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Measures Taken at the Institutional Level to Prepare and Motivate Students to Perform Well on the Associate Constructor Exam

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MEASURES TAKEN AT THE INSTITUTIONAL LEVEL TO PREPARE AND MOTIVATE STUDENTS TO PERFORM WELL ON THE ASSOCIATE CONSTRUCTOR EXAM

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by
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ABSTRACT

Construction education is relatively young as a discipline in academia. Due to the combination of the diverse curriculum offered by different construction programs and the unique nature of every construction project, it is very challenging to standardize the skill set demands of industry. A certification exam has the potential of acting as a bridge between the requirements of both industry and formal college education. As observed, the student AC exam pass rate varies for every construction program by a relatively large margin. The objective of this research was to identify the factors responsible for this variation in results and make recommendations to construction programs for improving student performance on the AC exam. After recommendations were made, the programs could further use the exam to more accurately reflect student learning. In the process of this study, the first stage was to identify the possible factors affecting the performance of a test-taker on standardized testing. Two factors were identified: motivation level and preparation method of the test-taker; therefore, in the second stage of the study, the impact of these two major factors was observed by determining and statistically analyzing various sub-factors within the context of preparation and motivation. Participants representing three diverse data points were considered for multiple surveys: 1) test takers at Clemson University in the fall of 2016, 2) overall student test takers for fall of 2016, and 3) Department Chairs of construction programs. Based on the results of statistical analysis and referring to study material provided by AIC, the similarity of course content of their program with AC exam syllabus and higher study hours invested for preparation positively influence the scores of test takers. Additionally, test takers who considered the exam

personally important and at the same time acknowledged the importance of the exam for their program performed better than test takers who did not acknowledge the same. However, test takers who valued the exam as more important for future employment purposes did not perform well in the exam.

DEDICATION

To all my teachers who taught me the impact of education on society as a whole.

ACKNOWLEDGMENTS

Foremost, I would like to express my sincere gratitude to my advisor and committee chair, Prof. Joseph M. Burgett, for his continuous support of my master's study and research, and for his patience and time during multiple reviews of the research content. His guidance and knowledge helped me throughout the research for, and writing of, this thesis.

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My sincere thanks also goes to Shatadru Saha, for taking out time to review all the codes for statistical analysis and ensuring a correct representation of results. Additionally, I would formally like to acknowledge the support of AIC and CCC for hosting surveys and providing disaggregated sampled data for the analysis.

In particular, I am grateful to all my friends for supporting me emotionally during my journey to my master's degree. I would also like to thank Laurie Gregory with YPS Construction for being tremendously accommodating with my internship work hours so that I could focus on my thesis writing. Last, but not least, I am forever thankful to my family, my parents—Abha Sinha and Anjani Sinha—for their unconditional love and encouragement, and my brother, Abhianjan Sinha, for always motivating me to continuously learn and improve as an individual.

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

The American Institute of Constructors (AIC) was established in 1971 with the purpose "*to promote individual professionalism and excellence throughout the related fields of construction*" (Professional Constructor, 2017). The AIC organization conducts the AC exam annually for students studying construction and for professionals who would like to transition to the construction industry. The AC exam is offered in two academic semesters: fall and spring.

The AIC provides value to academia and industry by conducting the AC level 1 exam. The AIC identifies certification as a "*Voluntary and non-governmental process to recognize the education and/or experience of an individual who meets certain criteria and standards. It is ongoing proof of commitment to ethics and professionalism and is something that is maintained throughout one's career*" (Professional Constructor, 2017).

1.2 Process of the Study

The AC exam has elements required for a benchmarking tool to establish the professional requirements of a constructor; however, the pass rate in the exam has varied over terms and different universities. In this research, several factors affecting the passing score of a student in on the AC exam have been studied. The research conclusion will focus on establishing the areas of improvement for increasing pass percentage in the AC exam.

In Chapter 2—Literature Review, multiple factors directly or indirectly influencing test-taker performance on a standardized test were identified, and later, survey instruments

were developed to study three data points. Identified factors were narrowed down to preparation methods and motivation level of the test takers for this research. Additionally, recent practices at the institutional level to prepare and motivate the students also contributed as valuable components in this study.

Due to the requirements of study, the data points considered here are diverse, yet connected in nature. Following are the three data sets evaluated in this study:

- Clemson test takers for the fall 2016 AC exam,
- Student test takers from all the universities, and
- Department Chairs from Construction programs across the country.

Chapter 3—Methodology specifically describes the process of survey development and supervision during the actual conduct and data collection. Chapter 4—Analysis and Results illustrates the results from the different statistical analyses performed on the collected data. Methods of data analysis implemented on the response set were divided as per the survey. Multiple Likert scale questions were designed in each of the three surveys to have measurable insight. The nature of responses in this study was mostly categorical. Stepwise regression and Pearson's Chi-square statistically support the findings for this research with quantified results. Student response to all of the survey questions was analyzed against the exam score of the student as a fixed variable. Lastly, in Chapter 5—Conclusions, recommendations and suggested future study have been detailed.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

The American Institute of Constructors (AIC) has been benefiting constructors and *"[generating] public trust and confidence in all construction…by certifying individuals as qualified constructors, by helping them achieve professional growth, and by developing ethical codes and high standards of performance"* since 1971 (AIC website, 2017). The literature of this paper focuses on the history of the AIC and the impact of this organization on the construction industry through its conducting of certification exams. Different factors related to motivation and preparation methods significantly influence the results in a standardized test, and papers have been reviewed to explain the impact of these two factors.

2.2 Purpose of the AIC

The complexity of construction projects has been consistently increasing with time, and construction processes are advancing rapidly to accomplish such projects. The industry has a high demand for professionals that can manage these projects within controlled cost, time and quality, and at the same time consider the needs of the larger society as a whole.

"The purpose of The American Institute of Constructors (AIC) is to promote individual professionalism and excellence throughout the related fields of construction" (2017, AIC website). Certification is one of the most important components of AIC's efforts to promote and maintain professionalism in the field of construction. As depicted in a white paper by Liska (2010), *"construction education is still relatively young as a*

discipline," and presently, the number of post-secondary education programs offering degrees in construction is over 300.

The white paper by Liska (2010) lists five beneficiaries of a constructor certification as depicted in Figure 2.1. It further highlights the advantages of certification as another measure of a candidate's capabilities and comprehensive outcome assessment in the academic arena. This thesis will primarily focus on the outcome assessment of the certification process.

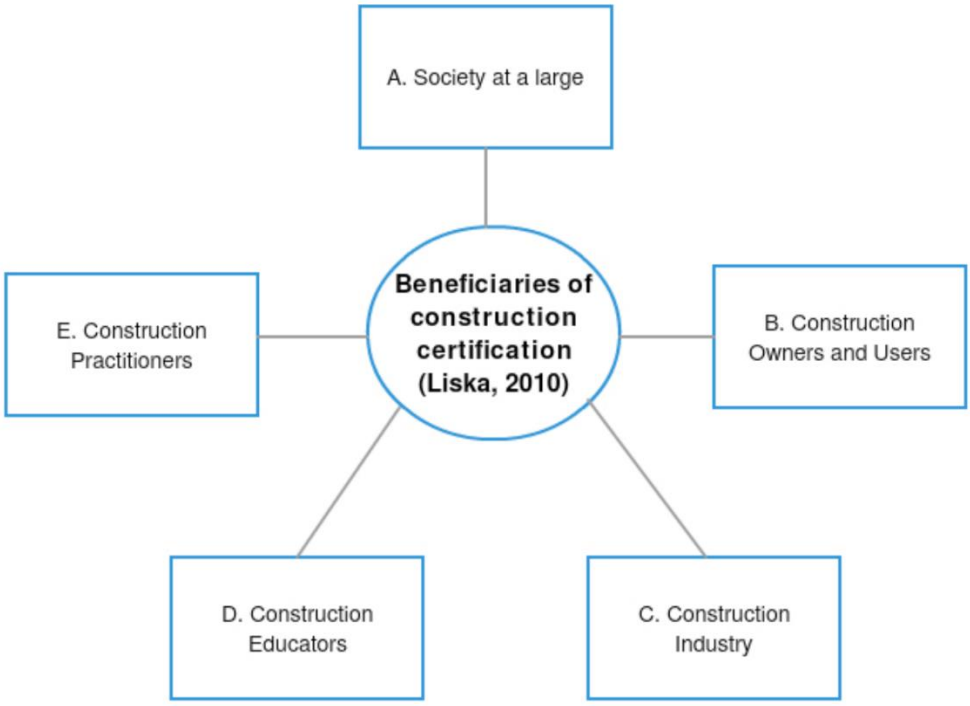

Figure 2.1: Beneficiaries of Construction Education (Based on White Paper; Liska 2010)

2.3 Licensing and Certification

Licensing and certification represent different levels of standards yet are often confused together. Usually, Licensing sets minimum standards of any practice to protect

the health and safety of the public, but certification is a voluntary process conducted by private organizations/associations that are non-governmental. However, at times certification is mandated too, based on professional requirements.

To ensure that the certification is effective for constructors, it must be administered, supported, maintained, and monitored by professionals and educators in the construction industry who recognize that the required improvements in the industry will be promoted by the certification of qualified practitioners (Liska, 2010). As per Vee and Skitmore (2003), *"There is growing demand for good ethical practice and professional behavior in all forms of business, including the construction industry."*

The AIC works with and is also comprised of construction professional societies, companies, trade associations, educators, and individuals interested in elevating construction as profession, and their consistent involvement in AIC validates the recognition of constructor certification "*higher than minimum standards and at the same time promoting continuous professional development at all levels"* (Liska, 2010).

2.4 Evolution of the AC Exam

The AIC established a task force in August of 1992 to study the issue of certification, and following that, the AIC conceptualized a process. After collecting valuable insights on relevant issues over several meetings, it was decided by AIC that the time was right to pursue certification for constructors.

The concept of AIC certification was developed as a two-examination procedure. The first is academic in nature: the Associate Constructor—or AC level exam; this is designed to be taken upon receipt of a bachelor's degree in construction or equivalent

qualification. The second examination procedure is for experienced professionals who have been practicing in the industry as professional: the Certified Professional Constructor exam; here, the exam questions are based on more experiential factors rather than foundational skills required for a constructor.

While the process for the AC exam is primarily designed for college graduates, candidates without a bachelor's degree could qualify through additional experience. Upon passing the respective certification examination and meeting any related requirements, the respective individual is awarded an AC or CPC designation.

After four years of process evolution, the first certification examinations were administered in 1996. To date, over 25,000 people have taken the AIC certification exam.

2.5 Correlation of the AC Exam and the ACCE 20 SLO's

Every construction program adapts different methods to design the curricula. There are a few bodies striving to bring "*better alignment and higher overall quality"* to construction education (Liska, 2010).

The American Council for Construction Education (ACCE) is a nationally recognized accrediting body that has defined processes of accrediting by reviewing the curricula content and making direct and indirect outcome assessments of construction education programs.

The ACCE has data collection methods for the purpose of assessment. The two methods of evaluating student learning outcomes are direct and indirect measures.

2.6 Direct and Indirect Measures of Assessment

Direct measures reveal student learning to a definable degree, as the results for test taker and feedback to instructors, but they do not provide information on the details of learning process of the student. Examples of direct assessments are licensure, certification, assignments, quizzes, and capstone projects.

In contrast, indirect measures are elaborate and detail the learning process, the results of which can further be used to interpret results and make improvements. Examples of indirect assessments are surveys given to students and alumni, employer surveys, and interviews.

2.7 Constructor Certification Commission

The Constructor Certification Commission was established by the AIC in 1996 to administer the Constructor Certification Program. It operates as a semi-autonomous organization outside of the normal AIC to ensure impartial decisions regarding certification programs.

The Constructor Certification Commission Examination Committee with oversight from the Professional Testing Corporation (Commission Examination Contractor), conducted a mapping analysis in 2014 which consisted of taking the 20 ACCE outcomes and determining from each outcome which AC examination specifications and associated questions fit into the *"cognitive domain"* of information covered by each outcome (ACCE meeting, 2016). A domain is a psychometric term for all the cognitive information or individual tasks one needs to know to be able to demonstrate mastery of an outcome.

2.8 ACCE Outcomes and the AC Exam

The ACCE has agreed for the AC exam to be a direct measure of its student learning outcomes (SLO) 6-8 and 12-20 (Accreditation Process, ACCE website, 2017). Figure 2.2 below referenced from "Listing of AIC Certification Testing Support of ACCE's Student Learning Outcomes (SLO's) Rev. 010317" depicts the ACCE outcomes measured by the AC Exam. It must be noted that since the publication of Figure 2.2, ACCE has now mandated that the AC exam cannot be used for the indirect measures based on this chart.

ACCE OUTCOME NUMBER MEASURE	AC EXAM AS DIRECT OR INDIRECT
1	Indirect
2	Indirect
3	Indirect
4	Indirect
5	Indirect
6	Direct
7	Direct
8	Direct
9	Indirect
10	Indirect
11	Indirect
12 - 20	Direct

Figure 2.2: ACCE Student Learning Outcomes (Rev 010317; American Council for Construction, 2010)

The exam is mainly oriented to test the ability of *"analyzing and understanding"* topics related to construction (Chini, 2015). The SLO's with their topic titles are listed in Table 2.1.

Table 2.1: ACCE SLO's and Approved SLO's for AC Exam

ACCE SLO'S	AC EXAM DIRECTLY MEASURES	AC EXAM INDIRECTLY MEASURES
1. Create written communications appropriate to the construction discipline.		**X**
2. Create oral presentations appropriate to the construction discipline.		**X**
3. Create a construction project safety plan.		**X**
4. Create construction project cost estimates.		**X**
5. Create construction project schedules.		**X**
6. Analyze professional decisions based on ethical principles.	**X**	
7. Analyze construction documents for planning and management of construction processes.	**X**	
8. Analyze methods, materials, and equipment used to construct projects.	**X**	
9. Apply construction management skills as a member of a multi-disciplinary team.		**X**
10. Apply electronic-based technology to manage the construction process.		**X**
11. Apply basic surveying techniques for construction layout and control.		**X**

Table 2.1 (continued): ACCE SLO's and Approved SLO's for AC Exam

ACCE SLO'S	AC EXAM DIRECTLY MEASURES	AC EXAM INDIRECTLY MEASURES
12. Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process.		**X**
13. Understand construction risk management.	**X**	
14. Understand construction accounting and cost control.	**X**	
15. Understand construction quality assurance and control.	**X**	
16. Understand construction project control processes.	**X**	
17. Understand the legal implications of contract, common, and regulatory law to manage a construction project.	**X**	
18. Understand the basic principles of sustainable construction.	**X**	
19. Understand the basic principles of structural behavior.	**X**	
20. Understand the basic principles of mechanical, electrical and piping systems.	**X**	

2.9 AC Exam Test Taker Criteria

The Associate Constructor (AC) is the first level of certification in the Constructor Certification Program. To take the associate constructor exam, there are two qualifying criteria: 1) that the test taker has graduated or is scheduled to graduate from an accredited 4-year construction management degree program or 2) has obtained 4 years of qualifying experience or education (or a combination of the two). On passing the AC exam, an individual is awarded the *"Associate Constructor"* credential. This exam is also known as AC level 1 exam.

2.10 Schedule and Format

The AC level 1 exam is conducted twice every year—in the spring and fall semesters, respectively. The exam is conducted in a single day in two sessions, each lasting four hours and is comprised of 300 multiple choice questions. Presently, there are 60 exam centers in the country and over 50 university construction management programs administer the test.

2.11 Subject Areas

In the AC exam level 1, there are 10 subject areas, and exam questions are based on the topics listed in Table: 2.2, along with their percentage in overall score calculations.

Table 2.2: AC Exam Subject Areas and Score Percentage

Subject Area	Percentage in overall score calculation
Communication Skills	13%
Engineering Concepts	5%
Management Concepts	12%
Materials, Methods, and Project Modeling and Visualization	10%
Bidding and Estimating	12%
Budgeting, Costs, and Cost Control	12%
Planning, Scheduling, and Schedule Control	12%
Construction Safety	7%
Construction Geomatics	2%
Project Administration	15%

2.12 Preparation Material

The AIC provides a comprehensive study guide that covers all the subject areas listed in Table 2.2. In 2016, the AIC introduced online learning modules for each topic. The AC reference text list is also available on the website along with the Mr. Ethics blog.

2.13 General Information

As of the 2016-17 testing cycle, the test fee is $165 for the first attempt, if they fail they can retake the exam. This fee excludes the AIC membership fee and the late enrollment fee. Every individual certificate is valid for two years beginning the first full year after earning the certification. AC's are not required to obtain continuing education

hours; however, they are encouraged by the AIC to stay current on industry trends by participating in continuing education events to prepare themselves for the next stage of certification. For an individual to maintain the AC certification, there is a fee, and an AC report is required every two years.

2.14 Student Motivation and Standard Testing

Achievement Motivation: *"Motivation is like the fuel that gives the vehicle energy to move towards a destination"* (Cole, Bergin, & Whittaker, 2008). The general definition aligning with most contemporary perspectives is that motivation is *"the process whereby goal-directed activity is instigated and sustained"* (Pintrich & Schunk, 2002). It implies motivation is an active process directed towards a target or goal, and that motivation is an initiator to start and continue a behavior.

The concept of *"achievement motivation"* alludes to the motivation to perform well in a specific situation or test. This is commonly termed as test-taking motivation. Various studies conducted on test taker performances have demonstrated that a well-motivated student performs better in achievement situations. The concluded reasons which explain the "why" behind better-performing students are as follows: higher educational aspirations, and comparatively more effort in learning new tasks—including continuous improvement in self-regulating strategies and persistence for difficult tasks, both of which are substantially higher as compared to a poorly motivated student (Harlen & Crick, 2003; Pintrich & Schunk, 2002).

Stakes of the Assessment: Irrespective of being theoretically distinct, it is difficult to empirically differentiate between task-specific performance expectations from

knowledge, skill, or competence (Wigfield & Eccles, 2002). This is particularly true for situations in which the stakes of the assessment are not equal for test-takers, such as teachers, schools, and policymakers. It is important to consider student test-taking motivation from an assessment validity perspective, particularly when the stakes of the test are low for the test-taker but high for other stakeholders.

Low Stakes Tests: A shortcoming of direct assessment techniques, which is often unrecognized or unacknowledged, is that *"for students, the tests have no consequence"* (Eklöf, 2010). Cole, Bergin, and Whittaker (2008) term these tests as *"low stakes tests."* While these are low stakes tests for the students, quite often, there is a high possibility that they would have high stakes for institutions as accreditation can depend on test score data. As per studies, teachers and school leaders informing students about the study area is a significantly important task in motivating the students (Cole, Bergin & Whittaker, 2008).

2.15 Model of the Assumed Relations Between Test-Taker Characteristics, Test Characteristics, Test-Taking Motivation, and Test Performance

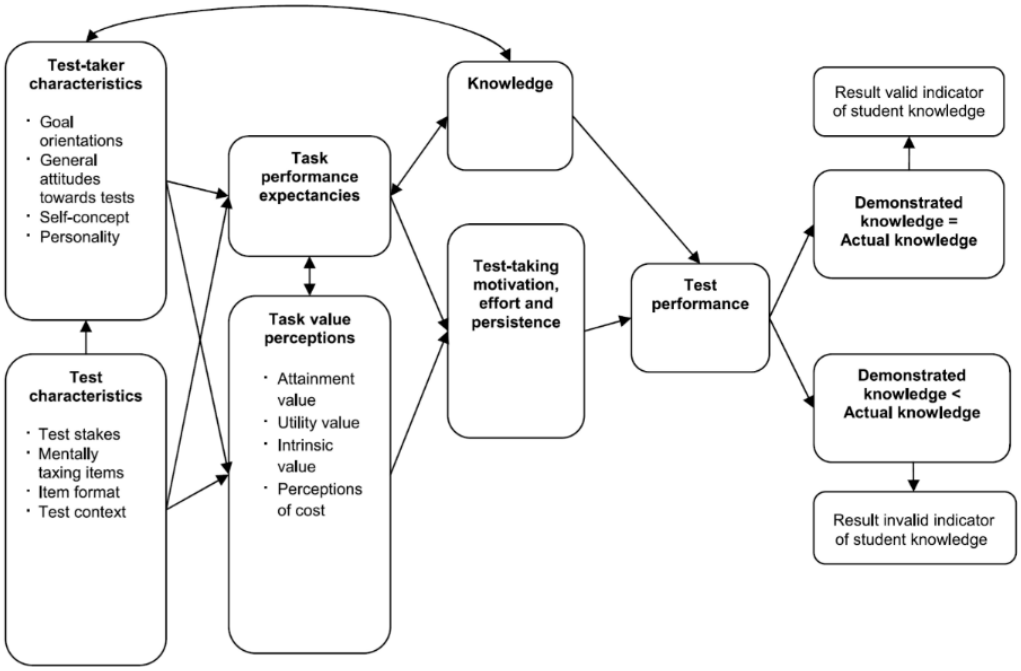

Figure 2.3: Eklof's Model on Factors in Assessment Situations (2010)

The model presented by Eklof (2010), is grounded in the theoretical and empirical literature on test-taking motivation and draws on the assumptions from the Expectancy-value theory of achievement motivation. The two major components of this theory are the expectancy component and the task-value component. The expectancy component corresponds to the question *"Can I do this task?"* and is explained in terms of the individual's self-concept, self-efficacy beliefs, goals, and expectancies for success. Whereas, the task-value component corresponds to the question *"Do I want to do this task, and why?"*

As depicted in Figure 2.3, there are four different perceptions of task value. The value aspects are *"attainment value (perceived importance of doing well), intrinsic value (subjective interest in the task), utility value (perceived usefulness of the task) and cost perceptions (perceived amount of effort required for the task)"* (Wigfield & Eccles, 2002).

