confidence in their ability to wield fundamental mechanical principles. This will occur through student driven exploration, analysis and solution design for a complex three dimensional mechanics problem in the new seminars sessions. Instructors of ENGR 141- Engineering Fundamentals may gain insight in aspects of the course.

6. Inconveniences

Identify and describe any known or potential inconveniences to participants: *Consider all potential inconveniences, including time devoted to the research.*

The researchers do not believe there are known or potential inconveniences to participants other than the class time involved with participation.

7. Estimate of Risks

Could this study involve the following? Please answer each question by putting an **X** in the appropriate boxes:

7a. Could a participant feel demeaned or embarrassed during their participation in the research?

Very unlikely Possibly Likely

7b. Could a participant feel fatigued or stressed due to the research?

Very unlikely Possibly Likely

7c. Could a participant experience any other emotional or psychological discomfort as a consequence of participation?

Very unlikely Possibly Likely

7d. Is there any social risk, possible stigmatization, loss of status, privacy and/or reputation?

Very unlikely Possibly Likely

7e. Are there any physical risks?

Very unlikely Possibly Likely

7f. Could a participant experience any economic risk? (e.g. job security, job loss)

Very unlikely Possibly Likely

7g. Do you see any chance that participants may be harmed in any other way? (e.g. risk to community)

Very unlikely Possibly Likely

8. Possible Risks

If you indicated in Item 7 (a) to (g) that any risks are *possible* or *likely*, please explain below:

8a. What are the risks?

The student-led learning experience may elicit mild emotional responses due the required participation in exploration, analysis and solution design for a complex three dimensional mechanics problem in the new seminars sessions.

8b. What will you do to try to minimize or prevent the risks?

The survey questions are designed to be benign.

8c. How will you respond if the risk of harm occurs? (e.g. *what is your plan?*)

The PI has years of teaching and research experience, and will respond professionally.

9. Deception

Will participants be fully informed of everything that will be required of them prior to the start of the research session?

Yes No (If no, complete the [Request to Use Deception form](#) on the ORS website.)

L. Compensation

10. Compensation

10a. Is there any compensation for participating in the research (e.g. gifts, honorarium, bonus points, reimbursement for transportation, parking, childcare, etc.)?

Yes No

If yes, explain the nature of the compensation and why you consider it to be necessary:

Also consider if the amount of compensation could be considered to be a form of inducement.

10b. Explain what will happen to compensation if participants withdraw during or anytime after data collection (e.g. compensation will be pro-rated, full compensation will be given, etc.).

M. Free and Informed Consent

The following questions address the competence of participants to give consent, the process used in your research to obtain consent, ongoing consent, and the participants' right to withdraw. Consult Appendix V of the Guidelines for further information.

11. Participant's Capacity (Competence) to Provide Free and Informed Consent

Identify your prospective participants: (Check all that apply.)

Competent	Non-Competent
<p><input checked="" type="checkbox"/> Competent adults</p> <p><input type="checkbox"/> A protected or vulnerable population (e.g., inmates, patients)</p>	<p><input type="checkbox"/> Non-competent adults:</p> <p><input type="checkbox"/> Consent of family/authorized representative will be obtained</p> <p><input type="checkbox"/> Assent of the participant will be obtained</p>
<p><input type="checkbox"/> Competent youth</p> <p><input type="checkbox"/> Youth 13 to 18: consent of youth will be obtained, and parental consent is required due to institutional requirements (e.g. school districts)</p> <p><input type="checkbox"/> Youth 13 to 16: consent of youth will be obtained, parents will be informed</p> <p><input type="checkbox"/> Youth 13 to 16: consent of youth will be obtained, parents will NOT be informed</p> <p><input type="checkbox"/> Youth 17 to 18: consent of youth will be obtained, parents will not be informed</p>	<p><input type="checkbox"/> Non-competent youth:</p> <p><input type="checkbox"/> Consent of parent/guardian</p> <p><input type="checkbox"/> Assent of the youth will be obtained</p>

<input type="checkbox"/> Competent children <input type="checkbox"/> Children under 13: consent of parent/guardian will be obtained, and child consent will be obtained <input type="checkbox"/> Other, explain:	<input type="checkbox"/> Non-competent children: <input type="checkbox"/> Consent of parent/guardian <input type="checkbox"/> Assent of the child will be obtained
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------

12. Means of Obtaining Consent:

(Check all that apply, attach copies of all consent materials, complete item 13)

Signed consent. *(Attach consent script(s) and consent form(s) - see [template](#) available on ORS Website)*

Verbal consent. *(Attach information letter(s). Explain below why written consent is not appropriate and how verbal consent will be documented.)*

Implied consent *(e.g. anonymous, mail back or web-based survey. Attach information letter, see [template](#))*

Other means. *(Explain below and provide justification.)*

Consent **will not be obtained**. *(Please see [TCPS Article 2.1c](#) and explain below)*

Explain consent procedure if “verbal consent,” “other” or “consent will not be obtained”:

13. Informed Consent

Describe the exact steps you will follow in the process of explaining and obtaining informed consent.

The research project will be described by the PI and RA during a class visit at the beginning of the term. At that time, the students will be informed that this research involves two components, one at the beginning of the term and one at the end of the term. Students will be asked to sign the consent form each time. Students will be informed that they may withdraw from participation at any time between the two questionnaires and before handing in the completed final questionnaire at the end of the term.

Please find the Participant Informed Consent form as Appendix 1.

14. Ongoing Consent

Ongoing consent is required for research that occurs over multiple occasions and/or multiple research activities and/ or extended periods of time (i.e., more than one point of contact, including second interviews, review of transcripts, etc.)

14a. Will your research occur over multiple occasions or an extended period of time?