Based on the model, a test taker evaluates the task at the hand and establishes the likeliness of success of a test by considering characteristics of the test and the test situation. Adding to this, the test taker's evaluation is also dependent on his or her own characteristics.

As the AC exam is a direct assessment measure for accreditation by ACCE, the overall literature on test-takers' motivation suggests that future studies could benefit from asking not only the test-takers but also test administrators about their attitudes towards the assessment and the steps taken with the purpose of motivating the test-takers.

2.16 Western Carolina University- Study

A research study was conducted by West Carolina University in 2012 to measure the effectiveness of an exam using the AC exam. In this research, the AC exam "*scores were observed for a three-year period and analyzed to identify variables that might significantly affect student performance on the Associate Constructor Exam"* (Ford, Kinard III, & Sims, 2012). The SAT scores of the students were correlated with the AC exam results for this research. The three recommendations from this paper were:

- *Provide support for students to teach them about the test. A required course for all seniors would be the optimal scenario.*

The pass results were below average for Western Carolina University for the years during which data were analyzed. The AC exam covers topics outlined by ACCE in learning outcomes for a four-year construction management degree program; therefore, the first conclusion was to mandate a course for all the seniors to review the AC exam content in an organized manner before the exam.

- *Provide students with AC exam familiarization in the pertinent areas of the program curriculum. Coursework could include AC related materials.*

The AIC provides AC exam preparation materials listed previously in the literature as AC level 1 study guide, and recently, the AIC launched online learning modules for all 10 chapters given in the AC exam syllabus. It would help to prepare coursework structure relevant to the AC related materials.

- *Provide instructors with feedback on student performance in their respective areas of the exam annually.*

The scores of the AC exam are confidential, given out to test takers individually, and provided to the department chair. This system prevents the instructors from receiving any feedback. An overview of feedback from the AIC on student performance could be a very helpful source of course evaluation for the instructors.

The data for this research was restricted only to the students of Western Carolina University; therefore, this trend could change with a more diverse data set. Figure 2.4 shows the data trend for this study.

	Passed	Failed	% Passed
<1000	9	72	11
1000-1099	7	33	18
1100-1199	12	14	46
1200+	9	4	69
Totals	37	123	23

Figure 2.4: Comparison of SAT scores number of students who took AC exam from Western Carolina University study, (2012)

Thirty-seven students, or 23% of those included in the sample, passed the exam. Sixty-nine percent of Western Carolina University students who scored above 1200 on the SAT passed the exam. Of those who scored between 1100 and 1199 on the math/verbal SAT, about 46% passed the AC exam. Of those students with scores below 1100, only about 11% passed (Figure 2.4).

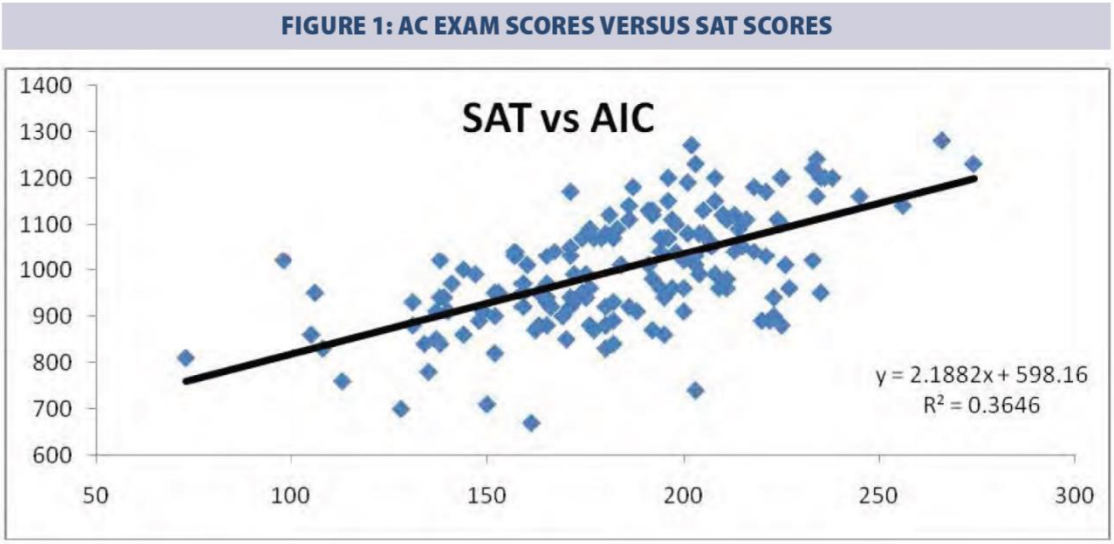

Figure 2.5: AC Exam Scores versus SAT Score from Western Carolina University Study (2012)

To determine if AC and SAT scores were correlated, a linear regression analysis was performed. A significant correlation (r=0.60) between SAT scores and AC scores was observed. A Pearson Correlation Coefficient (r=0.50) above 0.5 may be considered a large correlation (Cohen, 1988).

Figure 2.5: shows that higher SAT scores resulted in higher AC exam scores and a greater probability of passing the AC exam. Any inferences from this data are limited to Western Carolina University CM students' performance and potential program improvements.

2.17 Colorado State University- Study

Within the 2015 *"Assessment Results and Action Plan"* by the Colorado State University Department of Construction Management, the AC level 1 exam results were analyzed as per national average. Based on the results, an action plan was prepared

followed by updates on various aspects. Relevant facts from the report are listed in Table 2.3.

Table 2.3: Summarized Report of Colorado State University (2015)

Recommendation	Updates
Discuss results and present trends at a Department meeting.	The result of the discussion was a recommendation to review how well the AIC exam fit the goals of the Department with possible consideration of removing it from the assessment tools used by the Assessment Committee.
Survey employers to identify if they are aware of and/or support the AIC exam.	The survey indicated that few employers know about or look for AIC certification, suggesting limited support for the exam.
Re-evaluate how students are encouraged to, and their motivation for taking the AIC exam.	Feedback from students (to faculty and staff) is that they do not see value in paying for and taking the AIC exam for various reasons
Contact AIC about changes to the exam structure and reasons for those changes.	Tabled further action for now since AIC announced it is revamping exam to be in line with new ACCE SLO's.
Continue to discuss possible alternative certifications.	No further action since assessment will be switching to SLO's in Fall 2015.
Explore the possibility of using the professional fee to cover the cost of the AIC exam for students.	Professional fee has been discontinued.

The assessment results and action plans by the Colorado State University Department of Construction Management indicate a few reasons for the bad performance of the students in the AIC AC exam. These reasons include: the increase in cost of the AIC exam, lack of employer awareness of the AIC exam/certification, the time during the semester when the exam is offered, and a general lack of student motivation to take the exam.

This lack of motivation on the students' behalf appears to result from feedback they are receiving from employers/industry on what the exam is and what value it adds to their education. Employers were also surveyed to get an indication of their level of awareness of and the value they place on the AIC–AC level 1 certification when making hiring decisions. It was observed that the majority of employers did not know about the certification and therefore placed very little value on certification when hiring students. Also, the time during the semester when the exam is offered tends to fall after students have already accepted job offers, decreasing their motivation to pay for, study for, and take the exam.

In addition, the Senior Capstone policy in Colorado State University was revised to allow students to use their AIC exam results to replace their final exam regardless of their score on the exam in order to link coursework to the AC exam. The expectation was an improvement in the score of students on the AIC exam, but contradictory to the recommendation made by the research completed at Western Carolina, the performance did not improve. Figure 2.6 demonstrates the resulting trend in Colorado State University.

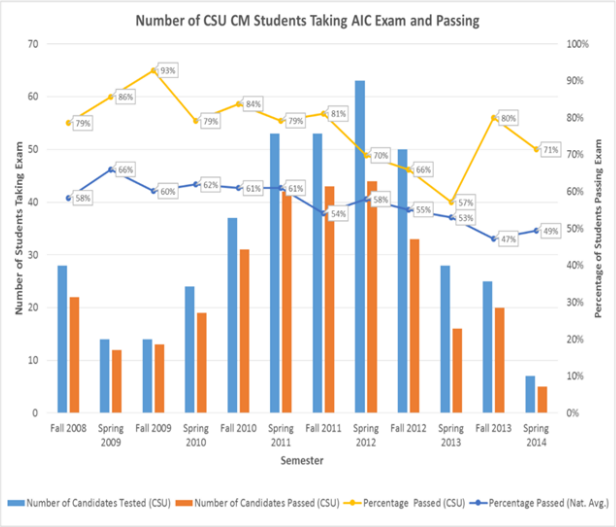

Figure 2.6: Colorado State University AC Exam Result Trend

2.18 Teacher's Reaction to Validity of Standardized Testing

L. Herman and Golan (1991) state that teacher reactions to the validity of standardized testing, according to the literature, range from concern to distrust. Findings from Dorr-Bremme et al. (1983) indicated that teachers were concerned about the utility of mandated tests, their appropriateness for some students, and the impact of testing on instructional time and student self-confidence.

Similarly, Smith et al. (1989) reported that teachers were pessimistic about what scores reveal. Less than one-fifth of the teachers interviewed felt that results from the mandated, standardized tests used in their schools accurately reflected their students' learning for the year. The results of this research suggest that the academic environment for the standardized test, like the AIC level 1 exam, should be optimized on the topics that are accounted for in the exam.

Research titled, *"Survey of Undergraduate Construction Programs Use of AC Exam as an Assessment Tool"* (MacDonald, R. R., Sessoms & E. C., 2012) evaluated construction programs by conducting a survey in two separate rounds. The survey focused on the adaptation of the AC exam and its implementation to measure ACCE SLO's. Table 2.4 represents the questions asked on the survey. All these factors were considered influential on the motivation and preparation of test takers of the AC exam.

Table 2.4: Questions from "Survey of Undergraduate Construction Programs Use of AC Exam as an Assessment Tool" (MacDonald, R.R., Sessoms & E.C., 2012)

Questions
Is the AC exam offered in your program?
Is it required that all students take the exam?
Are students required to pass the exam?
Are students incentivized?
Is your program using the AC exam as a tool for assessment?

2.19 Anxiety and Cognitive Fatigue

Another published work shows the relationship between test performance and test anxiety in an online exam (E.Powers, 1999). Duration of the exam plays a very important role in the anxiety level of the student in an online exam. The AIC level 1 exam has a duration of eight hours for the paper-based exam, and it is conducted in two sessions of four hours each. The performance of students has been observed to be better in longer duration exams, but the *"cognitive fatigue"* in subjective measures is observed. In research on test length and cognitive fatigue (L.Ackerman & Kanfer, 2009), the SAT exam scores were observed, and statistical analysis was performed which concluded longer testing times did lead to increases in reports of subjective fatigue that did not improve immediately at the end of the testing session.

The study hours of a student is conventionally taken as a parameter for the exam results. In research by Barbarick and Ippolito (2003), a sample of students was taken and the results indicated that students did not consistently match the Carnegie Rule of studying two hours outside of class for every hour in class. The AIC AC level 1 exam evaluates the fundamental understanding of the concepts important for a construction professional, and perhaps the hours of study could not be one of the factors influencing the passing scores.

2.20 GPA Based Study on CPC Exam Performance

Another paper titled *"Using the Constructor Qualification Examination to Assess Student Learning"* performed a statistical analysis based on the GPA of the students taking the CQE exam (Sylvester, 2011). The student GPA was divided into three groups representing average students (2.0–2.5 GPA), above average (2.5–3.5 GPA), and excellent

students (3.5–4.0 GPA). Average students, typically defined as "C" students, rarely pass the CQE exam, while above average students, typically referred to as "B" students, have an average pass rate of 36%. For excellent students, whom we would expect to have a minimum 80% pass rate, a 67% pass rate was found. (Sylvester, 2011)

The conclusion from the data analysis conducted in this study are mentioned in Figure 2.7.

#	Analysis	Description	Significance
1	Competency Mapping	Mapping of CQE testing categories with ACCE Curriculum areas	Identify courses in the curricula the correlate to the CQE testing categories
2	Pass Rate and Mean	Benchmarking student performance against expected standards	Develop baseline performance standards for future comparisons
3	Trend	Longitudinal assessment of historical student performance	Define causal relationship between programmatic changes and historical CQE test performance
4	Frequency	Assessment of GPA and test score distribution for normal distribution	Identify differences in the competency standards of the academic program and professional practice
5	ANOVA	Test for significantly different test means among GPA groupings	Identifies how student learning as ranked by GPA compares to the professional competency standards expected by the CQE level 1 examination.
6	Correlation	Identification of factors affecting student learning and test performance	Identify core course areas in the curriculum that require improvement and their interdependency

Figure 2.7: Conclusion from CPC Performance Data Analysis, (Sylvester, 2011)

2.21 Effective Ways for Students to Prepare for Standardized Testing

The literature suggests that many of the leading school test directors understand the issue of legitimate ways to prepare students for standardized tests but that many districts do not have any formal policy regarding test preparation (Meherens, 1989). Presently, there are study materials provided by AIC which will help the students prepare well for the exam.

Another recommendation, as per the Western Carolina University study, is course curricula revamping using the AC exam syllabus as a guide.

A monograph by Dunlosky, Rawson, Marsh, Nathan & Willingham (2013) discusses 10 learning techniques in detail. They further offered recommendations about the relative utility of learning techniques. However, the authors conclude with a comment that the monograph will not be a remedy for improving achievement for all students and will benefit only students who are motivated and capable of using them. Hence, motivation and capability are two major variables to evaluate the performance of a test-taker in any exam.

CHAPTER 3

METHODOLOGY

3.1 Overview

In the AC level 1 exam conducted during fall of 2015, steep fluctuation in overall performance was observed amongst Clemson University test takers. This observation led to the commencement of this research study in January 2016. As detailed in the literature review, there are multiple factors influencing a test taker's performance on the Associate Constructor (AC) Level 1 exam. During the process of survey design, "motivation level" and "preparation" were concluded as the two most important factors affecting a test taker's performance on the AC exam. Therefore, the objective of this study was to identify the influential measures taken at the departmental level to prepare and motivate students to perform well on the AC exam, followed by a statistical analysis of multiple data sets with respect to the AC exam test takers' scores in fall of 2016. The results will further provide AIC/CCC a sense of confidence in how impactful motivation and preparation were on exam scores. An additional objective of this study is to help construction management programs understand factors influencing student performance in the exam so that they can use the exam to more accurately reflect student learning. Surveys were designed for three different groups participating in the study. The first group was of Clemson seniors who sat for the AC exam in fall of 2016. The second group was all of the test takers in fall of 2016 and was surveyed at the end of the AC exam. Lastly, department chairs of institutes received an online survey to understand the implementation of institutional practices to keep the test takers motivated and prepare them well for the exams.

3.2 Survey Design Framework

The AIC works to promote “individual professionalism” and “excellence” throughout the related fields of construction by conducting certifications; additionally, the AC level 1 exam successfully aligns with 12 direct assessment measures for student learning outcomes outlined by ACCE (Figure 2.2). Dual utility of this exam as a measurement tool and a professional certification makes it important for the schools offering construction related degree/non-degree programs, as well as for the individual test takers. This consideration of dual utility led to the involvement of department chairs of institutes and test takers as two different data sets, ensuring careful construction of each survey within the aforementioned objective of the study.

The first stage of survey design framework included an extensive literature review followed by informal interview sessions with AIC members, Clemson University faculty members, and prospective AC exam test takers. All these interview sessions were non-structured conversations that helped to clarify the perception of various stakeholders involved in the AC exam. Further, the interviews were transcribed as a draft reflecting various factors listed by interviewees affecting test takers’ performance on the AC exam.

In the later stage of survey development, a relative comparison was made between factors complied of the literature review and the transcribed interviews. The evaluation at this stage identified the common factors from interviews and literature study.

Based on the results of the stage wise evaluation for survey design framework, the scope of study for this research narrowed down to two major factors influencing the

performance of the test taker in AC exam: *"motivation"* and exam-centric *"preparation"* methods.

3.3 Importance of Motivation

As referenced in the literature review, *"stakes of assessment"* is a critical factor affecting test taker performance in a certification exam, and based on the literature, it was assumed that the stakes of assessment proportionately align with the motivation of an individual test-taker. For the AC exam, the stakes of assessment of participating universities are relatively high compared to participating students because construction programs can use exam results as a tool to measure SLO, but students may not see much value in the exam. Therefore, this contradiction in the presumption of *"exam value"* between test-takers and universities narrowed down to identify the subfactors influencing motivation level of the test-takers.

The study further identified more sub-factors directly or indirectly affecting the motivation level of AC exam test takers. A few of the subfactors quantified in surveys are the availability of jobs, duration of exam, and exam fee related to motivation level of the test taker.

3.4 Importance of Preparation

Presently, 10 subject areas are considered for evaluation in the AC exam (Table 2.2). Industry experts design the AC exam questions after careful research of recent practices and skill demand in the industry. A four-year accredited degree program in construction management offers the 10 topics listed in AC exam syllabus, which may or may not align well with AC exam standards. The approach of course work varies from

university to university. The gap arising due to this situation makes it very important to evaluate the additional preparation required for the students taking the AC exam.

"Preparation methods" were further broken down to academic program level and individual study pattern to get a clear picture of the sub-factors within preparation criteria. Additional questions were designed to analyze the adaptation and perceived utility of AC exam preparation materials provided by the AIC in exam preparation.

3.5 Focus Group Selection

As explained above, the participation of accredited programs to motivate and prepare test takers being evaluated is effectively correlated to test takers' performance on the AC exam. Therefore, to statistically analyze the survey-based response around the two selected objectives—student motivation and exam preparation—the study was broken down into three separate focus groups.

The three groups are listed as follows:

- AC exam test takers for fall of 2016,
- Department administrators and department chairs, and
- AC exam test takers for fall of 2016 from Clemson University.

Selected focus groups belong to the academic arena but are different data sets. Therefore, every data set had a different survey with similar context of analysis. Specific methods applied to the design and administration of each survey is explained respectively.

3.6 Survey for AC Exam Test Takers – Fall 2016

This survey was designed for all the test takers nationwide (see appendix) and executed as an administered survey. The AC exam for fall of 2016 was conducted on November 4th and 5th across 40 test centers in the country. The total number of students who sat for the exam was 650.

The AC exam is a paper-based test, so this 13-question survey was attached to the last page of the exam sheet. The first eight questions in the survey were focused on specific subfactors under the head of motivation and preparation, followed by five general feedback questions. The survey had three questions based on motivation and five questions focused on preparation method. The preparation method questions included classroom review sessions, a reference to AC exam preparation materials, and similarity of coursework to AC exam questions. Similarly, questions on motivation focused on perceived personal importance, departmental importance, and importance of the AC exam to recruiting companies. Listed factors were selected for a survey to identify their influence on the passing score of the students. All the questions were designed on a category scale as an ordered answer scale survey with four or five point Likert scale questions. The results obtained are categorical in nature.

Ethical stance

The survey questions were added to the end the exam to ensure that the AIC/CCC could administer and further pair the student response to the respective exam score. This strategy ensured high response rate. The passing score and survey response information were provided to the researcher with sampled generic student ID and university code by

the exam hosting agency to provide anonymity to the students, university and confidentiality of scores.

3.7 Survey for Department Chairs

The respondents for this survey were the department chairs of construction management programs in different schools who are participating in the AC exam or have test sites. This survey was executed on a web-based portal and was hosted by AIC. Questions were designed to identify the present exam preparation practices adapted by universities for students taking the AC exam. Similarly, there were questions to analyze the importance and impact of motivation from the department chair perspective. An online survey tool of *"Survey Monkey"* hosted the survey.

This survey had 41 questions with multiple *"skip logic trigger."* The survey was a mix of yes/no, Likert scale, and open-ended questions. A total of 26 responses was recorded for further analysis including 15 department chair responses comparing with student responses from AC exam test taker surveys for fall of 2016.