Yes No

14b. If yes, describe how you will obtain and document ongoing consent:

Participants will be asked to sign the consent form at both administrations.

15. Participant's Right to Withdraw

Free and informed consent requires that participants have the right to withdraw at any time without consequence or explanation.

Describe what participants will be told about their right to withdraw from the research at any time.

"You may withdraw from participation with this research at any time up to the moment that you hand in your completed final questionnaire at the end of the term"

16. What will happen to a person's data if s/he withdraws part way through the study or after the data have been collected/submitted? If applicable, include information about visual data such as photos or videos.

It will not be used in the analysis and will be destroyed.

If participants decide to withdraw before handing in the completed final questionnaire at the end of the term, their data will be destroyed and not used.

It is logistically impossible to remove individual participant data (*e.g. anonymously submitted data*).

The consent form clearly states that participants may withdraw from participation up to the moment when they hand in the completed final questionnaire at the end of the term. Once a participant hands in their completed final questionnaire at the end of the term, it will be impossible to identify the participant's questionnaire.

When linked to group data (*e.g. focus group discussions*), it will be used in summarized form with no identifying information. Include this agreement in the consent form.

It will be used in the analysis if the participant agrees to this. Describe how this agreement will be obtained:

Free and Informed Consent Checklist:

Attach all documents referenced in this section (*check those that are appended*):

Consent Form(s) – Include forms for all participant groups and data gathering methods

Letter(s) of Information for Implied Consent

Verbal Consent Script

N. Anonymity and Confidentiality

17. Anonymity

Anonymity means that no one, including the principal investigator, is able to associate responses or other data with individual participants.

17a. Will the participants be anonymous in the data gathering phase of research?

Yes No

17b. Will the participants be anonymous in the dissemination of results (*be sure to consider use of video, photos*)?

Yes No

18. Confidentiality

Confidentiality means the protection of the person's identity (anonymity) and the protection, access, control and security of his or her data and personal information during the recruitment, data collection, reporting of findings, dissemination of data (if relevant) and after the study is completed (e.g., storage).

18a. Will the confidentiality of the participants and their data be protected?

No - If confidentiality will not be protected, explain why. If you are asking the participants to waive their right to confidentiality (you plan to identify them with their data), explain what steps will be taken to respect their privacy, if any.

Yes, completely

Yes, with limits (*Check relevant boxes below.*)

Limits due to the nature of group activities (*e.g. focus groups*) the researcher cannot guarantee confidentiality

Limits due to context: The nature or size of the sample from which participants are drawn makes it possible to identify individual participants (*e.g. school principals in a small town*)

Limits due to selection: The procedures for recruiting or selecting participants may compromise the confidentiality of participants (*e.g. participants are identified or referred to the study by a person outside the research team*)

Limits due to legal requirements for reporting

Other:

18b. If confidentiality will be protected, describe the procedures to be used to ensure the anonymity of participants and for preserving the confidentiality of their data (*e.g. pseudonyms, changing identifying information and features, coding sheet, etc*).

The starting and the final questionnaire are included on the same document. Participants will complete the starting questionnaire at the beginning of the term and then researchers will return the document to students at the end of the term to complete the final questionnaire.

The front page of the questionnaire has a small piece of paper stapled to the upper left hand corner; this paper will provide space for participants to write down a code that they will be able to recognize at the end of the term to identify their own questionnaire.

The instructions on the front page of the questionnaire read as follows:

Please create a code:

- **Your code can be a word, a phrase, a number or even a simple doodle that you will be able to recognize as your own in April.**
- **Your code should be something memorable to you.**
- **On the basis of the code, no one should be able to identify this package as yours. For example, do not use your phone number, your name, or your student number.**

At the end of the term the researchers will return the questionnaire to the students who completed the starting questionnaire at the beginning of the term. The researchers will place the questionnaire on a table in the classroom for the students to identify their own codes and therefore, questionnaires. Once the students pick up their questionnaires, the researchers will instruct them to remove the small piece of paper with their codes to ensure their anonymity.

When the researchers return to the classes at the end of the term for students to complete the final questionnaire, the students will be asked to sign the consent form a second time.

The researchers will not inspect or use the data until the academic term is completed and all grades have been submitted.

18c. If there are limits to confidentiality due to the methods (*e.g. group interview*), sample size or legal requirements (*e.g. reporting child abuse*) so that you cannot guarantee confidentiality, explain what the limits are and how you will address them with the participants:

O. Use and Disposal of Data

19. Use(s) of Data

19a. What use(s) will be made of all forms of data collected (*field notes, photos, videos, audiotapes, transcripts, etc.*)?

The anonymous results of this study will be shared with the ENGR 141- Engineering Fundamentals I course instructors, administrators and future ENGR 141- Engineering Fundamentals I course instructors. The anonymous result may also be used by the researchers, the Mechanical Engineering Department, the Faculty of Engineering for the use on Faculty of Engineering website, in scholarly journal articles, and at professional conferences.

19b. Will your research data be analyzed, now or in future, by yourself for purposes other than this research project?

Yes No Possibly

19c. If yes or possibly, how will you obtain consent for future data analysis from the participants (*e.g. request future use in current consent form*)?

19d. Will your research data be analyzed, now or in future, by other persons for purposes other than explained in this application?

Yes No Possibly

19e. If yes or possibly, by whom and how will you obtain consent from the participants for future data analysis by other researchers (*e.g. request future use in current consent form*)?

20. Commercial Purposes

20a. Do you anticipate that this research will be used for a commercial purpose?

Yes No

20b. If yes, explain how the data will be used for a commercial purpose:

20c. If yes, indicate if and how participants will benefit from commercialization.

21. Maintenance and Disposal of Data

Describe your plans for protecting data during the project, and for preserving, archiving, or destroying all the types of data associated with the research (*e.g. paper records, audio or visual recordings, electronic recordings, coded data*) after the research is completed:

21a. means of storing data (*e.g., a locked filing cabinet, password protected computer files*):

The anonymous data will be stored in a locked filing cabinet at the Mechanical Engineering Department for the duration of the project. Once the data have been transferred from paper copy to electronic files the data will be stored on a password-protected computer at the Mechanical Engineering Department. The original paper copies will be destroyed by shredding.

21b. location of storing data:

The Mechanical Engineering Department, EOW 531.

21c. duration of data storage (if data will be kept indefinitely, explain):

The anonymous data will be stored for 7 years on a password-protected computer at the Mechanical Engineering Department.

21d. methods of destroying or archiving data:

The paper copies of all surveys will be shredded once the information is transferred to electronic files. The consent forms will be stored for 7 years in a locked file cabinet at the Mechanical Engineering Department.

22. Dissemination

How do you anticipate disseminating the research results? (*Check all that apply*)

Thesis/Dissertation/Class presentation

Presentations at scholarly meetings

Published article, chapter or book

Internet

Media (*e.g. newspaper, radio, TV*)

Directly to participants and/or groups involved. Indicate how (*e.g., report, executive summary, newsletter, information session*):

The results will be presented to the faculty of Engineering to showcase our work to inspire and motivate others to adapt the student led tutorials approach into other Engineering courses. Venue for such presentations will likely be Faculty meetings.

Other, explain:

P. Researchers

23. Conflict of Interest

23a. Apart from a declared dual-role relationship (Section I, item 3), are you or any of the research team members in a perceived, actual or potential conflict of interest regarding this research project (*e.g. partners in research, private interests in companies or other entities*)?

Yes

No

23b. If yes, please provide details of the conflict and how you will manage it:

24. Researcher(s) Qualifications

In light of your research methods, the nature of the research and the characteristics of the participants, what training or qualifications do you and/or your research team have (*e.g. research methods course, language proficiency, committee expertise*)?

Dr. Buckham is an Associate Professor at the Mechanical Engineering Department /Faculty of Engineering with an intensive teaching and research work.

Sohad Kadhum is a graduate student at the Mechanical Engineering Department who worked as a Teaching Assistant for several courses and a Teaching Assistant Consultant for the Faculty of Engineering 2010-2012. She holds a Professional Development Program in University Teaching (PD-PUT) Certificate. She is an Instructional Skills Workshop (ISW) and Presentation Skills workshop (PSW) facilitator and Trainer. She also holds a Course Redesign Institution workshop certificate where research methods were explored and used.

25. Risk to Researcher(s)

25a. Does this research study pose any risks to the researchers, assistants and data collectors?

No

25b. If there are any risks, explain the nature of the risks, how they will be minimized, and how they will be responded to if they occur.

Q. Further or Special Questions

26. Multiple Site Research

26a. Does this project involve collection of data at multiple sites within Canada requiring the approval of other sites, bodies or organizations (*e.g., other ethics board(s)*)?

Yes No

26b. If you responded Yes to 27a. above, list the sites, bodies or organizations:

27. International Research

27a. Will this study be conducted in a country other than Canada?

Yes No

27b. If yes, describe how the laws, customs and regulations of the host country will be addressed:

Attachments*



*Ensure that all applicable attachments are included with all copies of your application.

Incomplete applications will not be processed and will be returned to the applicant.

Information for Submission

- Applications may be printed and submitted double-sided
- Do not staple the original application with original signatures
- The two photocopies may be individually stapled or clipped
- Do **not** staple or clip the individual appendices

Title and label attachments as Appendix 1, 2, 3 etc. and attach the following documents (check those that are appended):

Section I - Recruitment Materials:

X Script(s) – in-person, telephone, 3rd party, e-mail, etc.

Invitation to participate

Advertisement, Poster, Flyer

Section J - Data Collection Methods:

Standardized Instrument(s)

X Survey(s), Questionnaire(s)

Interview and/or Focus Group Questions

Observation Tools

Section M - Free and Informed Consent:

X Consent Form(s) – Include forms for all participant groups and data gathering methods

Letter(s) of Information for Implied Consent

Verbal Consent Script

Approval from external organizations (or proof of having made a request for permission)

Permission to gain access to confidential documents or materials

[Request to Use Deception](#) form

Human Materials Form

Other, please describe:

Appendix 2: Recruitment Script

To be used by Bradley Buckham (Principal Investigator) and Sohad Kadhum (Research Assistant)

ENGR 141 - ENGINEERING FUNDAMENTALS I- Student's led Group Tutorials Development

Engineering Fundamentals I is foundational courses in the UVic Engineering Faculty with approximately 280 students in attendance. Skills and knowledge acquired in this course affect student retention and performance at subsequent years of the program. Our specific inquiry is to measure the impact of student led seminars (group tutorials) on the students' learning outcome. This project focuses on the students as the main learners. By promoting and modeling the student led seminars we believe we will be able to increase the students' motivation and capacity for learning. Using this approach we will engage the students in different short-form mechanical projects, derived from situations on campus and in the community, to explore the practical application of fundamental mechanics concepts and theories introduced in the regular lecture and tutorial periods. By extending the learning time outside of the existing course venues, we think we will be contributing into their professional growth and to help creating lifelong learners.

The starting and final questionnaires, the projects that we will use through this project and the self reflection journals that we will encourage them to use will help the students to identify their learning needs. We will be modeling, guiding, and reallocating appropriate resources during the ENGR 141 - ENGINEERING FUNDAMENTALS I term to ensure the students' learning process is positively affected. We will generate connecting paths to their future careers through the involvement in the development stages. They will walk away with an enriched experience that will help them in setting their future career paths.