Pilot testing

Seven faculty members in the CSM department tested the survey link to validate the alignment with research objectives and verify the logic of questions based on desired output. Feedback was collected in written form and via in-person meetings to revise the survey.

Ethical stance

Before the data collection started, the department heads were informed about the upcoming survey from AIC in the ACCE's annual meeting in Atlanta, GA in July. At this

meeting, the department heads were told about the upcoming survey by Dr. Joe Burgett (Research Advisor). Few specifics were offered at that time except that the survey would be used to quantify what is being done at the institutional level to prepare and motivate students to do well on the AC exam.

By letting the department heads know about the survey in advance reinforced the AIC's commitment to continually improve the exam experience and presumably increase the number and thoroughness of responses to the survey.

After creating the survey on *"Survey Monkey,"* the authorization was transferred to AIC. Authorization transfer technically ensured that other than AIC, no other entity had access to the survey while it floated to department chairs for responses as well as results later.

Sampled results were shared with the Research Advisor and Main Researcher. Results did not include school name or any identification of the respondents. The exam hosting agency transferred the responses in an Excel sheet with school code.

The school code is a default system generated generic and non-descriptive ID provided for analyzing the student responses with department chair responses statistically. The research committee felt that it is important to understand the correlation between the department head responses and their students' average exam scores.

3.8 Survey for the AC Exam Test Takers Clemson University – Fall 2016

After the AC exam in the fall, the Clemson CSM seniors were asked to complete a survey addressing various motivation and preparation factors on November 21, 2016. The

paper-based survey was distributed and administered during a regularly scheduled senior class to ensure a high response rate. A total of 42 responses was received.

The Construction Science and Management program at Clemson University has combined the AC exam as 10% of a course grade. The program also organized out of class preparation sessions to prepare the students for the exam.

The survey was created after conducting an open-ended interview of four seniors taking the exam. The interviews were audio recorded and transcribed to understand the test takers' perception of the AC exam, preparation methods, and performance expectations. Multiple factors were included after transcribing and coding the contextual interviews in a list format, and the survey included all those factors.

The nature of this survey was very detailed with multiple Likert scale questions under each component of the evaluation. This survey was designed with specific questions related to present practices in the CSM department to motivate and prepare students for the AC exam. All coursework offered in the department was analyzed with its relevance to questions asked in the AC exam. Also, all the preparation material provided by the department, as well as by the AIC, was evaluated by students through Likert scale questions. The Clemson CSM survey was given out after a classroom session held following the AC exam.

Further, the CSM department at Clemson University provided disaggregated students' exam scores to compare with the survey responses. The data was shared strictly for research purpose.

Ethical stance

The general duration of each student interview was 30 to 45 minutes. Four students volunteered to participate in the interviews, and the audio recording was done with the students' consent. When the scores were received from the CSM department, the main researcher signed a confidentiality statement declaring that the *"scores will be used only for this research to conduct various statistical analysis."* The signed declaration is attached in the appendix.

3.9 Data Collection

The data collected for this study came from three separate surveys. Two out of three surveys had students as respondents; the department chairs were participants in one survey. The first survey for AC exam test takers in fall of 2016 was an eight-question student survey included with the fall 2016 AC Exam and an additional five general feedback questions. Questions on the student survey were provided to the students on the last page of the answer sheet, and the exam proctors made the students aware of the survey and of the logistics for completing it. The third-party testing service that administered the exam compiled the survey results. A total of 649 completed student surveys was compiled and paired by the testing agency with their raw exam scores. Test taker names and the schools they attended were replaced with randomly selected sampled ID codes. The testing agency ensured that all identifiers were removed before the survey results paired with exam scores were transferred to the authors.

The second student survey was specifically designed for Clemson CSM test takers. The Clemson CSM survey was given out as a paper-based survey during a classroom

session held after the AC exam. The researcher was personally present to conduct the survey. The first page of the survey clearly mentioned the participation as voluntary and that student identities would be kept confidential (see appendix). The total number of participants for this survey was 42. The CSM Department Chair at Clemson University provided disaggregated students' exam scores to compare with the survey responses, and the data was shared strictly for research purposes.

The third survey was sent to department heads of construction management programs. The term *"department heads"* also includes program coordinators, department chairs, and those with similar titles. An online survey instrument with *"Skip logic"* was designed, and open-ended follow-up questions were asked to get a detailed insight of present practices to motivate and prepare students taking the AC exam. The survey included over 41 dichotomous, multi-response, 5-point Likert scale, and open-ended questions. The Department Chair survey was administered by the AIC as the authorization of the survey was transferred to the AIC. It was sent out immediately before the fall of 2016 AC exam cycle with responses collected at the end of the year. There were 26 completed surveys received from 24 universities as dual school representatives responded to the survey for two schools. Therefore, four responses were generalized to two, meaning it was arranged in likert scale and in rare instances where contradicting response was observed, it was eliminated.

3.10 Statistical Analysis

Survey data was statistically analyzed by variety of methods. Descriptive statistics—frequencies and relative frequency—were computed to summarize each

question on the questionnaires. Further, for the student surveys, stepwise regression and Pearson's Chi-square test were conducted to find out the most influential factor on the score of test takers. Here, the pass score was considered as the dependent variable and fixed factor. The exam score was the component in the equation which is factored, and the responses to different factors questioned on the survey were of categorical nature. A significance level of 0.05 was used for all tests of significance. A section for the response of department chairs with results higher than 70% was also cataloged to understand what those individuals are doing to keep the students motivated.

CHAPTER 4

ANALYSIS AND RESULTS

4.1 Introduction

The results and analysis chapter has three sections. Each section discusses the result from individual surveys. In section one, the detailed survey given to Clemson students has been discussed followed by section two for the fall 2016 AC Exam test taker survey. Lastly, in section three, the department chair survey is cataloged and explained.

4.2 Section 1: Clemson Survey

The Clemson CSM survey was given out to 42 students after the AC exam with 100% completed response. It was a paper based survey and was administered in a classroom session where participation was voluntary. Overall, 42 students participated in the survey, and the responses have been analyzed by frequency tables and a Pearson's Chi-Square test. Each question in the survey has been discussed with results in this chapter.

4.3 Preparation Material

To prepare the test takers for the AC exam, study materials are provided by the AIC. There are available study materials provided by the CSM department of Clemson University to prepare for courses, and some of the provided course material is relevant as preparation material for the AC exam as well. Additionally, the department conducted study sessions specifically for AC exam preparation. Each preparation material relevant to

the AC exam was identified and listed in the survey. The study materials that have been analyzed per reference time are explained one by one.

1. Circle the range of hours spent on each study material/sessions to prepare for the AC exam? Select the one range for each study material below.

Study Material	***Hour range of reference***				
AC exam study guide	0	1-3	3-6	6-8	9 or more
Online AC exam study course	0	1-3	3-6	6-8	9 or more
Class notes by faculty	0	1-3	3-6	6-8	9 or more
Class notes by student	0	1-3	3-6	6-8	9 or more
Course textbooks	0	1-3	3-6	6-8	9 or more
Faculty lead study sessions	0	1-3	3-6	6-8	9 or more

Figure 4.1: Clemson CSM Survey Question 1 (2016)

For the AC exam study guide, a steep increase in average scores has been observed for study hours of 3-6 to 9 or more. The increase in score is from 220.4 to 253.5. However, the uneven trend was observed from 0 to 3-6 hours of study as the average score rose from 221.7 to 223.9 but then dropped to 220.4. The average score of respondents here suggest that if the study guide is referrenced for more than six hours of time, there is a high chance of getting better exam scores. Figure 4.2 and Table 4.1 represent the values explained here.

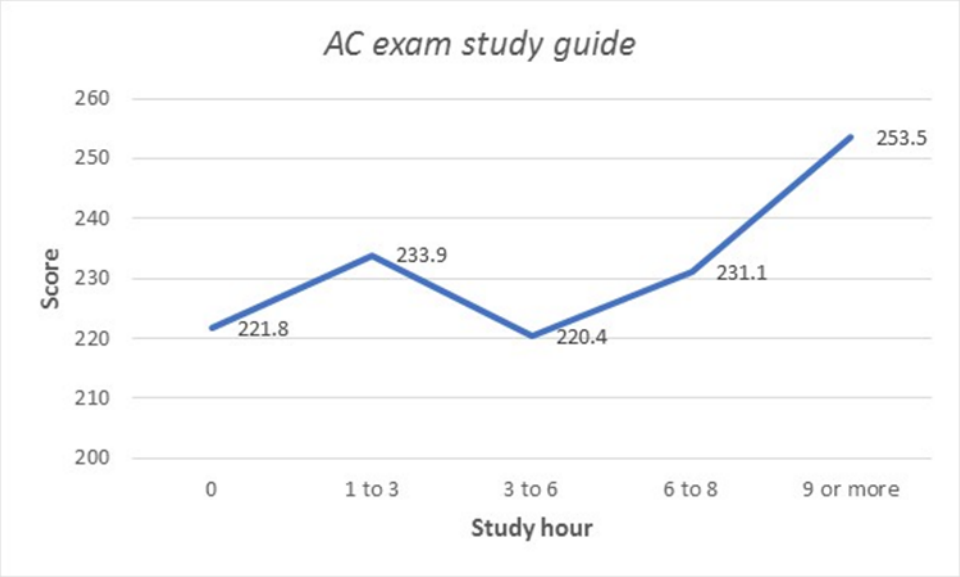

Figure 4.2: Average Score with Reference Time of AC Study Guide

Table 4.1 Count and Hour Range of Reference of Study Guide

	Hour range of reference for study guide					Total
	0	1 to 3	3 to 6	6 to 8	9 or more	
Count	4	12	7	16	2	41

Hour range of reference for the online study guide is represented above. The average score range for respondents for the online study course is 199 to 242.2. Highest average score has been recorded for the time range of 1 to 3 hours. It was followed by a drop to 224.7 for students selecting 3 to 6 hours and then the eventual rise of 235.3 for the time of 9 or more hours. Trends represent that there is an improvement in score if the study guide is used, but the average score drop is below average if the student does not select an option of referencing the online tutorials. Figure 4.3 and Table 4.2 represent the values explained here.

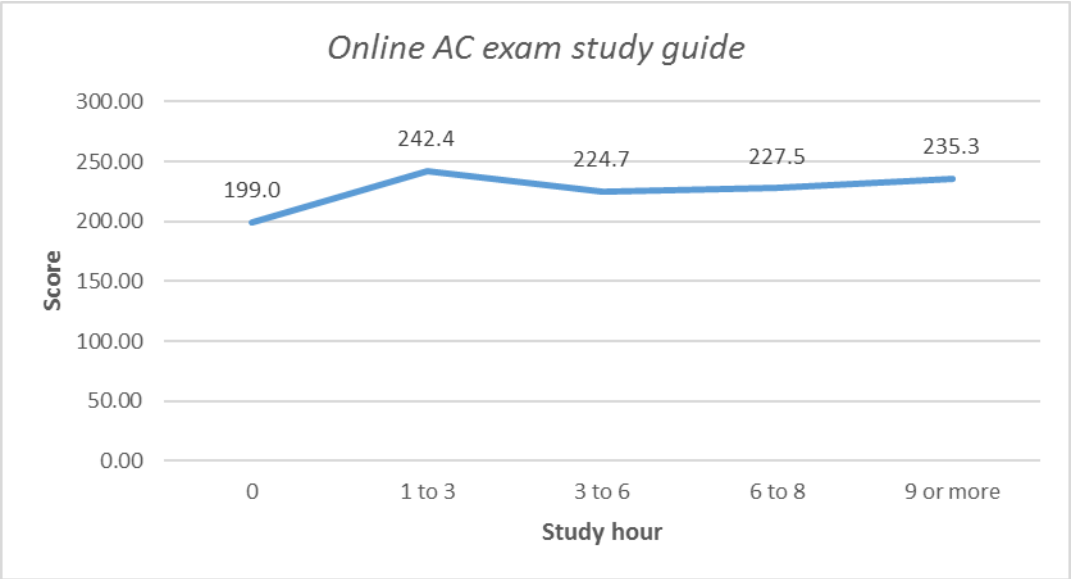

Figure 4.3: Average Score with Reference Time of Online Study Guide

Table 4.2: Count and Hour Range of Reference of Online Study Guide

	Hour range of reference for online study guide					Total
	0	1 to 3	3 to 6	6 to 8	9 or more	
Count	2	5	6	19	7	39

Class notes by faculty provided for different courses that had similarity with the AC exam syllabus did not appear to be a popular preparation material for the AC exam. The number of responses after the score set of 1 to 3 hours is very low to compare the average score. However, results suggest that most of the students did not refer to the class notes for the AC exam preparation, and the average score did not vary much for students selecting 0 hours to 1 to 3 hours which is 231.58 followed by 232.6 respectively. Figure 4.4 and Table 4.3 represent the values explained here.

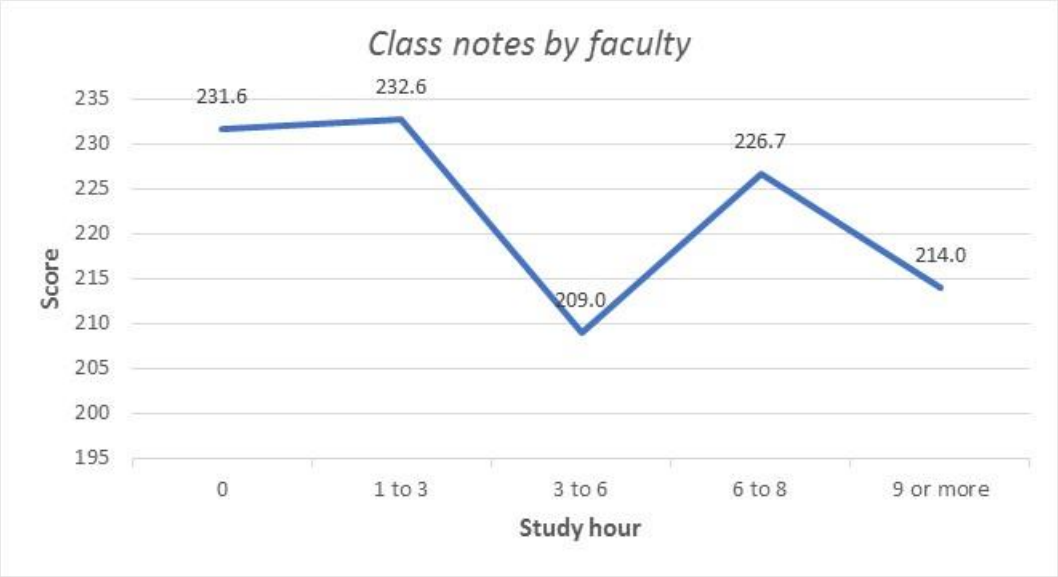

Figure 4.4: Average Score with Reference Time of Class Notes by Faculty

Table 4.3: Count and Hour Range of Reference of Class Notes by Faculty

	Hour range of reference for class notes by faculty					Total
	0	1 to 3	3 to 6	6 to 8	9 or more	
Count	17	16	3	3	1	40

Reference of 3 to 6 hours shows the highest average score of 236.6 and 6 to 8 hours shows class notes by students demonstrated the lowest score of 221.5. Zero and 1 to 3 hours have the same average score of 229.3. Class notes is a very student-dependent factor as every student has a different study pattern and therefore the defined trend in the average score as per selection is difficult to trace here. Also, the highest and lowest average score trend has a very small sample data set. However, it is very clear that more than 50% of the students did not prefer using any of their class notes to prepare for the exam. Figure 4.5 and Table 4.4 represent the values explained here.

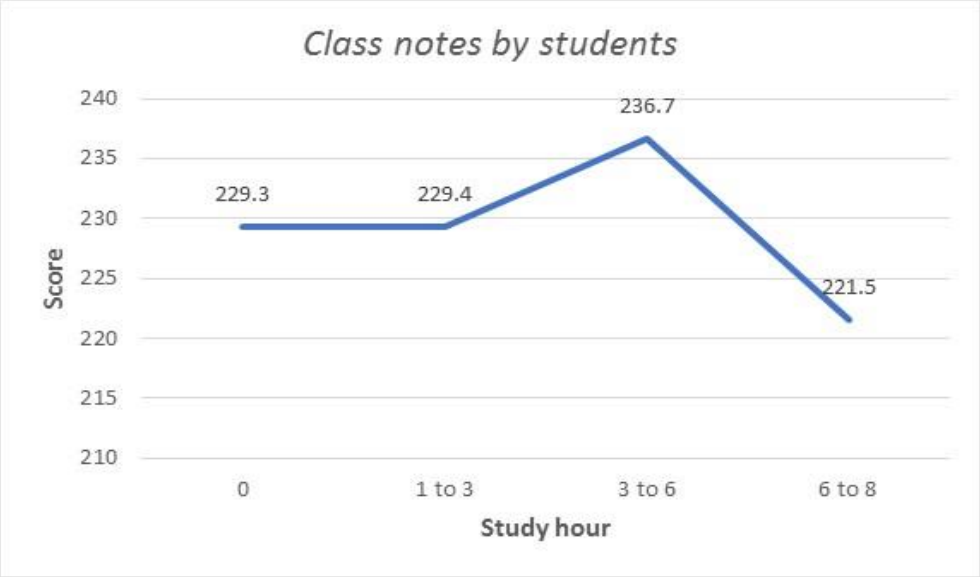

Figure 4.5: Average Score with Reference Time of Class Notes by Students

Table 4.4: Count and Hour Range of Reference of Class Notes by Students

	Hour range of reference of class notes by students				Total
	0	1 to 3	3 to 6	6 to 8	
Count	21	14	3	2	40

Course textbook was not referenced by 80% of the students for exam preparation. The possible reasons for this could be dependent on course structure or study pattern of the student. However, a reference to the course text displays a very high increase in average score from 225.9 to 247. There is a possibility that the course text, which relates to the AC exam content affects the exam performance, but the data sample here is too small to make a concrete conclusion. Figure 4.6 and Table 4.5 represent the values explained here.

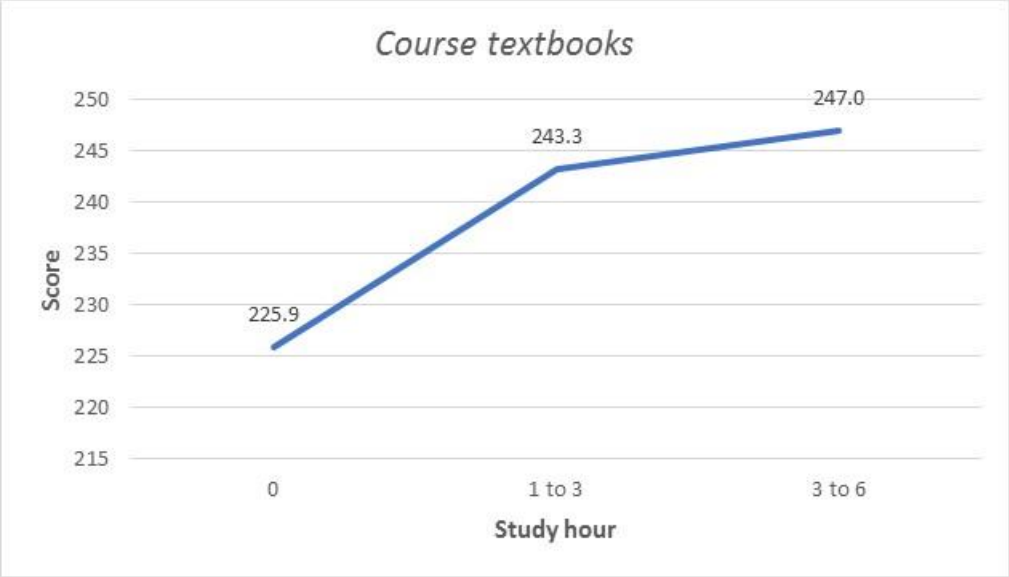

Figure 4.6: Average Score with Reference Time of Course Textbook

Table 4.5: Count and Hour Range of Reference of Course Textbook

	Hour range of reference of course textbook			Total
	0	1 to 3	3 to 6	
Count	32	7	1	40

The highest number of students attended the "faculty-led study sessions." The Clemson CSM department organized study sessions before the AC exam to review the course content of the AC exam. The highest average score observed was for students attending it for 1 to 3 hours. Figure 4.7 and Table 4.6 in appendix represent the values explained here.