We are inviting you to participate in questionnaires entitled the Student's led Group Tutorials Development that has been developed for the ENGR 141- Engineering Fundamentals I course. This questionnaires has been designed by Dr. Buckham, Assistant professor at the Mechanical Engineering Department and Sohad Kadhum, Graduate student in the Mechanical Engineering Department.

The questionnaires have two components: Starting questionnaire, to be filled in today if you choose to participate, and Final questionnaire to be completed near the end of term. Participation with this study is entirely voluntary and anonymous. We have designed the questionnaires to secure your anonymity with the use of a code, created by you, that you will be able to identify at the end of the term when we return to your class to complete the Final questionnaire of the study.

You may withdraw from participation in this study at any time up to the moment that you hand in your completed questionnaire at the end of the term. If you decide to withdraw before handing in the completed questionnaire at the end of term your information will be destroyed and not used for this research.

We do not believe there are known or potential inconveniences to you other than the class time involved with participation.

We do not believe there are any risks involved in your participation.

All data will be confidential. No identifying information will be shared.

The questionnaires will be stored in a locked filing cabinet at the Mechanical Engineering Department for the duration of the project. Once the data has been transferred from paper copy to electronic files the data will be stored on a password-protected computer at the Mechanical Engineering Department. The original paper copies will be destroyed.

The data generated from this assessment will culminate in a final report that will encompass recommendations for your ENGR 141- Engineering Fundamentals I course instructors, administrators and future ENGR 141- Engineering Fundamentals I course instructors. The anonymous result may also be used by the researchers, the Mechanical Engineering Department, the Faculty of Engineering for the use on Faculty of Engineering website, in scholarly journal articles, and at professional conferences.

This research will not be used for commercial purposes.

Our contact information:

Dr. Bradley Buckham, Mechanical Engineering Department at bbuckham@uvic.ca
or at (250)721-6035

Sohad Kadhum, Mechanical Engineering Department at skadhum@uvic.ca
or at (250)853-3200

Appendix 3: Participant Informed Consent Form

Mechanical Engineering Department

ENGR 141 - ENGINEERING FUNDAMENTALS I-

Student's led Group Tutorials Development

Participant Informed Consent Form

You are invited to participate in a study entitled: ENGR 141 - ENGINEERING FUNDAMENTALS I- Student's led Group Tutorials Development that is being conducted by Dr. Buckham, Assistant professor at the Mechanical Engineering Department and Sohad Kadhum, Graduate student in the Mechanical Engineering Department.

Purpose and Objectives

Engineering Fundamentals I is foundational courses in the UVic Engineering Faculty with approximately 280 students in attendance. Skills and knowledge acquired in this course affect student retention and performance at subsequent years of the program. Our specific inquiry is to measure the impact of student led seminars (group tutorials) on the students' learning outcome.

Importance of this Research

This project focuses on the students as the main learners. By promoting and modeling the student led seminars we believe we will be able to increase the students' motivation and capacity for learning. Using this approach we will engage the students in different short-form mechanical projects, derived from situations on campus and in the community, to explore the practical application of fundamental mechanics concepts and theories introduced in the regular lecture and tutorial periods. By extending the learning time outside of the existing course venues, we think we will be contributing into their professional growth and to help creating lifelong learners.

The starting and final questionnaires, the projects that we will use through this project and the self reflection journals that we will encourage them to use will help the students to identify their learning needs. We will be modeling, guiding, and reallocating appropriate resources during the ENGR 141 term to ensure the students' learning process is positively affected.

We will generate connecting paths to their future careers through the involvement in the development stages. They will walk away with an enriched experience that will help them in setting their future career paths.

Participant Selection

You are selected to participate in this research because you are enrolled in a course that has been supported by the Learning and Teaching Grants Project.

What is involved?

You are being asked to participate in this study by completing questionnaires. The questionnaires have two parts: a starting questionnaire in January and a final questionnaire in April. We anticipate that completing each questionnaire will involve 25 to 35 minutes of your time.

Inconvenience

The researchers do not believe there are known or potential inconveniences to you other than the class time involved with participation.

Possible Risks

The researchers do not believe there are any risks involved in your participation.

Benefits

The results of this study will guide instructors, future ENGR 141 instructors and program administrators with future funding decisions and program improvements.

Researcher's Relationship with Participants

Neither the Principal Investigator for this study, Dr. Bradley Buckham, nor the Research Assistant, Sohad Kadhum, hold a power-over position with students enrolled in ENGR 141 course.

Voluntary Participation, Anonymity & Right to Withdraw

Your participation in this study is entirely voluntary and anonymous. The researchers have designed the 2 questionnaires to secure your anonymity with the use of a secret code that you will create. You may withdraw from participation in this study at any time up to the moment that you hand in your completed survey at the end of the term. If you decide to withdraw before handing in the completed questionnaires at the end of term your information will be destroyed and not used for this research.

Confidentiality

All data will be confidential. No identifying information will be shared.

Maintenance & Disposal of Raw Data

The questionnaires will be stored in a locked filing cabinet at the Mechanical Engineering Department for the duration of the project. Once the data have been transferred from paper copy to electronic files the data will be stored on a password-protected computer at the Mechanical Engineering Department. The original paper copies will be destroyed.

Dissemination of Results

The anonymous results of this study will be shared with the ENGR 141 instructors, administrators and future ENGR 141 instructors. The anonymous results may also be used by the researchers and the Mechanical Engineering Department for use on the Mechanical Engineering Department AND for the Faculty of Engineering website, in scholarly journal articles and at professional conferences.

Commercial Purposes

This research will not be used for commercial purposes.