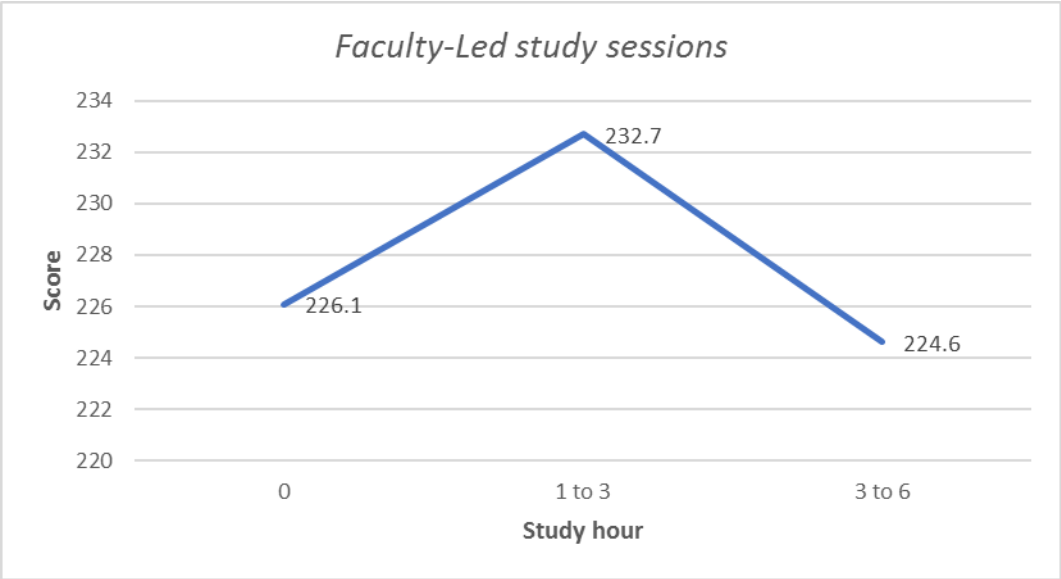

Figure 4.7: Average Score with Reference Time of Faculty-Led Study Sessions

Table 4.6: Count and Hour Range of Reference of Faculty-Led Study Sessions

	Hour range of reference of faculty-led study sessions			Total
	0	1 to 3	3 to 6	
Count	13	24	5	42

4.4 Coursework Relevance

Selected courses from the CSM Clemson curriculum that tie up with the AC exam syllabus were added for analysis in the survey. Fourteen courses were included to understand the student perspective of courses helping to prepare for AC exam. The overall average rating for all the courses is 3.6 on the scale of 1 to 5 where 1 is representing “not well at all” to 5 representing “very well.” The average rating indicates that CSM courses align close to very well based on student perspective.

The highest average rating was observed for the course “Construction Scheduling” with a value of 4.4, and the lowest average rating was observed for “Soil and Foundations” with a value of 2.8. Table 4.7 illustrates the average rating indicating how well each course offered in the Clemson CSM program prepared the test takers for the AC exam.

Table 4.7: Average Rating for Each Course in CSM Survey

Course Title	**Average Rating**
Construction Scheduling	4.4
Construction Estimating	4.2
Safety in Building Construction	4.2
Environmental Systems	4.1
Construction Economics	4.1
Construction Project Management	3.8
Materials and Methods of Construction	3.8
Contract Documents	3.5
Introduction to Construction Science and Management	3.1
Structures	3.0
Construction Capstone	3.0
Construction Problem Solving	2.9
Competition Team	2.9
Soils & Foundations	2.8

Further, this rating selected by students was analyzed statistically by Pearson’s Chi Square test. The null hypothesis for the equation states that the exam score is independent of the 14 courses listed here. To validate the null hypothesis, the test statistic was calculated and P-value was observed for each course. In cases where the null hypothesis was rejected and the alternate hypothesis was accepted validated the influence of those courses on preparation and the score achieved by CSM students.

In this analysis, the null hypothesis was rejected for the course of "Construction Scheduling," and the alternate hypothesis was accepted. Out of 14 courses that are offered in the CSM Clemson program, one course achieved a p-value of less than 0.05: "Construction Scheduling." Validation of the alternate hypothesis explains this course's relevance and impact on the score of the students taking the AC exam. "Safety in Construction" had a low p-value of 0.05 after scheduling but it was not below the minimum probability value. The tabular representation for p-values of each course is listed in Table 4.8.

Table 4.8: Probability Value Achieved by Each Course Offered in CSM

Course Title	**Probability value**
Introduction to Construction Science and Management	0.8372
Construction Problem Solving	0.4427
Structures	0.6493
Materials and Methods of Construction	0.2833
Contract Documents	0.2637
Soils & Foundations	0.215
Environmental Systems	0.07099
Construction Estimating	0.4216
Construction Scheduling	0.01845
Safety in Building Construction	0.05033
Construction Project Management	0.7131
Construction Economics	0.6516
Construction Capstone	0.3365
Competition Team	0.2345

The student interpretation and actual impact on score have shown a clear correlation. Construction scheduling was highest rated by the test takers and in the Pearson's chi-square test, this has shown minimum p-value.

4.5 Additional Coursework for Preparation

A suggestion of adding an additional course to the curriculum dedicated for AC exam preparation was proposed to students on Yes, No, and No Opinion scale. Test takers willing to add a course had an average score of 227.2 compared to students who selected "No" and had an average score of 231.56. However, the students with no opinion had the highest average score of 243. The possibilities here are that the students who are not looking for a new course successfully utilized all the available preparation materials compared to students who still need assistance. Figure 4.8 and Figure 4.9 represent the selection frequency and average score for each selection respectively.

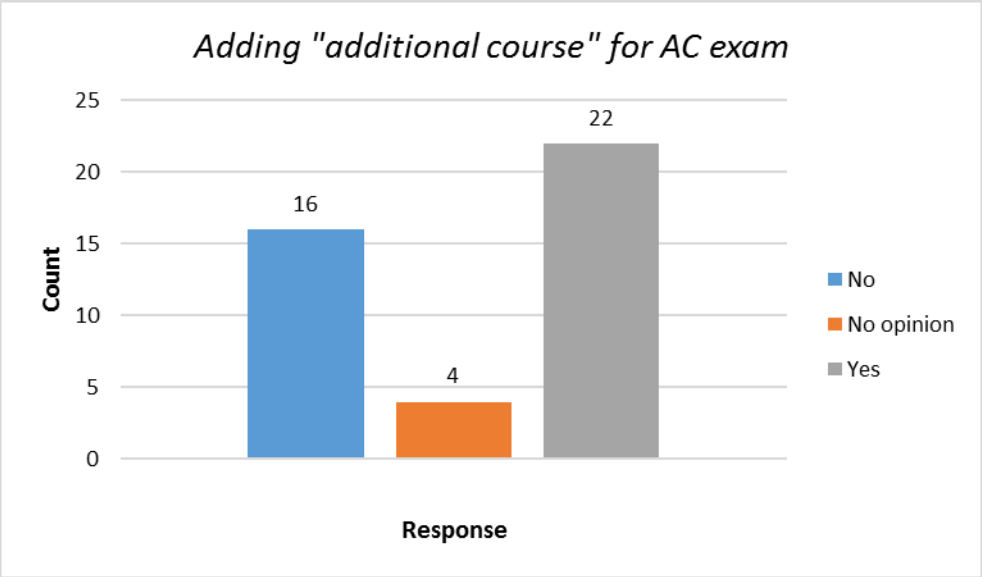

Figure 4.8: Frequency for Opinion on an Additional Course for AC Exam

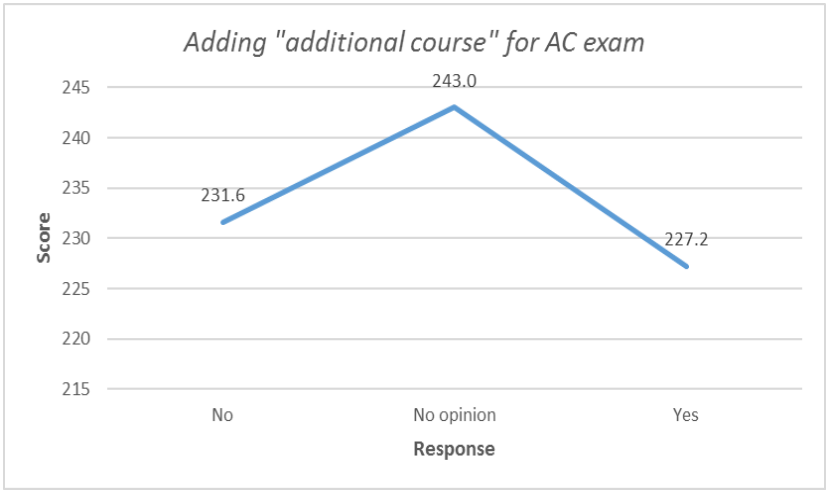

Figure 4.9: Average Exam Score for Opinion on an Additional Course for AC Exam

Overall 22 students who selected to add a course to prepare for the AC exam further checked for the preference of credit hours the course should have. Figure 4.10 represents the frequency of selected credits. A highest average score of 237.33 was observed for students selecting two credits for the course. Figure 4.11 represents the score trend for test takers selecting various credit hours.

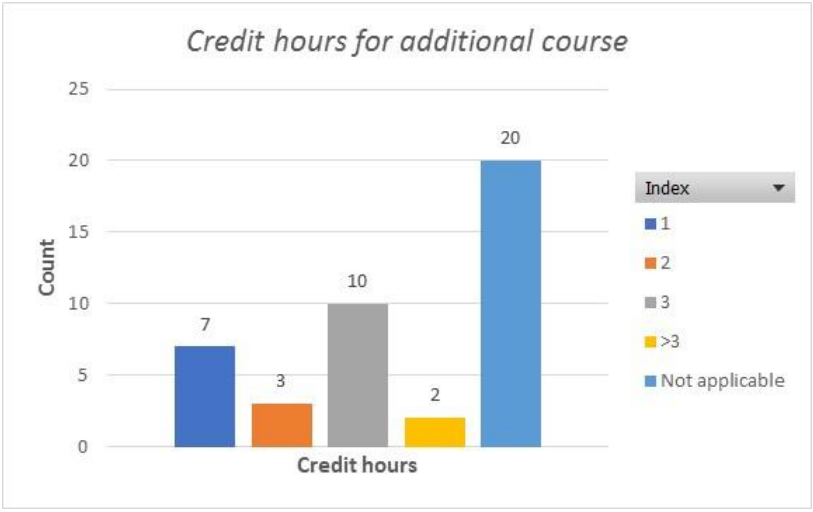

Figure 4.10: Frequency of Selected Credits

Figure 4.11: Average Score Trend for Test Takers Selecting Various Credit Hours

4.6 Online Preparation Module and Study Guide

The average selection on the scale of 1 to 5 where 1 represented "not supportive at all" to 5 which represented "very supportive," the average rating was 4.58 which indicates that most of the students are supportive of the idea of an online preparation module.

In addition, Pearson's chi-square test was conducted to find the correlation between student's perception on the value of the AIC creating an additional module of the AC exam online preparation course and their exam score.

P-value obtained for this factor is 0.22 and is greater than the minimum p-value required to have an influence on the passing score. Therefore, the scores of Clemson students taking the AC exam is not being affected by presence or absence of an online preparation course, and the null hypothesis is accepted as a variable not influencing the exam score by any means.

Clemson test takers were asked to rate how comprehensive the AC study guide was. An average rating of 3.9 was obtained based on a Likert scale response representing 1 for "not comprehensive at all" to 5 for "very comprehensive."

Pearson's Chi-Square test was conducted to further understand the correlation between exam score and student perception of the AC exam study guide. The results of Pearson's Chi-Square test gave the p-value of 0.02, which rejects the null hypothesis stating that this variable does not have any impact on the scores. An alternate hypothesis is accepted for this factor with the statement that there is a relationship between predictor and variable with a significance value of approximately 2%.

4.7 AC Exam as a Requirement to Graduate

The opinion of Clemson students was quantified with a question pertaining to the requirement of the AC exam to graduate. Fifty-two percent of the overall respondents did not think that CSM students should be required to pass the AC exam to graduate from the program. The average score is relatively lower for the students who do not support the idea of making the AC exam mandatory to graduate compared to 26% of the students who think it should be a requirement to graduate. Twenty-one percent of the students had no opinion on this question and had an average score of 233.33, close to students who would select "yes" to make it mandatory. The average scores with respect to their response selection are represented in Figure 4.12.

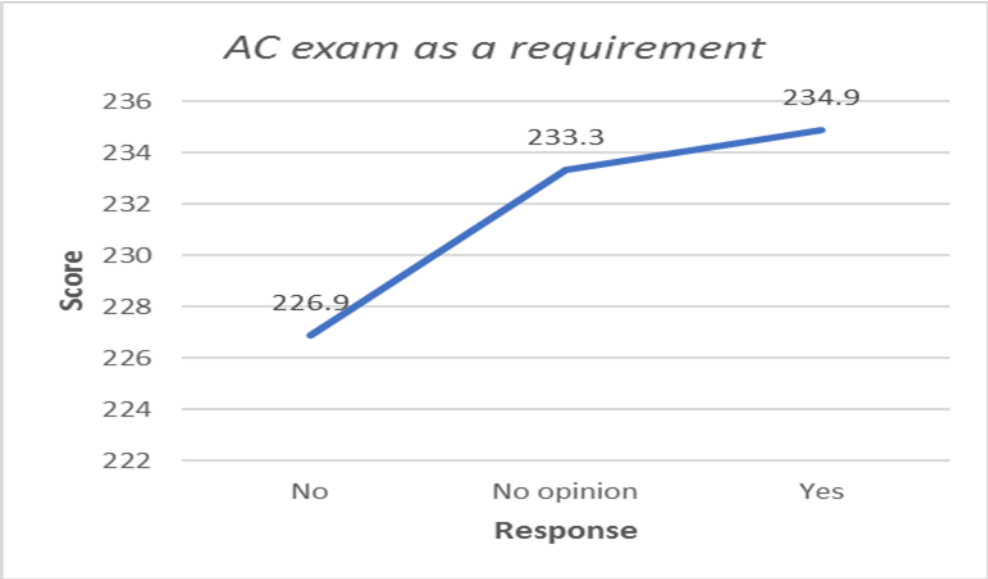

Figure 4.12: Average Score Trend for Making AC Exam Mandatory to Graduate

As the average scores indicate, the students selecting “yes” can be considered to have better preparation and are motivated to take up the exam as a requirement to graduate compared to students that have no opinion or selected “no.”

Half of the students selected an option of not taking the AC exam voluntarily if it was not a requirement by the CSM department. The average score of people saying “no” to voluntary participation is higher as compared to the students selecting “yes” to voluntary participation for the AC exam. There is a possibility of multiple reasons influencing this response but certainly, the involvement of the program to implement the AC exam for SLO can increase the number of test takers. Figure 4.13 represents the average score range of options selected by CSM students.

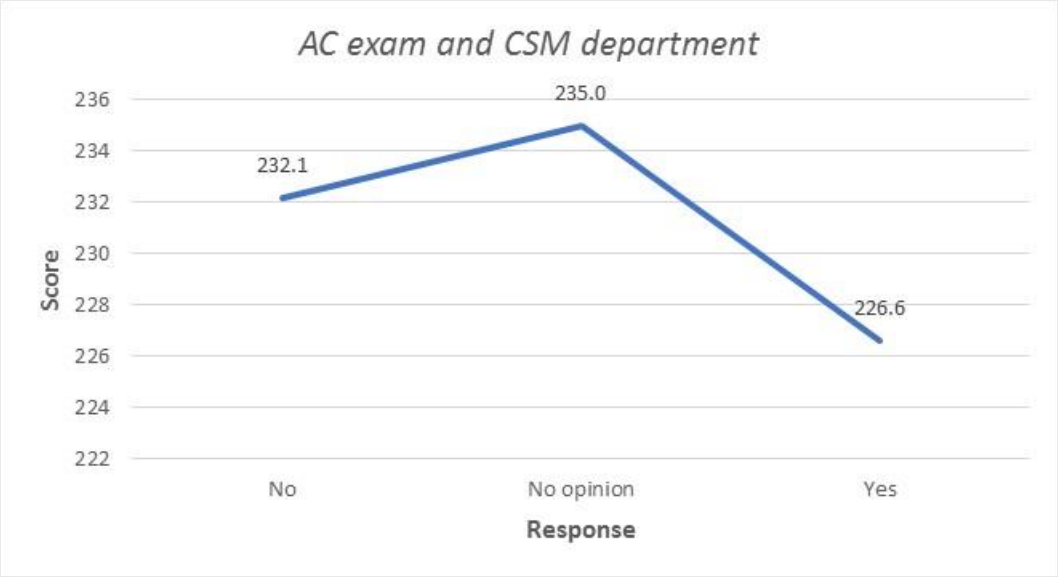

Figure 4.13: Average Score Trend for Voluntary Participation on AC Exam

Overall 86% of Clemson test takers selected the option of "yes" to prepare more if passing the exam was mandatory to graduate. However, the average score of the students has increased from 224.8 to 231.3 for those who selected the option of "no" to "yes."

4.8 GPA and Exam Score

GPA shows a direct relationship to the passing score. Clemson test takers who had a GPA of 2-2.5 scored 220.2 on an average compared to test takers of GPA 3.5-4 scoring an average of 257.2. Figure 4.14 represents the average score for students of each GPA range, and Figure 4.15 represents the frequency of selection. The results here clearly relate to the analysis done by Western Carolina University in 2012 where the statistical significance of students' record of class performance was directly related to their AC exam scores.

Figure 4.14: GPA Range and AC Exam Score

Figure 4.15: Frequency Table for GPA

4.9 Importance of AC Exam for Different Stakeholders

This question was focused on understanding the motivation level of students in the context of their perception of importance given by different stakeholders in this exam. Further, the responses were evaluated by Pearson's Chi-Square test to find out the effect on score based on their consideration of the importance of these factors.

The question asked Clemson test takers to rate the importance of the AC exam for eight different factors that oriented to academic, industry, and their personal aspects. On the scale of 1 to 5, selection of 1 indicated "not important at all" through 5 signifying "very important." The response trend indicates that the importance emphasized by academia is rated higher by the test takers with an average of 4.0 for the first four factors listed in Table 4.9.

Table 4.9: Average Rating for Each Stakeholder in AC Exam

Serial number	Exam Stakeholders	Average rating
1	CSM chair	4.2
2	CSM department	4.3
3	CSM faculty	4.0
4	CSM IAB	3.6
5	Potential employer	2.6
6	Previous employer	2.0
7	Construction industry (in general)	2.9
8	For you personally	2.9

Following that, the importance emphasized by the industry from student perspective has rated an average of 2.5. This average includes factors on serial number position 5, 6, and 7 on Table 4.9. Clemson test takers rated an average of 2.9 for the personal importance of AC exam.

After, comparing the averages Pearson's Chi-square test was conducted for eight factors listed in the table. Null hypothesis states that the exam score is independent of the selected eight variables. To validate the null hypothesis, the test statistic was calculated and P-value was observed for each factor.

In this analysis, the null hypothesis was rejected only for one factor with a p-value of 0.001. The factor is the perception of AC exam importance emphasized by the department chair of the CSM Clemson University. Table 4.10 indicates all the P-value obtained in the Pearson's Chi-Square test.

Table 4.10: Probability Value for Each Stakeholder in the Exam

Serial number	Exam Stakeholders	Probability Value
1	CSM chair	0.001
2	CSM department	0.14
3	CSM faculty	0.15
4	CSM IAB	0.16
5	Potential employer	0.57
6	Previous employer	0.66
7	Construction industry (in general)	0.92
8	For you personally	0.55

Students' perception of the AC exam importance given by school leadership impacts their scores in a very significant manner. Although, there is a clear gap in importance given by students and industry compared to academia as rated by the Clemson test takers in their response to each factor.

4.10 Significance of the AC Exam for Employment Opportunities

This question was focused on understanding the motivation level of Clemson test takers based on the presumed importance of the AC exam score in the different context of

employment. Further, the responses were evaluated by Pearson's chi-square test to find out the effect on exam score based on their consideration of the importance of these factors.

The question asked Clemson test takers to rate the importance of the AC exam for five different factors that focused on employment opportunities and professional growth. On a scale of 1 to 5, selection of 1 indicated "not important at all" through 5 signifying "very important." The average rating calculated for Clemson test takers signifying the importance of the AC exam in getting employment opportunities and professional growth was 2.5. Table 4.11 denotes the average rating for each factor considered in this question.

Table 4.11: Rating for Factors Focused on Employment Opportunities

Serial Number	Factors	Average Rating
1	Inclusion of resume	3.41
2	To achieve professional goals	2.67
3	Number of employment offers	2.18
4	Promotions	2.16
5	Starting salary	2.13

Interestingly, the average rated value of 2.5 exactly corresponds to the importance emphasized by the industry from student perspective in the "importance of the AC exam to stakeholder" section. This similarity is because of these motivational factors directly relating to the construction industry.

After comparing the averages, Pearson's Chi-Square test was conducted for five factors listed in the table. The null hypothesis states that the exam score is independent of the selected five variables. To validate the null hypothesis, the test statistic was calculated, and P-value was observed for each factor. In this analysis, the null hypothesis was not

rejected for any factor. Table 4.12 indicates all the p-value obtained in the Pearson's Chi-Square test.

Table 4.12: Probability Value for Each Factor Relevant to Employment Opportunities

Serial Number	Factors	Probability Value
1	Starting salary	0.4619
2	Number of employment offers	0.6191
3	Promotions	0.8574
4	To achieve professional goals	0.9186
5	Inclusion of resume	0.3695

Industry emphasizing the importance of the AC exam affects the other motivational factors relating to employment opportunities. This is clearly shown by an exact similar average of 2.5 for the importance emphasized by the industry from student perspective of employment-related factors analyzed in this question (Table 4.9). The average rating will be considered as moderate because it is 50% on the Likert scale given in the survey.

4.11 Section 2 – Test Taker Survey

The AC exam survey was given to students at the end of the exam in the presence of a proctor. It was attached to the last page of the answer sheet. Total population of this survey was 649 with response rate of 74.7%. The survey had eight questions and additionally five feedback questions. The observations were statistically analyzed by three different methods: Stepwise regression method, Pearson's Chi-square test, and Frequency tables. The method of application followed by findings from each analysis is explained further.

4.12 Stepwise Regression Method

Stepwise selection involves analysis at each step to determine the contribution of the predictor variable entered previously into the equation. By this method, it is possible to understand the contribution of the previous variables now that another variable has been added. The process of forwarding stepwise regression systematically adds the most significant variable. Whereas, the process of backward stepwise regression removes the least significant variable during each step.

Adjusted R^2, Mallow's C_p, and Bayesian Information Criterion are the three parameters that were considered in selecting the best regression model. The value of adjusted R^2 has been considered to evaluate the findings because the results demonstrated the impact of more factors compared to the other two parameters.

The process of analysis is automated in statistical tools. The correlation between survey questions and pass score was established during survey design framework explained in the previous chapter. Now, the correlation will be tested by stepwise regression to identify the factors influencing the passing score.

The stepwise regression was applied for eight different combinations based on the nature of questions. A total of 16 models was prepared against factored pass or fail status and categorical scores respectively.

The survey had 649 observations, but there were missing values where the students had not responded to all the questions in the survey. For the analysis, any record having at least one missing value was removed. The missing rows of data constituted around 30% of the data set, so if the missing values were considered as "X," it would constitute a large

portion of the data, and the model will be influenced by this category. The missing observations are not included to reduce the bias caused due to this new category. A total number of observations included in the analysis was 475.

The student survey data was analyzed in "R." R is an open source statistical tool, widely used for data analysis and machine learning. The data was converted to a "Model Matrix" to execute stepwise regression on R. Total coefficient value of the equation was 216.29. Inferences from the coefficient value for each factor is explained with respective values further illustrated in tables. Figure 4.16 graphically represents the values of regression coefficients.

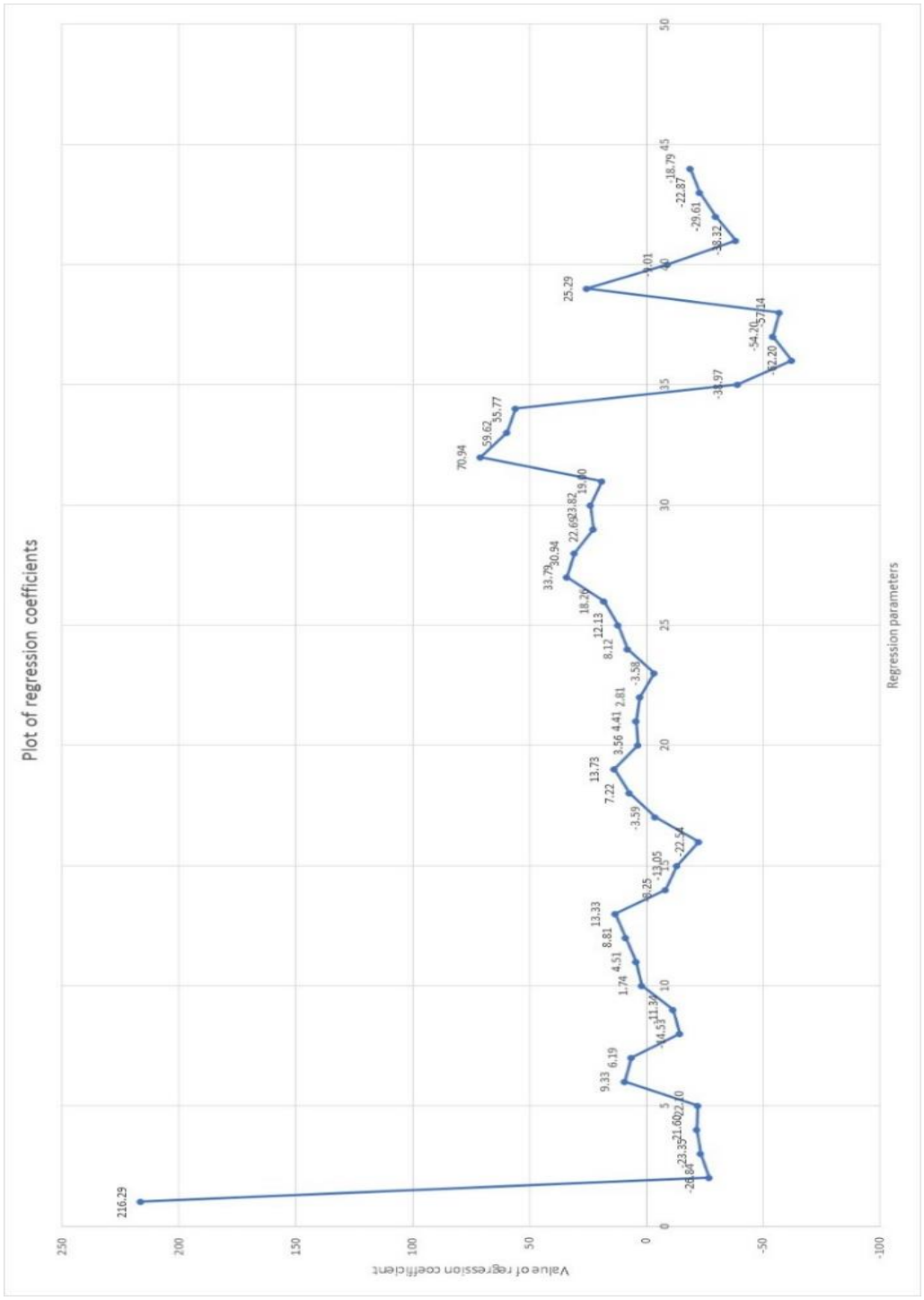

Figure 4.16: Plot of Regression Coefficients

Findings have been evaluated from the coefficients of the best model selected. The best model has a highest adjusted R-squared value of 0.21 (Figure 4.17) and highest R-squared value of 0.29. It includes eight survey questions along with five feedback questions against the exam score of all the survey takers.

From the best model equation which eliminated the factors not affecting the scores at all, the following conclusions can be drawn:

"Review Session Hours" reveal that they have a considerable negative impact on the score of the students. As irrespective of the option selected by the test-taker, all the values of coefficients are negative (Table 4.13).

Table 4.13: Coefficients for Review Session

Names	Coefficients
ReviewSessionHours>6	-26.8372
ReviewSessionHours1-3	-23.3467
ReviewSessionHours4-6	-21.5951
ReviewSessionHoursNo	-22.098

"Exam Study Hours" has a more positive effect on the scores of the students than those who did not study at all. As per the response set fitting in the best regression model, the number of hours invested in studying should be five or more hours to have a positive impact on scores. If the test taker selected the option of not spending any time on preparation outside the structured course or review sessions, it has a clear negative impact on the test score, but less than 1 to 4 hours had no effect on the performance. Table 4.14 illustrates the coefficient values.

Table 4.14: Coefficients for Exam Study Hours

Names	Coefficients
ExamStudyHours>8	9.330928
ExamStudyHours5-8	6.187863
ExamStudyHoursNo	-14.5308

"Personal importance of exam" has a mixed impact on the overall score. It has a negative impact on the score for respondents who selected "Slightly Important," but it has a positive impact for those who said "Very Important." This indicated that the test takers who have the high self-motivation to take the test perform better in the exam. Values are represented in Table 4.15.

Table 4.15: Coefficients for Personal Importance of Exam

Names	Coefficients
ExamImp_Personal2	-11.3405
ExamImp_Personal4	1.743153

"Program's importance of exam" has a positive impact on the overall score of students. There is a steep rise in scores of students selecting slightly important for the program to very important for the program with coefficient values given in Table 4.16. This leads to the conclusion that students who consider that their performance in the AC exam is important for their construction management course to tend to score higher; and therefore, it is important for schools to keep their students motivated.

Table 4.16: Coefficients for Program's Importance of Exam

Names	Coefficients
ExamImp_Program2	4.510889
ExamImp_Program3	8.809242
ExamImp_Program4	13.33084

"Companies' importance of exam" has an overall negative impact on the score of a student. Therefore, it can be said that the students who give much importance to the AC exam with the intent of getting hired by construction companies have their test score impacted in a negative way. This also indicates that the industry participation to acknowledge the AC exam for recruitment purposes is not beneficial with the observed statistics. The student's motivation and test score in this context are inversely related Table 4.17.

Table 4.17: Coefficients for Company's Importance of Exam

Names	Coefficients
ExamImp_Companies2	-8.24882
ExamImp_Companies3	-13.0471
ExamImp_Companies4	-22.5442

"Similarity of Course" has an overall positive effect on the score of the students. Students who felt that the concepts tested in the AC exam and the materials taught in the course were "Similar" and "Very similar" had a positive effect on their scores. For those who felt it "Slightly similar," it had a negative impact on their scores. This suggests that the alignment of course content with subject areas in the AC exam can significantly improve the performance of test takers as per the coefficient values in Table 4.18.

Table 4.18: Coefficients for Similarity of Coursework

Names	Coefficients
Similarity_Course2	-3.59106
Similarity_Course3	7.216995
Similarity_Course4	13.7284

"Useful Study Guide" Test takers who did not use the study guide also had a positive effect on the score, but test takers who eventually found it slightly useful and useful had a higher positive effect on their test scores. However, selection of finding the study guide "not useful" or "very useful" is not included in the regression. Exclusion of these two options in the regression equation explains that the study guide reference influences the score in a positive manner but does not impact the scores at all if it is referenced too much or not at all, Table 4.19.

Table 4.19: Coefficients for Usefulness of Study Guide

Names	Coefficients
Useful_StudyGuide2	3.557338
Useful_StudyGuide3	4.412295
Useful_StudyGuideNo	2.812629

"Useful Online Tutorials" has a positive effect on the scores, except for test takers who selected the option of "Not useful" in the survey. There is an increase in coefficient value for test takers finding the online tutorial slightly useful to very useful. The results indicate that online tutorials have a promising impact on the performance of students, Table 4.20.

Table 4.20: Coefficients for Usefulness of Online Tutorials

Names	Coefficients
Useful_OnlineTutorials2	-3.5798
Useful_OnlineTutorials3	8.117407
Useful_OnlineTutorials4	12.12683
Useful_OnlineTutorialsNo	18.26322

"Registration Process" and "Site Location" had a strong positive effect on the model score. Although "Unsatisfied" also has a positive impact, it is interesting to note that "Neutral," "Satisfied," and "Very satisfied" have a strong effect on the scores of the students. Table 4.21 illustrates the coefficient value for each option.

Table 4.21: Coefficients for Exam Registration Process and Site Location

Names	Coefficients
EvalExamRegProcess2	33.79364
EvalExamRegProcess3	30.93533
EvalExamRegProcess4	22.69497
EvalExamRegProcess5	23.8194
EvalSiteLocation2	18.99989
EvalSiteLocation3	70.93699
EvalSiteLocation4	59.62217
EvalSiteLocation5	55.76662

"Room condition" has a strong negative impact on the model score. Thus, irrespective of the options selected, it will always have a negative effect on the score. "Proctor Preference" has a mixed influence on the model score. "Overall Experience" has a considerable negative effect on the model score, irrespective of the options selected by the students. Table 4.22 represents coefficient values for three factors described here.

Table 4.22: Coefficients for Room Condition, Proctor Performance,

and Overall Experience

Names	Coefficients
EvalRoomcondition2	-38.9652
EvalRoomcondition3	-62.2013
EvalRoomcondition4	-54.2016
EvalRoomcondition5	-57.1367
EvalProctorPerf2	25.2893
EvalProctorPerf4	-9.01243
EvalOverallExp2	-38.3213
EvalOverallExp3	-29.6117
EvalOverallExp4	-22.8662
EvalOverallExp5	-18.7927

4.13 Adjusted R-squared

R-squared is a measure to define how well any linear model fits a set of observations. R-squared provides an estimate of the strength of the relationship between the model and the response variable. The adjusted R-squared is a modified version of R-squared that has been adjusted for the number of predictors in the model. The adjusted R-squared increases only if the new term improves the model more than would be expected by chance. It decreases when a predictor improves the model by less than expected by chance.

4.14 Reasons for 0.21 Adjusted R-Squared

Generally, in the case of human behavior, the predictors are unlikely to be very closely related to the outcome, as there are multiple factors that can affect the equation. This study focuses on the behavioral aspect of students in terms of preparation methods

and motivation and in a psychological scale, part of adjusted R-square value is always going to be measurement error.

The nature of factors included in this survey is categorical and the number of rows for analysis was relatively low. That affects the adjusted R square value.

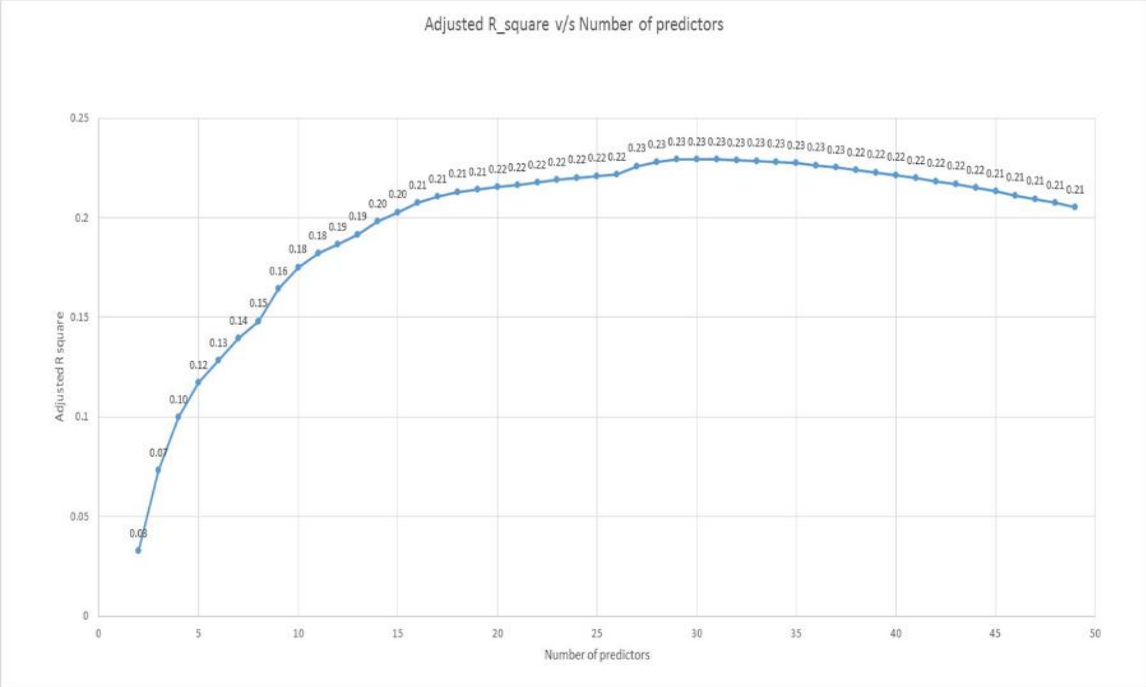

Figure 4.17: Adjusted R-Squared

4.15 Pearson's Chi-Squared Method

Chi-squared test is also referred as Pearson's Chi-Squared test. It is carried out to conclude if there is any significant difference between the expected frequencies and the observed frequencies in one or more categories. The test is used to validate the null hypothesis. According to the null hypothesis, the frequency distribution of event(s) seen in

a sample is same as that with the theoretical distribution. Pearson's Chi-Squared test can be used for measuring the goodness of fit, homogeneity, and independence.

To determine, whether there is any relationship between the outcome and the observed distribution hypothesis testing is done. It includes null hypothesis (H_0) and alternate hypothesis (H_a). The null hypothesis states that the outcome/result is independent of any variable and is itself responsible for the outcome. To validate the null hypothesis, the test statistic is calculated. P-value (probability value) is the probability, under the assumed hypothesis (H) of obtaining an outcome same as or more extreme than the actual observed ones.

The smaller the p-value, the larger is the significance of the predictor/variable. As it leads to conclude that the null hypothesis (H_0) under consideration might not hold well, and it is rejected. The significance level is usually chosen at 5% or 1% and is denoted by α. When the P-value is less than α, the null hypothesis is rejected and the alternative hypothesis is accepted. This leads to the conclusion that there is a relationship between the predictor and the outcome.

The null hypothesis is valid if the observed outcome falls within the 95% of the distribution. If the outcomes fall outside the 95% distribution, it becomes statistically significant. Choosing the significance level depends on the user and the work involved. The calculation has been based on pass/fail status of the student as the responses here are categorical in nature.

Here in the survey data, the predictors that had a p-value less than 0.05 (significance level of 5%) are listed in Table 4.23. These values signify influence of these seven factors on the passing score of a test-taker.

Table 4.23: Factors with Probability Value Less Than 0.05

Factor	Probability value
Exam Study Hours	0.006782
Exam's Personal Importance	0.04323
Exam's Program Importance	0.008676
Course Similarity	0.0224
Study Guide Usefulness	0.006943
Online Tutorials Usefulness	0.04674
Overall Experience	0.04006

4.16 Frequency Table

A frequency table is explained for eight survey questions. The total number of responses is 435 which includes 293 candidates that achieved the passing score and 142 students who failed. In fall of 2016, the pass percentage was 67% considering the respondents who answered all the questions.

Review Session Hours

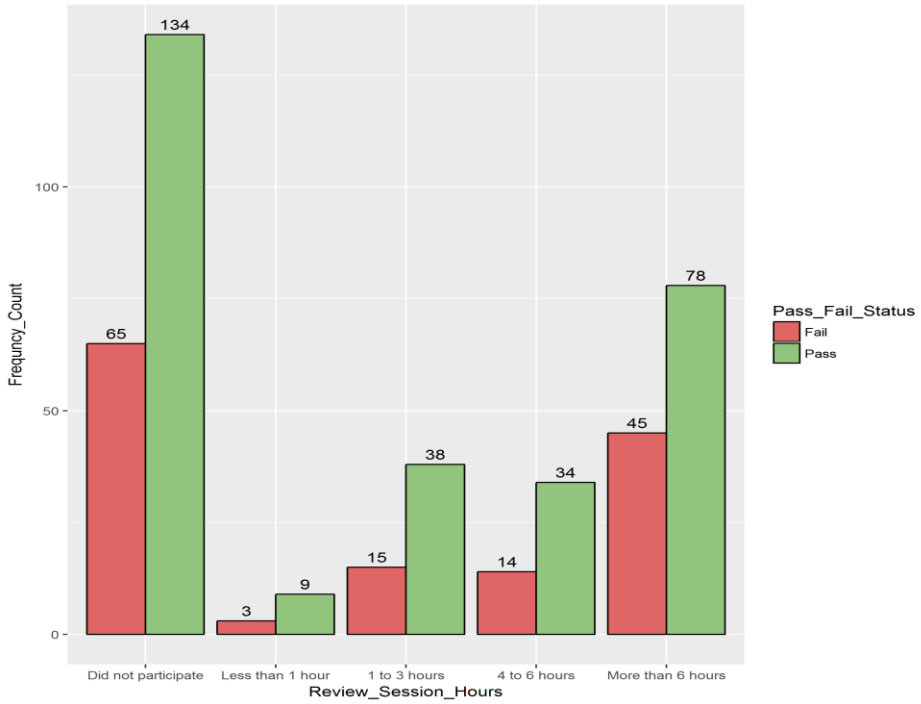

Figure 4.18: Frequency Table for "Review Session"

When compared with department head response, most of the schools did not conduct a review session; the percentage of students attending them is very low (i.e. 199 out of 435). Also, the Maximum pass percentage of the students is recorded who attended sessions for less than 1 hour. Here, the trend of pass percentage increases only from the option of did not participate in less than 1-hour participation and it drops consistently until the option of more than 6 hours. Consequently, no specific trend is identified to make conclusions on this factor. As per stepwise regression and chi-square test, this factor does not have any impact on the passing score which is further validated by frequency table analysis.