Contacts

Dr. Bradley Buckham, Mechanical Engineering Department at bbuckham@uvic.ca or at (250)721-6035
Sohad Kadhum, Mechanical Engineering Department at skadhum@uvic.ca or at (250)853-3200

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Associate Vice-President of Research at the University of Victoria (250-472-4545).

Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

Starting Questionnaire: January Consent

Name of Participant _____
Signature _____
Date

Final Questionnaire: April Consent

Name of Participant _____
Signature _____
Date

Appendix 4: Application Form for a Learning and Teaching Grant

*Please read the “Application Guidelines for LT Grants” before completing this application. Submit completed application electronically as a Word document attachment to ltc@uvic.ca by **May 15, 4:00PM**. Applications must be submitted electronically. Rename your file <Surname_First Name_LTGrant_12> e.g. <Doe_Jane_LTGrant_12>*

Principal Applicant: Dr. Bradley Buckham **Phone:** (250) 721 6603

Department/Program: Mechanical Engineering **E-mail:** bbuckham@uvic.ca

Co-Applicant: **Phone:**

Department/Program: **E-mail:**

Co-Applicant: **Phone:**

Department/Program: **E-mail:**

Project Title: ENGR 141 - ENGINEERING FUNDAMENTALS I- Student’s led Group Tutorials Development

Abstract (50-word max):Engineering Fundamentals I is one of the foundational courses in the faculty of Engineering at the University of Victoria, with approximately 280 students in attendance. Skills and knowledge acquired in this course will effect students retention and performance at subsequent years. Our specific inquiry is to measure the implementation of students’ led tutorials on the students’ learning outcome and retention.

If approved, do you wish to Postpone Initiation of funding (up to 1 year)? ___ Yes X No

Have you received approval from the Human Research Ethics Committee? ___ Yes X No

One half of the total grant money will be transferred to your research account only after notification of approval or a waiver is received. You will need to provide your research account number to the LTC. The balance of the grant money will be transferred to your research account upon receipt of the required Final Report.

Total Grant Amount Requested: \$7,500

Prior LT Grant funding? ___ Yes X No **If Yes, Year?** _____ **Amount? \$** _____

Required Signatures (electronic versions acceptable – see guidelines)

Principal Applicant Signature: _____ **Date:** _____

Print Applicant Name: Dr. Bradley Buckham..... **Email:** bbuckham@uvic.ca

Chair/Director/Dean Signature*: _____ **Date:** _____

Print Chair/Director/Dean Name: Dr. Zuomin Dong..... **Email:** zdong@uvic.ca

**If applicant is a Chair or Director, the Dean’s signature is required.*

Budget Table

Item				Cost
1. Salaries: You must adhere to University Policy and Procedures. Note: Include 8% benefits and 4% holiday pay.				
Type (e.g. TA)	Total hours	Rate of pay	Comment	
Graduate Student as a Sessional Instructor/ Graduate Research Assistant	287.79 (on a period of 3 terms)	\$26.06 per hour to include 4% vacation pay and 8% benefits (net pay \$23.27 per hour).	137.79 hours to help in the design of the Student’s let tutorials materials 70 hours to help analyze the data from the control groups 40 hours to help in Implementing of the findings to next year course outline 40 hours to help in documenting and writing paper to be published at an Engineering Teaching Research Journal	\$7,500

2. Supplies and Operating Expenses: Include all applicable taxes, <i>etc.</i>		
Note: Journal subscriptions, society memberships, and supplies normally covered by the department are <i>not</i> covered.		
Expense Item	Comment	
3. Travel		
Note: Costs of travel to present at scholarly meetings <i>not</i> covered.		
Travel item	Comment	
4. Other (please specify)		
Total costs		\$7,500
Less funding obtained from other sources, if applicable		—
Total amount requested		\$7,500

- *Please follow the Application Guidelines.*
- *Write your answer directly below each question respecting the word limit.*

1) What are your student learning goals and your teaching goals? (limit 150 words)

Student learning goals:

By the end of the ENGR 141- Engineering Fundamentals I, students will be able to:

- **Define a methodology used to calculate certain forces and moments acting on, or within, rigid bodies, structures and machines that are in equilibrium,**
- **Apply the basic principles of vector algebra and operations that one re-used throughout a professional engineering career, regardless of one's engineering discipline,**
- **Analyse and construct the free body diagram to solve complicated mechanics projects in a clear and concise manner to meet industrial standards,**

by attending and participating in lectures, tutorials, student led tutorials (group tutorials), completing assignment that are derived directly from the textbook Mastering Engineering by Hibbeler, participating in field studies to explore the practical applications, writing quizzes and examinations, and attend and participate in the help center activities.

Teaching Goals:

Providing a student-centered learning experience for all students by helping them to prepare for their learning journey in engineering were they will be exploring, learning, implementing, designing, and adhering to a professional practice in the engineering field.

2) What is your specific inquiry question? (limit 100 words)

Will student led tutorials involving presentation of group work and discussions facilitate students' ability to apply the Engineering Fundamentals concepts and theories into practical applications and increase their retention?

3) What does the literature tell us about your question? (limit 400 words)

To our knowledge, there are some articles and abstracts that indicate the use of group work approach in the Mathematical field, Chemistry and Biology but we could not locate any papers with published findings about the use of students' led tutorials in the Engineering field.

4) What procedures and methods will you use to answer the question? (limit 500 words)

We will design a starting questionnaire that will be taken by all students at the beginning of the course.

We will introduce the students to the Stages of Tuckman's Team Development Model. This way the students will be familiar with the group dynamics and ready for their group work and the students' led tutorials.

We will design two control groups: A and B. At the first part of the course, we will apply the student led tutorials method with group A, where we will be monitoring the students' progress through self reflection journals, in class observations, and the outcome of a final questionnaire.

We will repeat the same procedure with group B at the second part of the course to compare findings.

We will be seeking an ethical approval from the Human Research Ethics Committee in order to implement the starting and final questionnaires, sharing the project findings, write up the results of this project for publication.

5) How will you evaluate the impact on student learning? (limit 250 words)

To measure the learning outcomes, we intend to:

- *Design class projects driven from UVic campus buildings and projects that will reflect the skills and knowledge acquired through the participation in the students' led tutorials.*
- *Design class projects driven from the city of Victoria buildings and projects that enable the students to apply their skills and knowledge to practical application and to the community.*

6) What contributions might this project make to our understanding of student learning in general? (limit 250 words)

This project focuses on the students as the main learners. By promoting and modeling the apprenticeship approach we will be able to increase students' motivation and learning. Through this approach we will engage the students in different projects on campus and in the community to explore practical application of the concepts and theories that they were introduced to in the lectures. By extending the learning time to outside the course venues, we think we will be contributing into their professional growth and to help creating a lifelong learners.

The starting and final questionnaires, the projects that we will design to be used through this project, and the self reflection journals that we will encourage them to use will help the students to identify their learning needs and we will be modeling, guiding, and providing the appropriate resources to improve the students learning process.

We will be connecting paths to their future careers through the involvement in the development stages. They will walk away with a much enriched experience that will help them in creating the future professional engineers.

7) How will you communicate your project findings? (limit 200 words)

We will share our experiences and findings at the end of the year, probably fall of 2013 through talking, presentations and articles.

We will provide presentations to the faculty of Engineering to showcase our work to inspire and motivate others to adapt the student led tutorial approach into other Engineering courses.

We will implement the new approach fully into the course outline for the following academic years. We will Work with the curriculum committees in our department/faculty to implement the change.

We will be willing to provide report at the end of the developmental period to indicate how funds were spent.

We will write up the results of this project for publication.

8) Justify each item in your proposed budget. (limit 250 words)

The primary cost involved with this initiative will be to hire a graduate student for the period of three terms that will help in the design of the Student led tutorial materials, analyze the data from the control groups, implementing of the findings to next year course outline, and documenting and writing paper to be published at an Engineering Teaching Research Journal.

Appendix 5: Starting and Final Questionnaires

The Student's led Group Tutorials Development ENGR 141- Engineering Fundamentals I course



© Johnson Street Bridge, City of Victoria, BC Canada

designed by

Dr. Bradley Buckham, Assistant professor at the Mechanical Engineering Department
and

Sohad Kadhum, Graduate student at the Mechanical Engineering Department.

Thank you so much for taking the time to participate in this study. The questionnaires have two components: Starting questionnaire, to be filled in today if you choose to participate, and Final questionnaire to be completed near the end of term. Participation with this study is **entirely voluntary and anonymous**. We have designed the questionnaires to secure your anonymity with the use of a unique code at the top right of the page and then add three digits created by you, that you will be able to identify at the end of the term when we return to your class to complete the Final questionnaire of the study. You may withdraw from participation in this study at any time up to the moment that you hand in your completed questionnaire at the end of the term. If you decide to withdraw before handing in the completed questionnaire at the end of term your information will be destroyed and not used for this research.

ENGR 141- Engineering Fundamentals I course



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designed by

Dr. Bradley Buckham, Assistant professor at the Mechanical Engineering Department

and

Sohad Kadhum, Graduate student at the Mechanical Engineering Department.

Thank you so much for taking the time to participate in this study. The questionnaires have two components: Starting questionnaire, to be filled in today if you choose to participate, and Final questionnaire to be completed near the end of term. Participation with this study is **entirely voluntary and anonymous**. We have designed the questionnaires to secure your anonymity with the use of a unique code at the top right of the page and the added three digits created by you, that you will be able to identify at the end of the term when we return to your class to complete the Final questionnaire of the study. You may withdraw from participation in this study at any time up to the moment that you hand in your completed questionnaire at the end of the term. If you decide to withdraw before handing in the completed questionnaire at the end of term your information will be destroyed and not used for this research.

1. Mark all that apply:

- I recently graduated from high school.
- I finished pre-engineering courses at a college.
- I hold a Bachelor degree. Please specify.

- I am a domestic student.
- I am an international student.

2. Which Engineering discipline (e.g. Mechanical, Electrical, Computer...) are you intending to pursue?

3. Mark the five most interesting engineering fields to you:

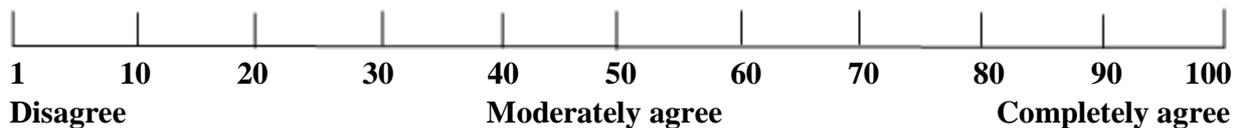
- Advanced materials.
- Mechatronics.
- Computer aided engineering.
- Energy systems.

- Advanced manufacture.
- Fluids and aerodynamics.
- Biomedical.
- Computer engineering.
- Software engineering.
- Computer music.
- Engineering degree with business minor.
- Computer communications and networks.
- Computer graphics and gaming.
- Civil engineering.
- Other, please specify:

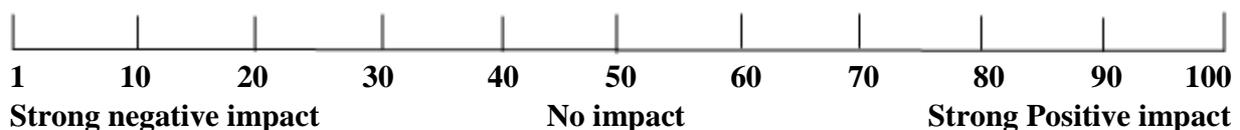
4. What are the learning outcomes that you would like to gain from taking the ENGR 141 Course?