Exam Study Hours

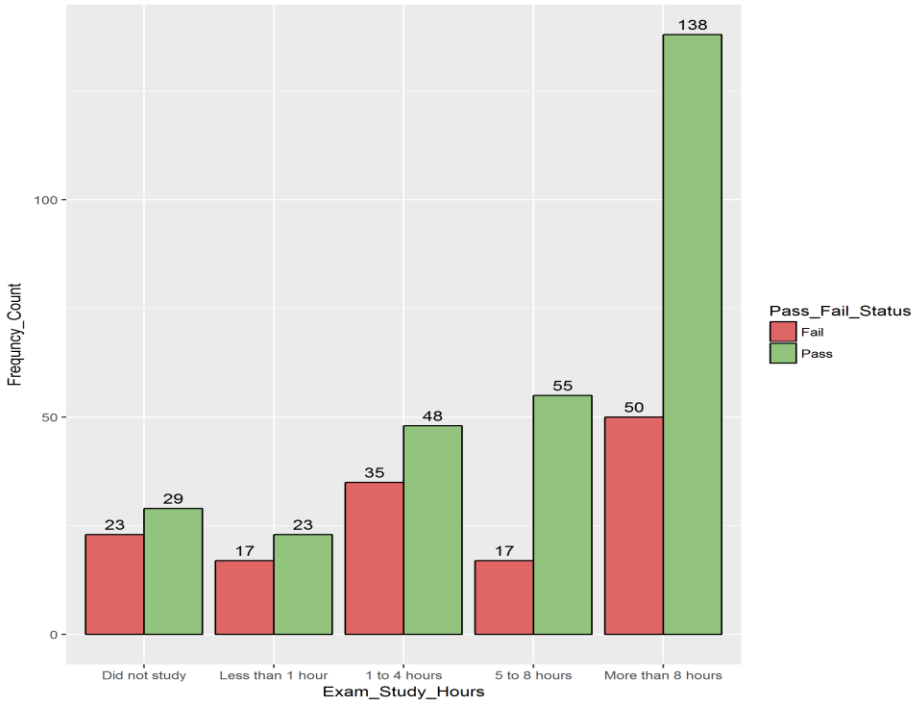

Figure 4.19: Frequency Table for "Study Hours"

The maximum difference in pass-fail percentage was observed at the study duration of 5 to 8 hours: 76.3%. Also, the pass percentage showed steep rise till it came down to 73.4% at study hour range of more than eight hours. Based on the results of chi-square and stepwise regression equation, this factor is significant to the passing score of the student and steep rise trend shows the same result, implying significance.

Personal Importance of the Exam

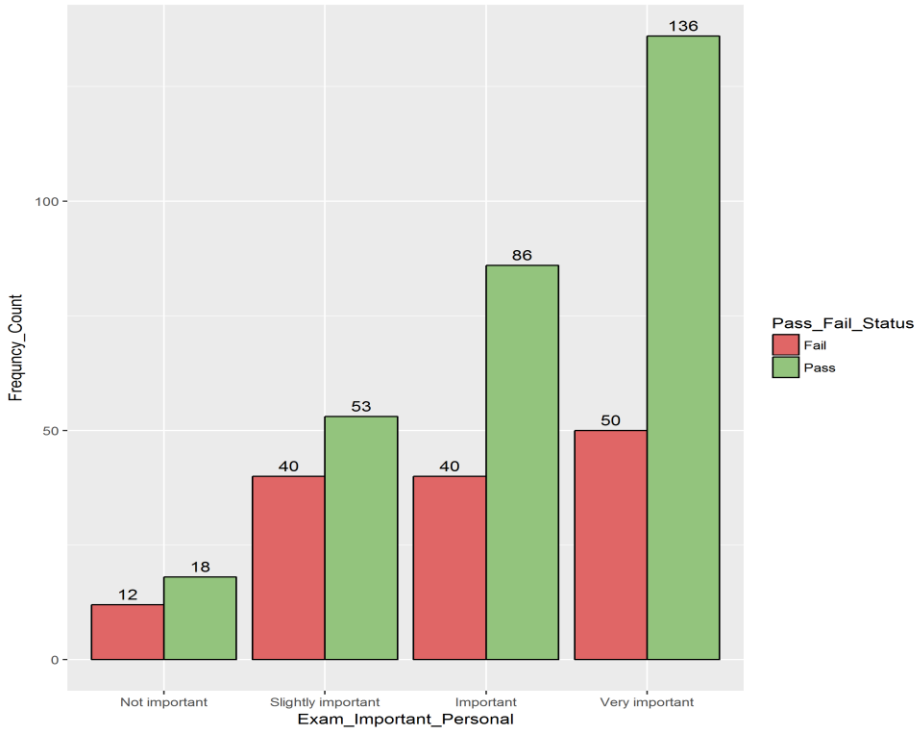

Figure 4.20: Frequency Table for "Personal Importance"

Here, 45.7% of test takers considered the exam very important personally and had the highest pass percentage of 73.1%. This indicates that the level of motivation highly influences the performance. Students who considered the exam as not important or slightly important had a pass percentage of 58%. This is a factor influencing the student performance.

Importance of Exam to the Program

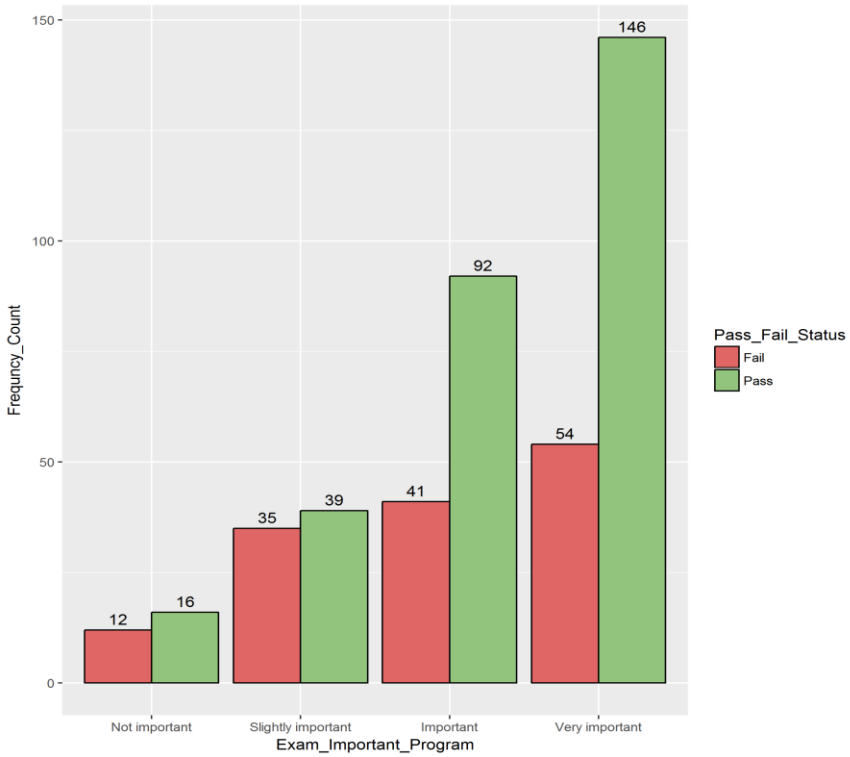

Figure 4.21: Frequency Table for "Program's Importance"

The trends show a steep increase in pass percentage of students understanding the importance of the AC exam for their program. This suggests that the student motivation relatively improves based on the level of importance pursued by the department. Pass percentage increased from 54.95% to 73.78% for the first two options of "not important to slightly important" to "important to very important" respectively.

Importance of Exam for the Companies

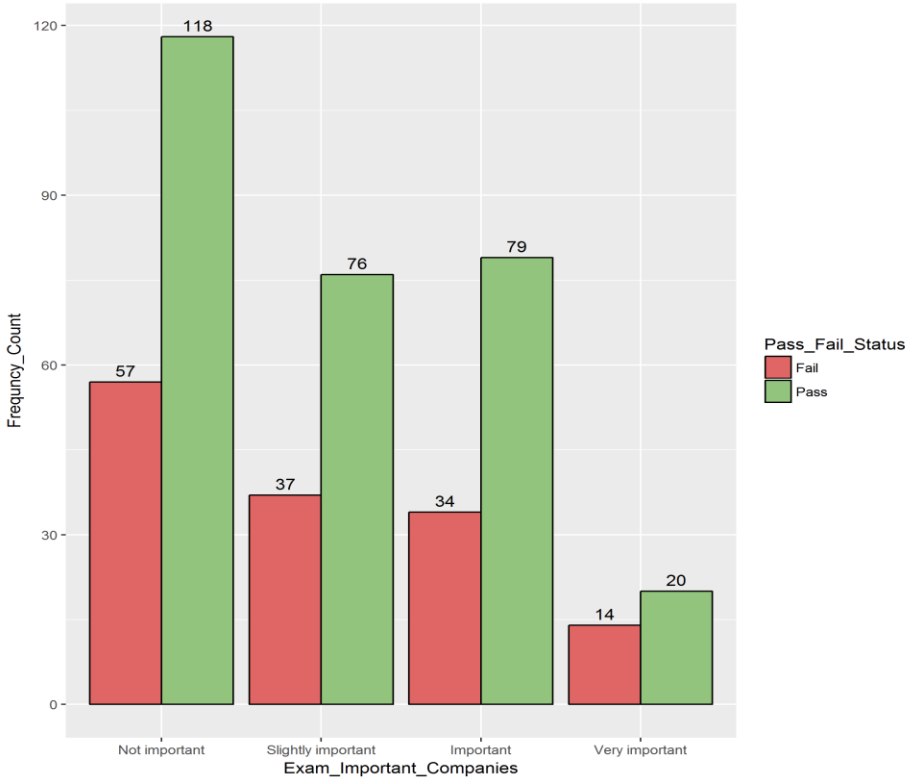

Figure 4.22: Frequency Table for "Companies' Importance"

Maximum pass percentage is observed for the set of respondents who selected the option of "important." However, the trend for overall pass percentage reflects a steep drop in passing percentage of the students: from low to high. Also, 175 out of 435 respondents think that it is "not important" for the companies. Conclusion would be the factor is not influencing the passing score, which is again validated by the other two tests.

Similarity of Course

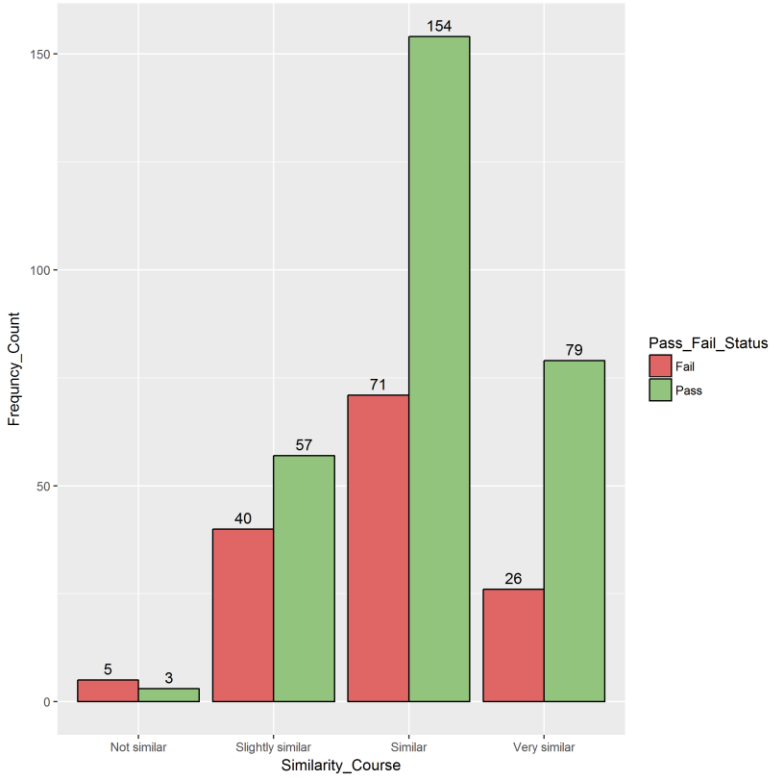

Figure 4.23: Frequency Table for “Course Similarity”

For this particular factor, overall pass rate has steep growth of pass percentage: 37% to 75.2%. This represents that high similarity of course material with the AC exam syllabus improves the pass percentage. A total of 330 out of 435 test takers selected the option of “similar” and “very similar” to this question.

Useful Study Guide

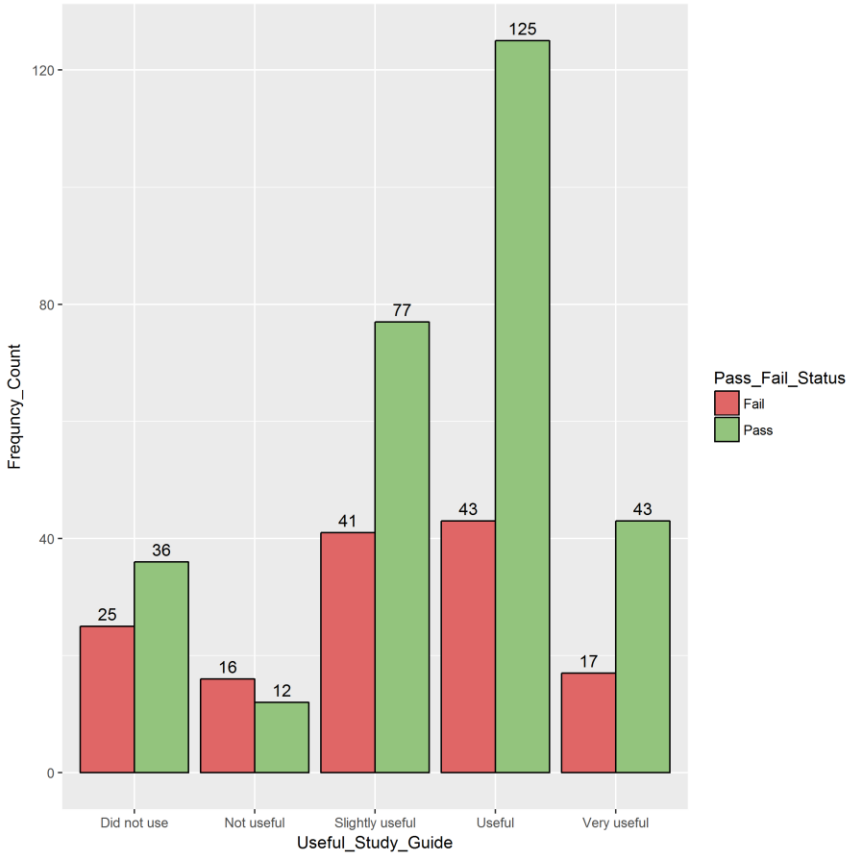

Figure 4.24: Frequency Table for 'Usefulness of Study Guide'

Total of 83.5% of the students who passed the exam have rated study guide from slightly to very useful. The gap in the number of students on pass-fail percentage gap has significantly increased from an average of 16% for students who selected the option of "did not use" and "not useful" to 40.8% for students who selected the last three options. This explains the importance of the study guide as a preparation material, followed by its impact on pass rate.

Online Study Guide

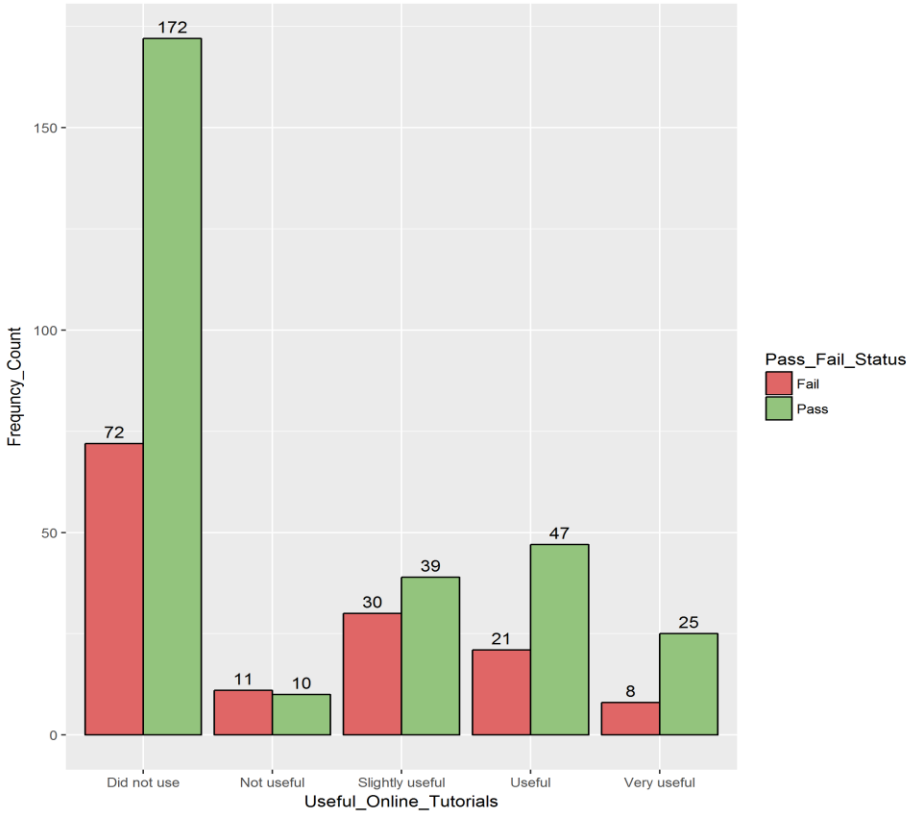

Figure 4.25: Frequency Table for "Usefulness of Online Tutorials"

Two hundred and forty-four out of 435 test-takers did not know about the online tutorials. However, as per the frequency table, the results show that pass percentage for students who selected "not useful" to "very useful" went up from 47.6% to 75%. Therefore, the use of online tutorials has promising results if used properly.

4.17 Section 3 – Department Chair Survey

A total number of responses received for this survey is 26. Total population of this survey was 66 with response rate of 39.3%. There were two different respondents from the same schools. In questions where they had the same response because of similar academic

programs, the total number of responses is 24, but in the open-ended questions or opinion-based questions, the total number of schools is 26. Nine programs did not have test takers for fall of 2016, and scores are not provided to match up results. Fifteen schools have the student results to compare with the department chair response.

4.18 Accreditation and Student Capacity

Twenty-one out of 24 schools participating in the survey are accredited with ACCE. Two schools are accredited by ABET, and one was not accredited. One school had additional accreditation of IFMA Foundation along with ACCE.

Table 4.24 represents the frequency of a total number of undergraduate students enrolled in the program. Maximum frequency was recorded for enrollment capacity of student number between 100-200 followed by capacity between 300-400 students. This explains that maximum department chairs participating in the survey were leading medium-sized schools based on student intake.

Table 4.24: Frequency of Enrollment

Frequency	Student Capacity
2	Less than 100
8	Between 100-200
4	Between 200-300
5	Between 300-400
1	Between 400-500
3	More than 500
1	Not specified

4.19 Department Support for AC Exam

In this context, three different questions were asked in the survey. The first question checked with the departmental mandate of taking the exam. Seventeen out of 24 department chairs selected “Yes” to this question. Six selected “No,” and one department chair did not respond to the question.

Participants who selected “No” to the previous question were directed to another page that had additional questions on their understanding of primary reasons for students to sit for the AC exam. Afterward, they had a five point Likert scale question on how strongly they encourage the students to take the AC exam.

For the primary reasons, only two participants selected the provided options. One respondent checked the option of “perceived value to the employers” and other respondent selected “personal achievement” as the reason for students sitting to take the exam. However, in the open-ended response section, three participants typed in where one of them talked about the importance of the AC exam as an internal validation for ACCE SLO’s, and another response mentioned the AC exam being tied to a course that can help students earn extra credit. One department chair mentioned that the students have never participated in the AC exam.

On the Likert scale of 1 to 5, where 1 represented “not encouraged at all” to 5 representing “highly encouraged,” the department chairs selected an average rating of 2.2 on the scale. The seven department chairs who responded to this question have not mandated the AC exam for the students. Figure 4.26, represents the selection pattern.

The pass percentage of the test takers was higher for school departments where chairs rated 3 and 4 compared to chairs rating 1 and did not encourage the exam at all. Schools who rated 3 and 4 had pass percentages of 55% and 67% respectively.