9. Why did you rate you group expertise as above?

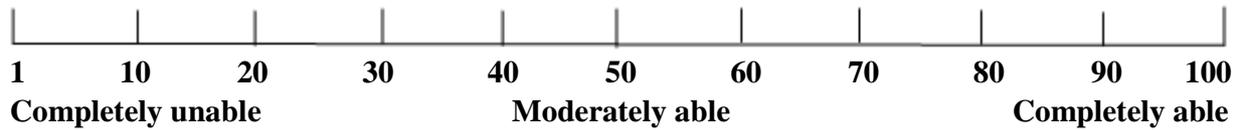
10. Circle the number on the scale below, 1 to 100, to rate your agreement with the following statement: "Skills and knowledge acquired in ENGR 141 affect retention and subsequent performance of students in my area of engineering."



11. Circle the number on the scale below, 1 to 100, and to your best of knowledge, to estimate the impact of student led seminars (group tutorials) on student learning outcome.

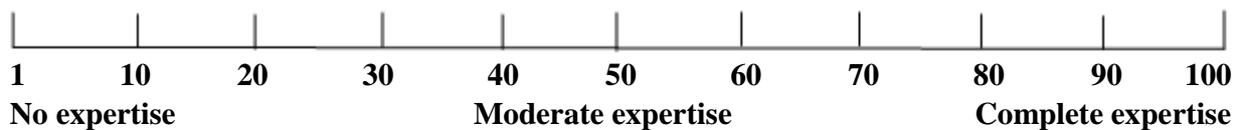


14. Circle the number on the scale below, 1 to 100, and to your best of knowledge, how would you rate your current ability to apply a standard engineering methodology to calculate certain forces and moments acting on, or within, rigid bodies, structures and machines that are in equilibrium.



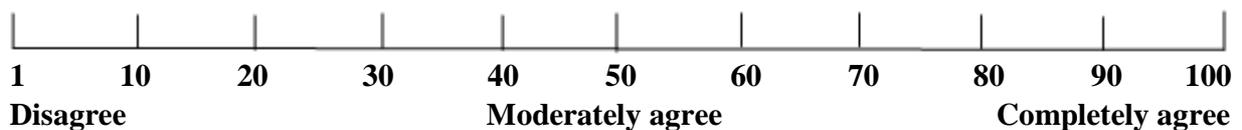
5. What is your opinion about your current group work experience (the Student's led Group Tutorials) ?

6. Circle the number on the scale below, 1 to 100, to rate your current experience working in groups?

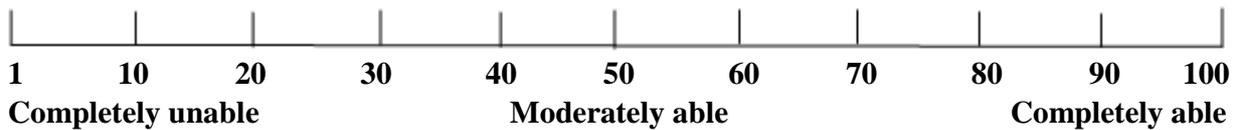


7. Why did you rate you group experience as above?

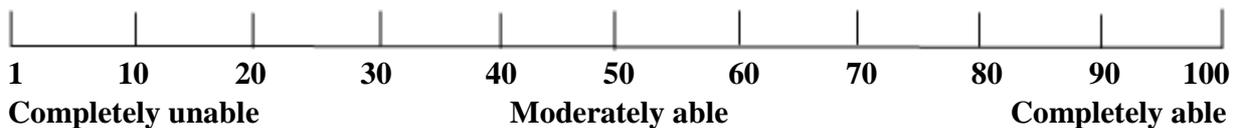
8. On scale of 1-100 and to your best of knowledge how would you rate the following statement:
"Skills and knowledge acquired in this course affect student retention and performance at subsequent years of the program."



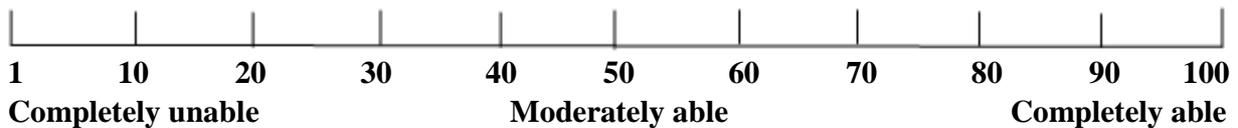
12. On scale of 1-100 and to your best of knowledge how would you rate your current ability to apply the basic principles of mechanics and vector algebra that one re-uses throughout a professional engineering career, regardless of one's engineering discipline, to fundamental equilibrium problems?



13. On scale of 1-100 and to your best of knowledge how would you rate your current ability to construct and analyze a free body diagram in order to solve complicated mechanics problems in a clear and concise manner in accord with industry standards?



14. On scale of 1-100 and to your best of knowledge how would you rate your ability to apply a standard engineering methodology to calculate certain forces and moments acting on, or within, rigid bodies, structures and machines that are in equilibrium?



15. List any suggestions that you have to improve the ENGR 141 contents and delivery:

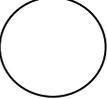
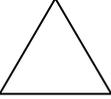
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-
-
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Note: After finishing your final questionnaire, we invite you to revisit your scaled responses to the starting questionnaire questions and make changes as needed.