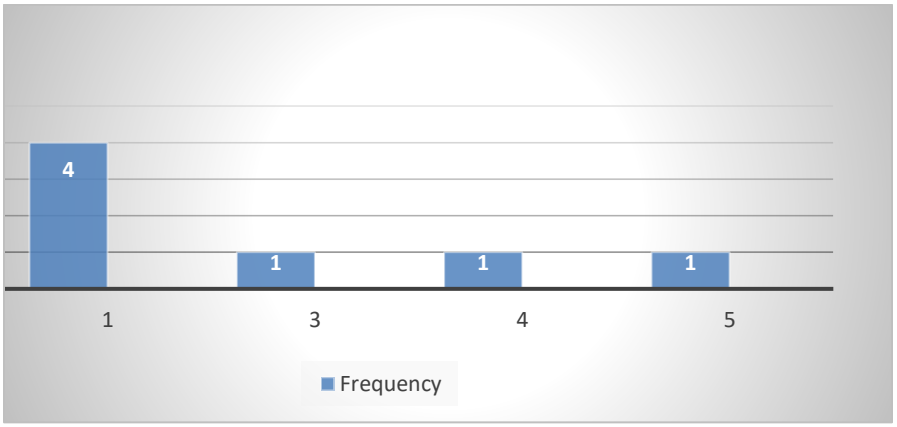

Figure 4.26: Selection Pattern

4.20 AC Exam and Graduation

In this section, two questions were designed. First, "Do the students in your program need to earn a minimum score on the AC exam to graduate," followed by required minimum percentage if respondents selected "yes" to the last question.

Six out of 24 participants selected "Yes," and 18 out of 24 participants selected "No." Based on available data, average pass percentage for the schools selecting "yes" is 61% and for "no," it is 69%.

Seventy-one percent is the average of minimum percentage required by six schools who selected "yes" to the previous question. This relates to the actual percentage required to pass the AC exam. Therefore, the schools who require students to earn a minimum score

on the AC exam to graduate, statistically require the students to pass the exam, as 70% is the passing score required on AC exam.

The comparison with student performance suggests that the schools who had a requirement to earn a minimum score on the AC exam to graduate showed lower pass percentage compared to schools who did not have this requirement.

4.21 AC Exam and Course Grade

Few questions were added to see the present practices interrelating AC exam scores with grades in existing courses. The first question was if the AC exam scores are incorporated into a course grade; the department chairs who selected "yes" further answered to how the scores are being incorporated.

Fifteen schools out of 24 responses with an average pass rate 66.2% are incorporating the AC exam scores into the course grade. Six out of 24 schools are presently not incorporating the AC exam scores with the pass percentage, and none of them participated in the exam.

Three department chairs selected the option of "other" and their typed in responses are quoted in Table 4.25 along with the results of school. Based on the results maximum schools have AC exam scores incorporated to the course grade.

Table 4.25: Quoted Response of Department Chairs about Incorporating AC exam in Course Grade

Pass percentage	Response
67%	Not yet, but we hope to make the AC Exam a graduation requirement in the near future.
73%	We have created a Pass/Fail course.
Data unavailable	We are experimenting with our Capstone to make it part of the course and part of the grade. Normally the Proj Mgt course uses the exam for extra credit.

Table 4.26 represents the frequency of options selected by department chairs on incorporating the AC exam as a part of the course grade. Most of the selections were made in a combination of given options, but "score accounting for a percentage of course grade" had maximum selections overall. By average sampling, 25.3% of the course is being accounted by the AC exam for the schools who selected that option.

Table 4.26: Frequency of Options Selected on Incorporating the AC Exam as a part of Course Grade

	Incorporated as final exam	Passing exam is requirement to pass the course	Score accounts for a percentage of the course grade
Frequency	2	5	13

Two department chairs had an explanation on how the AC exams are being incorporated into the course grade. Quoted responses are mentioned below.

"The class is a required one-credit class that prepares students to take the exam. If a student receives a score of 60% or better on the exam the students pass the class. If not,

the student does not pass the class (pass/fail to grade) and the student will not graduate. However, students can, and do, retake the exam."

"A small percent of the final grade in one course is based on passing the AC exam. This year onwards the students in this course must pass both of the course exams with 70%. If they do not achieve 70% on one of the course exams, they must pass AC exam to pass this course which is required for graduation."

4.22 Departmental Assistance to Prepare for the Exam

Additional assistance from the program was another factor listed under the section of preparation material. Department chairs selected "yes" or "no" for assistance in the form of in-class sessions and optional outside the class review study sessions.

"No" was selected by six schools, and their pass rate is 53.5% on an average. Eighteen schools have additional assistance to prepare for the AC exam, and the average pass rate is 68.3%. There is a difference in average pass percentage but the number of responses in both the options has a huge difference, as 74% of the schools are providing additional preparation assistance to test takers.

All the 18 department chairs who selected "yes" further answered questions on specifics of the assistance being provided by the department for AC exam. Specifics are as follows:

Unique Course for AC Exam

Fourteen out of 18 schools do not have a unique course number for preparing and taking the AC exam. There are four schools who have a unique course for the AC exam. A

comment for one school, which does not have a course for preparing and taking the AC exam read as follows, “It is part of a course that contains multiple assessment measures.”

Time Devoted During an Existing Course

Eleven out of 18 schools devote time during an existing course to prepare students for the AC exam. An average of 13.5 hours of in-course class time is provided by these 11 schools and the average pass rate is 70.1% as per the available score data. Seven schools do not devote any time in existing courses with an average pass rate of 68%.

Outside the Classroom, Instructor-Led Preparation Classes

This preparation assistance is being provided just by one school, and 17 schools marked “No” for the availability of this resource.

Other Resources Provided by Programs

In this open-ended question, five department chairs provided different responses. The majority of the responses were focused on the level of support for the exam/registration fee, review sessions for preparation, and providing information on AC exam preparation material provided by AIC. One response was, “We are always looking for means to motivate students to do well, and are looking for ideas.”

4.23 New Study Guide

A new comprehensive study guide has replaced the old study guide recently. The level of satisfaction of department chairs with new study guide was compared on the scale of 1 to 5. Where 1 represents “not satisfied at all” and 5 represents “very satisfied.” The average rating received by the respondents was 3.6 on a scale of 5. Also, five respondents selected the option “don’t know” for the new study guide.

Many suggestions were provided for the improvement of the study guide. They are cataloged in Table 4.27.

To summarize the table there are a few points:

- Department chairs are seeking some level of standardization in project management practices that are explained in the AC exam study guide.
- More practice questions at the end of every chapter.
- Suggested improvement in the scope of mechanical and alternative project delivery methods.
- Misinformation amongst students that the AC exam pattern has changed as per comprehensive study guide.
- Exam questions should align with the new study guide.
- Tie more to the student learning outcomes.
- Existence of online practice exam on the website.

Table 4.27: Quoted Suggestions for Improvement of Study Guide

Clear Examples of Typical Problems Presented on the Test
Still in the process of getting information on the new study guide.
Many sections of the guide along with sections of the exam are not universal in the industry. This is very evident in the roles, titles, and positions sections. All companies handle this a little differently, specifically where the responsibilities differ in an assignment in an estimator, PM, PE, and a super by the company and it would also depend on if you were in a union area vs a right to work area concerning other job titles and responsibilities. The previous exam guide seemed more comprehensive than this streamlined version. Haven't decided if that is better or worse yet. Will have to see several semesters of scores to compare. As far as the reference list goes our program along with many others, based on conversations use different texts to teach the material during the BS program. That would likely have an effect on the outcome and the familiarization to some of the material or variation in some concept instruction.
Perhaps by adding more questions at the end of each section.
Have some issues with content of study guide. For example, teaching the psychrometric table in the mechanical section is total waste of time. That tool is used for design, not something our Construction Managers will be required to perform in the field. Also, content of Alternative Project Delivery Methods not consistent with body of knowledge. Agency CM or Construction Manager-Agent is not a delivery method, it is a management strategy. Also, Job Order Contracting not listed as a delivery method and it is probably most widely used Alternative Method across the country in terms of completed projects.
Students tend to think that the AC exam has been modified since the study guide was shortened. We find that we have to use the old study guide to make sure they know that the exam has not changed. We think this is something that we need to explain in more detail with the new guide in our class. This is the first class we have taught with the new guide. We would like to see the communications between PTC and the students in terms of training materials. We have been told that one student received a practice exam, if so we would like to incorporate it into our class.
I believe it is much improved over the previous long study guide. This one is concise. Faculty have mixed reviews. I am very satisfied with portions relevant to my classes. Some faculty have indicated that they disagree with some of the sample question answers, or some questions are subjective. I haven't heard many student views on it.
The questions need to align with the new guide, not the old one.
Tie more to the SLO's
It would be helpful to have a online practice exam on your website.

4.24 Online Study Guide

Online study guide was launched as a beta trial version on AIC website before 2016 fall exams. This is a relatively new preparation material. The level of satisfaction of department chairs with the online study guide was compared on the scale of 1 to 5, where 1 represents “not satisfied at all” and 5 represents “very satisfied.” The average rating received by the respondents was 3.4 on the scale of 5. Also, being a very recent addition to preparation material, 14 participants selected the option of “don’t know.”

Table 4.28 catalogs suggestions from department chairs on the online study guide. Mainly all the suggestions and responses trend on the online study guide exhibit lack of awareness about the availability and access of study guide.

Table 4.28: Quoted Suggestions for the Improvement of Online Tutorials

May want to develop something that could be used as course content for an instructor to use as part of teaching.
This is a very hard question to answer since I am NOT the one taking the exam or using online tutorials.
Don't know. The Department is not aware of this training and would like to use it in our class as outside materials to help pass the AC exam. We did a search and cannot locate the training modules on the internet. If this information is being given to the students they are not sharing it with the Department.
Tie to the SLO's
I'm unable to find the tutorials.

4.25 Exam Fee

Table 4.29 represents the frequency for options selected by different department chairs for consideration of payee of exam fee.

Table 4.29: Frequency for Payee of Exam Fee

Frequency	Option
4	Program pays the examination fee
1	Program pays a portion of the examination fee
16	Student pays the examination fee

The results clearly represent that in 16 out of 24 schools, students pay the exam fee. However, one school reimburses the fee to students who pass AC exam. Another school reimburses the fee for students who pass the exam and also give them the permission to see their scores. There were two schools where the program pays for the fee and students just need to sit for the exam, and two school require the student to score more than 70% for the program to cover their exam fee.

Six out of 24 schools pay for the students to retake the exam if acceptable scores are not obtained at first attempt. The majority of schools paying for students to retake the exam have an average pass rate of more than 70% or passing AC exam mandatory to graduate. Emphasis by the department on the AC exam is another factor that improves pass rate of the students and subsequently, the department paying the exam fee until the student passes is a way to encourage students to prepare well for the exam.

4.26 ACCE Student Learning Outcomes

Interestingly, all the six schools that are making the students retake the exam by paying for exam fee are using the AC exam as a measure to access ACCE Student Learning Outcomes. Overall, 17 schools are using the AC exam as a measure to access ACCE SLO's. Three department chairs selected "no," and those schools are not participating in the AC

exam anyways. One response checked “unsure” as they are in the process of transitioning to use the AC exam for ACCE SLO’s.

The results indicate that most of the schools are using the AC exam to access applicable ACCE SLO’s. Two department chairs specifically mentioned that they are using the exam for ABET SLO’s as well. Table 4.30 consolidates the quoted description of how outcomes are measured by different programs.

Summary for Table 4.30 is as follows:

- AC exam is used for few or maximum of 12 SLO’s.
- Less number of questions on the topic of sustainability during AC exam to tie up with SLO’s.
- Most of the schools create an average of all the measurement tools for SLO evaluation.
- Few schools are still working to setup the new system of measurement including the AC exam.

Table 4.30: Quoted Responses on ACCE SLO and AC Exam

AC exam results are consolidated into groups that represent the program's learning outcomes and these are reported to the University on an annual basis. It is our intent to use them to assess some of the ACCE SLOs but we have not yet completed the transition to the new system yet.
All our students must pass the exam to graduate. Our secondary standard is that our passing percentage (first-time taking the AIC exam) is above the national average, and we out compare our students performance with the national average in each learning outcomes to identify weakness for improvement
Currently evolving to the SLOs and this currently plays a role, but unsure how large that role will be in the future.
Still in development - AIC exam not required for a few years yet.
We will in the future, when we require all students to take and pass the AC Exam.
Will be used as one of two direct assessments for SLOs 6 through 20.
We have mapped the 20 ACCE outcomes and use the AC exam for indirect and direct measure depending on the outcome. We have also mapped it for the ABET outcomes and use as direct and indirect measure with seven out of the eight outcomes. ABET has one outcome that requires students to design and conduct an experiment that the AC exam cannot measure.
We look at the average score of all of our students who take the AC exam at a given sitting.
The AC exam is a supporting tool that helps confirm a number of the direct measure outcomes
Scores are tied to ACCE SLOs and this data is compiled into an annual assessment report.
We are just starting to use this. It is why now require the AXC exam. We understand 12 SLO can be assessed with the AC exam, but some SLO seems to have too few questions to be effective. This is the case in the Sustainability SLO which appears from the scores to only have three questions. We had LEED GAs also determined by testing that earned 67% on the AC exam because they missed one of three questions. We will reconsider using the AC exam, for those SLO, where there doesn't seem to be enough questions.
The AC exam is used for some of the ACCE SLO's. Usually where there are a large quantity of questions. Otherwise, the SLO's are measured from student work.
One of the measures, but not the only one.

4.27 Local Industry and Advisory Board Support

The level of support of local industry and advisory board was evaluated on the scale of 1 to 5. Where 1 represents “not supportive at all” and 5 represents “very supportive.”

The average rating received by the respondents is 2.6 on the scale of 5. Table 4.31 quotes additional comments from the department chairs.

Summarized points from Table 4.31 are as follows:

- Some support has been observed from state government level and a few local contractors in favor of AC certification.
- Exam 'value' is compared to other available certifications and rated less.
- Higher utility as an SLO measurement tool.

Table 4.31: Quoted Responses for Support of Local Advisory Board and IAB

They like it as a tool to assess student learning but are not requiring it, or the CC exam, as part of the hiring and promotion process. There has been some movement in support of it at the state government level, but only for state employees.
Our advisory board is supportive but the industry has NO CLUE what
Some of the questions are dated and use terms not common in all areas of the US
Some local contractors have started offering "signing bonuses" of around $100 to students who have passed the exam.
They understand that we require student to pass the AC exam as part of a course but do not provide additional salary if they obtain it. They value the OSHA 30 hour card more than the AC certification. We are going to start an effort to make the AC have more value to them.
Industry does not seem to be very aware of the exam and, in general, does not place much value on students passing. I think that this is unfortunate and presents a huge opportunity to educate the construction industry on the value of the exam.
Local industry is not asking about it, but our Alumni and Industry Advisory Board is very supportive.
Our IAB has never heard of the exam and sees little value as a certification tool.

Another aspect that was evaluated in this context was consideration of potential employers about the AC exam. On the scale of 1 to 5 where 1 represented "never" and 5 represents "very often," an average rating of 1.6 was calculated. Table 4.32 quotes the response in additional comments.

Conclusion from the comments highlight unawareness of employers about AC exam and CPC exam conducted by AIC.

Table 4.32: Quoted Responses for Support of Potential Employers

Not a major point of concern in the current hiring process.
Industry that recruits - be it local/in-state or out-of-state have no clue what this exam is etc. This might be one of the major pitfalls why CPC Level II exam takers is so low.
Programs need to stress the value of the exam through our Industry Advisory Councils to help generate greater acceptance from potential employers. Also, our program's industry outreach arm conducts training for project owners which advocates for owners to give additional points for CPC credentials in a qualifications-based selection process.
One of the local contractors requires it.
I have never heard an employer ask about our use of the exam in 11 years.
When students ask the contractors, most are not aware of what they are talking about

4.28 Fundamentals of Construction Management and AC Exam

Department chairs rated the alignment of AC exam preparation materials provided by AIC with the fundamental skills and knowledge needed to manage the construction process. Scale represented 1 for “not at all” and 5 represented “very well.” The average rating received by the respondents is 3.6 on the scale of 5.

4.29 Schedule of Exam

Considering the issue of “cognitive fatigue,” if each four-hour exam is to be scheduled on two different days then the days of preference were asked to the department chairs. Highest preference was received on Saturday followed by Sunday. In the additional comments section, many respondents mentioned the possibility of a clash with routine course work if the exam is scheduled on weekdays. The quoted comments are tabulated in Table 4.33.

Table 4.33: Quoted Responses for Exam Schedule

For students here, it is almost certain that they will not have classes on Saturdays. It is important not to disrupt the scheduled academic programs.
I don't think two exams for active college students would work but if it became a point, I can only see giving it on TWO Saturdays....otherwise, you are interfering with a student's regular day-to-day classes.
Personally, I don't agree with "cognitive fatigue" assessment. We are trying to elevate acceptance of CPC certification by other construction industry professionals. Our exam needs the same academic rigor of the PE and AIA exams or we will continue to be looked upon as a "less than" profession.
I think an 8 hour exam is a good experience for our students. They will be entering a profession that often requires 10, 12, or more hours per day of concentrated problem solving.
I think mid-week would be best, as students have a chance to re-orient themselves from the weekend.
The challenge is scheduling around classes and class schedules.

Preference on administering two 4-hour exam sections on separate days, instead of both sections on the same day was rated 2 on the scale of 5. Where 1 represented “not supportive at all” and 5 represented “very supportive.” Table 4.34 represents quoted comments on this idea.

Table 4.34: Quoted Responses for 2 Day Exam

Requires significant administrative effort to support a 2-day exam.
We don't have the staff to do this and I would think all small colleges/universities might side here.
This would be very easy for us to do. I was having problems with our Testing Services being able to schedule our exam since they have other exams at the same time. I have now hired a third party in the College Student Services that deal with recruiting to administer and proctor the exam. The exam is now locked up in her office and Department faculty have no access to it. We would like to do two Saturdays and would support this change.
This would cause greater scheduling problems with the students and the testing center on campus.
The challenge would be class scheduling, room scheduling.
If it were given in two four hour blocks on consecutive days I think it would help.

4.30 Computer Based Test

Presently, the AC exam is a paper based test, and the support to make it a computer-based test was rated 3.9 on the scale of 5. Where 1 represented “not supportive at all” and 5 represented “very supportive.”

Quoted comments are listed in Table 4.35. The summary of response indicates interest towards a computer-based test, but also the duration of the exam should be reduced if it goes to computer based.

Sixteen out of 24 schools have access to facilities needed to administer the computer-based test, and 12 out of 16 schools have the facility of proctored computer testing site with capacity for all the students for an 8-hour period. Five schools have two monitors per test taker facility. However, other limitations were observed for the computer-based testing as per participants. Table 4.36 has a list of limitations mentioned by the department chairs.

Table 4.35: Quoted Responses on Adaptation of Computer Based Test

Only if it speeds up the turn around time for grading and compiling of statistics.
It is about time that AC and CPC exams align with other exam that are computer-based with real time feedback.
We like this idea.
Not a bad idea, but the test should be shorter than 8 hours if this is done. Not sure how well some of our students would do with a computerized exam.
It's much easier to look at paper for 4 hours than at a screen.

Table 4.36: Quoted Responses on Infrastructure Availability for Computer Based Test

We only have 2 computers dedicated to this type of exam on campus and the EIT is given on those computers as are other required senior exams in various majors. It has become an issue in some respect with our Civil students as seniors required to take the EIT and scheduling becomes a huge issue with other majors and has affected some students and their potential graduation because our policy is NO graduation is the exam is NOT taken for both the EIT and CQE Level 1.
We would need to use multiple rooms which would increase our cost but it could be done. We have a testing site on campus but it only has a few stations. We would have to administer the test in one of our computer labs
We would need to reserve computer labs and hire a proctor. This would be difficult but might be possible. Since these are general computer labs for teaching, how would we bar internet use?
limited by the number of seats in our computer lab - scheduling other testing facilities could be an issue based on number of students taking the test at the same time.
We have access to a bank of computers on a scheduled basis but not for four hour time frames and not enough for as many as 50 to 60 students at the same time.There would be one monitor per person and proctors would have to be hired and trained (an additional cost to the program). The current testing facilities being used do not have banks of computers.

4.31 Overall Satisfaction and Improvement Suggestions

Average rating for satisfaction with the exam is 3.9 on the scale of 5, where 1 represents “not satisfied at all” and 5 represents “very satisfied.” To improve the AC exam as per department's perspective major comments were focused on updating the exam questions and study material as per industry trend. Some respondents also mentioned that the proctoring fee should be included with the exam fee. Table 4.37 represents the suggestions by department chairs for improving the exam experience.