Appendix 6: The Code's Matrix

The Code's Matrix:

$$3 \times 4 \times 4 \times 10 = 480$$

Shape	Colour	Letter	Number
		A	1
		B	2
		C	3
		D	4
			5
			6
			7
			8
			9
			10

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Appendix 7: ENGR 141 Student's Led Group Tutorials Survey- Final Questionnaire pick up instruction

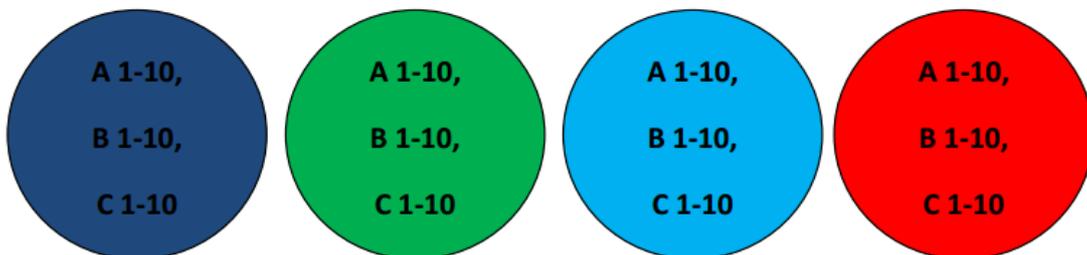
**ENGR 141 Student's led Group Tutorials Survey-
Final Questionnaire pick up instruction**

There will be three sections to identify the Questionnaires:

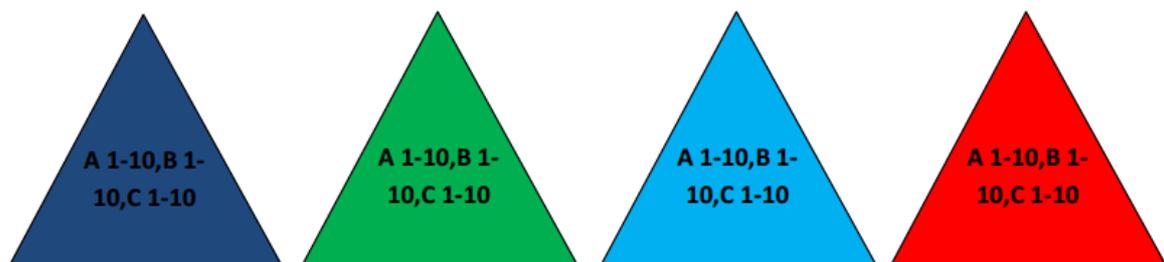
1:



2:



3:



Appendix 8: Rod-Collar Problem- Tutorial #2

2017 Midterm Solutions

START OF HANDWRITTEN PROBLEMS

1. Bar AB is straight and fixed in space. Spring CD has 4 N/mm stiffness and 200 mm unstretched length. If there is no friction between collar C and bar AB , determine the weight W of the collar that produces the equilibrium configuration shown. Note that (to simplify your calculations) the unit vector pointing from point A to point B is: $\underline{u_{AB} = \frac{1}{3}i + \frac{2}{3}j - \frac{2}{3}k}$.

Find the position of 'C':

$$\vec{r}_C = \vec{r}_A + 240\vec{u}_{AB}$$

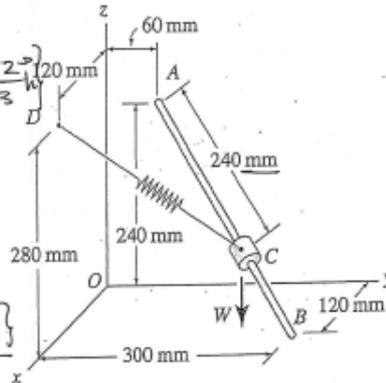
$$= \{0\vec{i} + 60\vec{j} + 240\vec{k}\} + 240\left\{\frac{1}{3}\vec{i} + \frac{2}{3}\vec{j} - \frac{2}{3}\vec{k}\right\}$$

$$\vec{r}_C = \{80\vec{i} + 220\vec{j} + 80\vec{k}\}$$

Find \vec{u}_{CD} :

$$\vec{u}_{CD} = \frac{\vec{r}_D - \vec{r}_C}{|\vec{r}_D - \vec{r}_C|} = \frac{\{(120-80)\vec{i} + (0-220)\vec{j} + (200-80)\vec{k}\}}{\sqrt{300^2}}$$

$$\therefore \vec{u}_{CD} = \{0.133\vec{i} - 0.733\vec{j} + 0.666\vec{k}\}$$



FBD of collar 'C':

$$\sum F_{x'} = 0 = \{F_s + R + W\} \cdot \vec{u}_{AB}$$

$$\therefore \vec{F}_s \cdot \vec{u}_{AB} + W \cdot \vec{u}_{AB} = 0$$

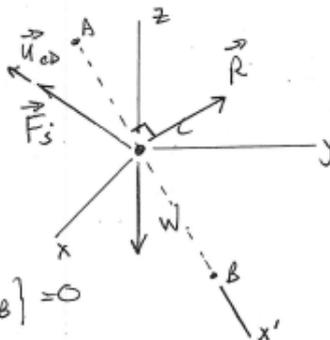
$$\therefore F_s \{0.0443 - 0.4882 - 0.444\} + W \{-0.666\} = 0$$

$$\therefore F_s (-0.8879) + W(-0.666) = 0$$

$$\therefore 0.8879 F_s = 0.666 W$$

$$\therefore 0.8879(400) = 0.666 W$$

$$\therefore \underline{W = 533.3 \text{ N}}$$



GET MAGNITUDE OF F_s

$$r_{CD} = 300; F_s = 4(300-200) = 400 \text{ N}$$