Table 4.37: Improvement Suggestions

The body of knowledge can be can be updated. The study guide, though revamped, can be improved.
We pay $175 per proctor for proctor's to administer the exam. With the fee of $165 per student there should be some percentage of this fee 5%-10% per student fee that should come back to the program to pay for proctors. Especially when we require students to take the exam, we (the program) are generating the business for AIC to make money and create this profit center.
There needs to be some revisions to content to be more reflective of actual practice in construction industry.
I have students for the past two exams ask me about OSHA Log 200. This was replaced by OSHA Log 300 twelve years ago so this was an outdated question. This is my concern that some of the questions are outdated.
I'm surprised that the exam fee does not cover proctoring costs. Since the exam is on a Saturday we have to use foundation funds to pay for proctors, which gets quite expensive on a weekend. This is especially true if a student requires special accommodations (more time) and the proctors have to come in on Sunday as well.
We like the very quick feedback on the results from Joe, we appreciate that! Also I think the front end interactions, registering/receiving tests etc. works very well. There are very good communications. Responses to questions we ask of AIC are very quickly returned. Improvements: Since very little is known about the actual question content. We do not know how to improve in the areas where students do not perform well form the reports. We should publish the distribution (number) of questions by SLO category rather than by the 10 main areas. for example how many Sustainability Q's will be on the test, then we can decide if this is an adequate amount in deciding whether to consider the AC exam as one of our assessment tools. Difficult to tell exactly how questions on SLO fit into the 10 categories. Lastly, we like the new reporting by ACCE SLO..... But there is confusion from some of our administrators when they review the results. Twelve SLO have been deemed to be measureable using the AC exam, eight are not. Our understanding is that the eight cannot be used as a "direct" measure or as an "indirect" measure, therefore they should just be left off of the SLO portion of the report. It is distracting for administrators to see an SLO score for an SLO that AIC and ACCE both agree can't be measured with this test. If scores are low in one of these un-measureable SLO we have to explain they don't mean much since they can't be used for assessment.
Computerize the exam would be a great advancement.
Be sure question bank is reviewed immediately after the completion of each five year Task Analysis to delete any questions do not assess the most up-to-date test specs.

CHAPTER 5

CONCLUSIONS

5.1 Summary

The major components of this chapter include results, recommendations for each stakeholders, limitations, and suggestions for future study. The results section summarizes the outcome for each factor quantified and analyzed in this research. The next section is comprised of best practices summarized from the response of top performing schools in a narrative format. General recommendations for Construction Management programs adapting the AC exam follows the best practices narrative and a few specific recommendations for the Clemson University CSM program. Lastly, the limitations of data collection and analysis are presented followed by the further study section.

5.2 Results

AC exam study guide: Reference to a study guide is identified as an important factor to perform well on the exam. This result is statistically supported as the usefulness in preparation and reference time of the study guide was analyzed in three different surveys where conclusions reflect its importance in each context. Overall, negative impact on exam scores was observed for students who selected the option of not finding the study guide useful for preparation of the exam. Also, in the Pearson's Chi-square test for the student survey and the Clemson CSM survey, this factor achieved a probability value of less than 0.05. In the department chair survey, the response of the schools scoring above 80% results had an average selection of 4.5 compared to 3.6 overall rating on the scale of 1 to 5, where 1 represented "not satisfied at all" and 5 represented "very satisfied" with the content of

the AC exam study guide. In addition, in the suggested improvements section, better performing schools reflected positive remarks compared to other schools.

Online tutorials: Although online tutorials are newly introduced preparation material from AIC, the positive impact of its reference was observed in the student performance. However, the majority of the test takers are not aware of its availability. The group that used it, though, showed a steep rise in scores. As in the student survey for fall 2016, this was identified as one of the factors with positive coefficients in the stepwise regression test (Table 4.20). Further, in the Pearson's chi-square test, this was also highlighted as the one with a probability value of less than 0.05. Clemson test takers were aware of the online study guide and as per frequency analysis (Figure 4.3), the trend has been observed that students who used it for 1-3 hours had a better score on average.

Similarity to course content: As per Pearson's chi-square test, the similarity of coursework has been identified as a significant factor resulting in the improvement of student scores. With the increase in course content similarity, even the frequency table analysis showed a steep rise of pass percentage: from 37% to 75.2% (Figure 4.23). Additionally, the schools where additional time was given in an existing course to prepare students for the AC exam had an average pass rate of 70.1%, which is equivalent to the percentage required pass the AC exam. 75.9% of the overall test takers selected the option of 'similar' to 'very similar' for the concept tested in the exam with the relevant course content offered in their respective programs.

Review session: This factor was not identified as a positive factor influencing the exam score in all the statistical tests. In addition, out of 24 department chairs participating

in the review, only one school provided a review session for the fall 2016 AC exam. Therefore, overall this factor is not affecting the exam score of the test takers presently. However, Clemson CSM conducted review sessions for the term of fall 2016 AC exams, and the results had improved significantly from last year; however, the statistical influence of this factor was not identified. Logically, there is a certain implication of "review sessions" on the student's performance, but here are a few possible reasons for this factor not reflecting as statistically influential as it could: the limitation of small sample size, the nature of content in review sessions and its relevance to the AC exam syllabus. Given these limitations, this factor is suggested for further study to identify the impact on exam score.

Self-study: Based on the results of Pearson's chi square test this is an influential factor. Given the observations of frequency table analysis, the steep rise in exam score was observed until 5-8 hours of self-study time (Figure 4.19). This suggests that self-study time starting from 1 hour to 8 hours has a positive increase on the score.

Exam's importance to the program: Test takers acknowledging this factor as important had better results. Based on the results of CSM survey, where students selected the importance of the AC exam to various stakeholders, "department chair" received the highest rating (Table 4.10). Additionally, "importance of exam to department chair" was the only value which received probability value of less than 0.05 and hence, was found influential in the exam score of test takers. School leadership must effectively communicate the academic value of this exam to test takers which should help to increase the motivation. Further study is possible on how and when the institutional leadership should start creating awareness in students about the AC exam and its value.

Exam's importance to companies: In the department chair survey, the question related to employer's consideration of AC exam resulted in a sense that the AC exam is generally not considered for recruiting purposes. Also, as per the rating based of Clemson Student's perception, the employment related factor were not rated very high with respect to their AC exam participation. The recommendation following this observation is to highlight the academic importance of the AC exam and eventually after universities adapting the exam focus on the employer's awareness.

Academic Standing of the test taker: Students with higher GPA had better average scores based on the CSM survey (Figure 4.14). This result wholly aligns with the study conducted by Western Carolina University where the correlation of AC exam scores with SAT scores and GPA of the student was analyzed.

5.3 Present Practices in Top Performing Schools

A total number of students from these schools is 255 out of the total student sample of 649, which translates to 39.2% of the total student population participating in this research. Response from department chairs of schools securing a pass percentage of 70% or higher was observed, and all the seven top scoring schools are "requiring" the AC exam for their students. Additionally, all the schools have ACCE accreditation except one with ABET accreditation. Three out of seven schools require students to earn a minimum score on the AC exam which averages to 65%, whereas the remaining four schools do not have a minimum score defined. Here, every school that has results of 70% or higher incorporates the AC exam score into course grades; one exception indirectly incorporates it into grades

by creating a pass/fail course, and in order to pass the course, students need to have a passing grade on the AC exam.

For score accounting for a percentage of the course grade, three out of seven schools have a requirement to pass the AC exam to obtain a pass in the course. However, for four schools, the AC exam score accounts for a certain percentage ranging from 10% to 50% or point system grades, to be included in the course grades. All the schools assist the students in some or the other way for exam preparations. As per data, two out of seven schools have preparing and taking the AC exam as a standalone course with a unique course number. Further, time devoted by five out of seven schools to prepare students for the AC exam within an existing course ranges from a minimum of two hours to maximum of 40 hours.

None of these schools are presently providing an outside the classroom instructor-led preparation class. When asked to list other preparation resources, one school provides both a new and old study guide to the students, and also communicates with the students in the beginning of the senior year about the preparation for the AC exam. For the awareness of the study guide and online tutorials, these schools had a better rating; for example, five out of seven schools were aware of recently released online tutorials.

Students for five out of seven programs pay the exam fee themselves. Only two construction programs pay for the fee with the only condition being that the student appear for the exam. None of the programs pay the fee to retake the AC exam. For accreditation, each of the seven schools use the AC exam for directly measuring the applicable student learning outcomes. The support of the Industry Advisory Board and local industry was recorded low for top performing schools as well. An average rating of 2.7 was received for

support of local industry, Industry Advisory Board, and 1 was received for awareness and consideration of potential employers hiring their students; here the scale was 1 to 5 where 1 indicated “not supportive at all” to 5 indicating “very supportive.”

Department chairs and representatives think that study material provided by the AIC aligns with the skills needed to be a constructor, as 3.5 out of 5, where 1 represents “doesn’t align at all” and 5 represents “perfectly aligns.” The highest preference of scheduling the exam is on “Saturday” followed by Sunday, Monday, and Friday with one vote each. Below average support was observed for conducting exam on two separate days, but a good level of support was noticed to change the exam format from paper-based to computer based. Overall satisfaction of these schools with the work of the AIC is 4 on the scale of 5, where 1 represents “not satisfied at all” and 5 represents “very satisfied.”

Recommendation for Departments requiring the AC exam

AC exam ties with the 12 direct Student Learning Outcomes by ACCE. The third party testing validates the SLO for each student in a very organized way with adequate feedback to the schools. 75.9% of the Students who took the test in Fall 2016 agreed that the concepts tested in the AC exam were ‘similar’ or ‘very similar’ to the material taught in the courses offered by their program. Additionally, AIC provides study materials available online which has been statistically proven influential as a significant factor which is positively influencing the performance of test takers.

To motivate the students for AC exam, department chairs and faculty members should communicate the importance of the exam for their senior year coursework or graduation. Statistically, departments’ involvement with the AC exam has very high

possibility to boost the scores of the test takers as it has been proven statistically significant in this research. Also, the 86% of the Clemson test takers agreed on putting in more effort for the exam preparation if it is required by the department, consequently, this indicates indirect influence of departments consideration of AC exam on motivation and preparation efforts made by the test takers.

- Factors listed under motivation and having an impact on test taker performance are interlinked with preparation for some factors. For example, if a student considers the AC exam "important personally," then there are higher chances that the "study hours" invested will be more. This will definitely result in a better score. Given the factor based possibility explained in the example, the 'institute should take measures to introduce the students to the academic value associated with the exam before senior year'.
- Students' perception of "importance to department" has a statistically proven effect on their performance on the exam. Also, the communication extended by school leadership impacts the understanding of students in the context of the importance that the department is placing on the exam. If departments start emphasizing the value of the AC exam followed by its importance for their grades and graduation, there is a possibility of improvement in the scores.
- Importance of the AC exam score to the employer or further growth opportunities in an organization does not correlate as an independent factor in Chi square test. Therefore, any further analysis on this possibility is not suggested for now, but the students should be made aware that the exam value is focused on academia and

their long-term value as professionals if they choose to continue the certification rather than getting hired at entry level positions.

- Educating and assisting the school administration to use the AC exam for a direct measure of applicable 12 ACCE SLO's is another possibility to increase the number of test takers. As the schools will understand the utility of the AC exam to measure student learning, there is a higher chance that adaptation will increase.
- "Similarity of coursework" is another factor affecting the test-taker performance. Additionally, new study guide and online tutorials presented as considerably important preparation material in the analysis. Incorporating these two study materials is suggested for universities who have selected the AC exam to tie with ACCE SLO's for accreditation. Rather than creating a new curriculum comprised of content from the AC exam syllabus, relevant chapters from the study guide and online tutorials can be linked to existing coursework.

5.4 General Recommendations

For AIC

- Create awareness and ease of access for online learning tutorials because department chairs marked that it was not easily accessible, and a major percentage of students did not use the tutorials. One way to remind students who signed up for the exam is '*automated emails*'. The AIC can send automated emails a few times before the exam providing information on available preparation material for the exam and access instructions.

- Some percentage of Proctor cost should be possibly included in the exam fee as per suggestion of three department chairs. This will be one way, to increase convenience for adaptation in the schools, that have limited funds to conduct a certification exam of this scale. No major impact on performance was observed if the school paid for the exam fee, so as per the analysis, it is completely an administrative decision to establish who pays for the exam fee. However, care should be taken that the exam fee does not increase by a high margin. The AIC can consider this factor and try to optimize the exam cost including proctor fee. There is a possibility of low participation from students where the exam is not required if the exam fee is increased.
- Eventually, upgrade to computer-based testing in the next few years as most of the department chairs who participated in this survey were positive in the context of available resources and other benefits of evaluation that will follow computer-based testing. However, the department chair sample size in this research is not sufficient to determine available infrastructure with construction programs supporting an online exam.
- The AIC should update and revise the exam questions based on standard practices and policies pursued nationwide in the construction industry to avoid repetition of questions. This was observed in a few of the recommendations by department chairs. For Clemson CSM department
- Analysis on the Clemson CSM presents that coursework relevance is low when compared to student results by Pearson's Chi Square test for independence. Only 1

out of 14 relevant courses had an impact on student performance. However, the percentage of questions from each coursework in the AC exam syllabus is not clearly defined so this conclusion can not be stated with statistical confidence.

- More than half of Clemson survey participants did not support the idea of making the exam mandatory to graduate. Although, it is recommended that the AC exam can possibly be tied to a course as a percentage or made a separate mandatory graduation requirement as there will be higher level of effort from the students if department mandates AC exam in some or the other way, 86% of the Clemson students agreed to putting in more time for preparation if the exam was a requirement from the department.

5.5 Limitations

A few limitations in data collection and sampling was observed. In the department chair survey, two schools had more than one respondent. The responses were generalized wherever possible and discarded in case of unacceptable contradictions. Another factor in the student survey—which is not limiting the study but somehow reduced the sample size—was the number of incomplete survey responses discarded for statistical analysis; therefore, overall sample size analyzed was reduced to 435 irrespective of the total number of participants: 649.

When the nature of data was analyzed, one limitation for the exact statistical conclusion was the nature of variables being measured. Here, motivation and preparation are categorical variables, which restricted the mathematical tabulation of regression to higher R-square values. Also, only fall 2016 results were considered for the analysis. There

is a possibility of variances if two terms i.e. spring 2017 and fall 2016 results were considered for evaluation.

5.6 Future Study

In this study, “review sessions” is certainly a factor that can be subjected to further study. The sample size and practice of review sessions for AC exam preparation at present is not enough to draw conclusions. However, it has shown positive trend in the Clemson test taker survey with the average scores of the students going up as per participation in review sessions. Another factor that could be possibly studied is “creating awareness at the departmental level,” where departments should be made aware of the value of the AC exam, and once they adapt, the same should be communicated to the students. The impact of “online tutorial” was vaguely measured in this study. After complete implementation and acknowledgment of the tutorial as an additional study material provided by the AIC, its impact can be reevaluated.

Few questions that are possible in the next round of this research assuming that most of the recommendations suggested for department chairs are implemented and also some buffer time is provided for online study guide to be implemented wholly

1. How well you think the following chapters from AC exam study guide helped you prepare for the exam, based on Likert Scale.

2. How well you think the following chapters from online AC exam study guide helped you prepare for the exam, based on Likert Scale.

3. How well you think the department assisted for/communicated the preparation strategies for AC exam on your senior year course/graduation, Likert Scale.

4. How likely are you to use the AC exam results on your resume, Likert Scale.

5. Did your program offer any other certification exam during your entire course duration? List the certifications.

Interestingly, at this point of time based on the indicative statistical results, industry is not considering AC exam for initial hiring purposes, but the certification certainly adds career benefit for a practicing professional. Future study is recommended to understand and increase the level of awareness in the industry about the value associated with AC exam. Perhaps, there are more factors that could be identified indirectly or directly influencing the test taker performance, example- 'if the students were well rested before the exam.'

APPENDICES

Appendix A

Clemson CSM Survey

1. Circle the range of hours spent on each study material/sessions to prepare for the AC exam? Select the one range for each study material below.

Study Material	***Hour range of reference***				
AC exam study guide	0	1-3	3-6	6-8	9 or more
Online AC exam study course	0	1-3	3-6	6-8	9 or more
Class notes by faculty	0	1-3	3-6	6-8	9 or more
Class notes by student	0	1-3	3-6	6-8	9 or more
Course textbooks	0	1-3	3-6	6-8	9 or more
Faculty lead study sessions	0	1-3	3-6	6-8	9 or more

2. How well did the following courses prepared you for the questions asked on the AC exam? Select on the scale of 1 to 5, where *1 represents not well at all* and *5 represents very well*.

Course Name	***Not well at all***				***Very well***
Introduction to Construction Science and Management	1	2	3	4	5
Construction Problem Solving	1	2	3	4	5
Structures	1	2	3	4	5
Materials and Methods of Construction	1	2	3	4	5
Contract Documents	1	2	3	4	5
Soils & Foundations	1	2	3	4	5
Environmental Systems	1	2	3	4	5
Construction Estimating	1	2	3	4	5
Construction Scheduling	1	2	3	4	5
Safety in Building Construction	1	2	3	4	5
Construction Project Management	1	2	3	4	5
Construction Economics	1	2	3	4	5
Construction Capstone	1	2	3	4	5
Competition Team	1	2	3	4	5

3. Would you support adding an additional course to your curriculum dedicated to preparing for the AC exam?

Yes **No** **No opinion**

4. If you selected "yes" to the previous question, how many credit hours should the course be?

1 2 3 >3

5. How supportive would you be of the AIC creating an additional module of the AC exam online prep course with nothing but sample questions. The sample questions would be similar to the questions

included throughout the existing modules of the prep course. Please select on the scale of 1 to 5, where *1 represents not supportive at all* and *5 represents very supportive*.

Not supportive at all				**Very Supportive**
1	2	3	4	5

6. If you used the AC exam study guide, how comprehensive do you think study guide was? Please select on the scale of 1 to 5, where *1 represents not comprehensive at all* and *5 represents very comprehensive*.

Not comprehensive at all				**Very Comprehensive**
1	2	3	4	5

7. Do you feel that CSM students should be required to pass the AC exam to graduate?

Yes **No** **No opinion**

8. Would you take the AC exam if the CSM department did not required you to?

Yes **No** **No opinion**

9. Do you think you would prepare more if passing the exam was required to graduate?

Yes **No** **No opinion**

10. What is your GPA?

- 1.5 – 2
- 2 - 2.5
- 2.5 - 3.0
- 3.0 – 3.5
- 3.5 - 4.0

11. On the scale of 1 to 5, where *1 represents not important at all* and *5 represents very important*. How important is the AC exam for;

	Not Important at all				**Very Important**
CSM chair	1	2	3	4	5
CSM department	1	2	3	4	5
CSM faculty	1	2	3	4	5
CSM IAB	1	2	3	4	5
Potential employers	1	2	3	4	5
Your previous employers	1	2	3	4	5
Construction industry (In general)	1	2	3	4	5
For you personally	1	2	3	4	5

12. On the scale of 1 to 5, where *1 represents not significant at all* and *5 represents very significant*, how significant do you think AC certification is for;

	Not Significant at all				**Very Significant**

Starting salary	1	2	3	4	5
Number of employment offers	1	2	3	4	5
Promotions	1	2	3	4	5
To achieve your professional goals	1	2	3	4	5
Inclusion on resume	1	2	3	4	5

Appendix B

Department Chair Survey

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American Institute of Constructors
Constructor Certification Commission
Examinee Satisfaction Survey

One of the goals of the American Institute of Constructors (AIC) Constructor Certification Commission (CCC) is to ensure that the certification examination process occurs in a quality manner. Various activities associated with the examination process may impact the level of satisfaction of those involved including the Examinees.
NOTE: Your responses and comments will not impact your score on your examination. This survey is only used to help improve the examination.

Instructions: Please respond to each of the items below. Leave your completed survey with the Examination Proctor before you leave the testing room.

Examination Site Code (Required)
(EX: NY005)

Student ID Number (Optional)

Do you want to be contacted regarding this survey? ☐ Yes ☐ No ☐ OfficeUse

1. If you participated in a structured AC exam review session(s) that was sponsored by your institution, how many total hours did you participate in the session(s)?

- ○ I did not participate in a review session
- ○ Less than an hour
- ○ 1 to 3 hours
- ○ 4 to 6 hours
- ○ Longer than 6 hours

2. How many hours outside of a structured course or review session(s) did you spend studying for the AC exam?

- ○ I did not study for the exam
- ○ Less than 1 hour
- ○ 1 to 4 hours
- ○ 5 to 8 hours
- ○ More than 8 hours

3. How important is it for you personally to do well on the AC exam?

- ○ Not important
- ○ Slightly important
- ○ Important
- ○ Very important

4. How important is your performance on the AC exam to your construction management program?

- ○ Not important
- ○ Slightly important
- ○ Important
- ○ Very important

5. How important is the AC exam to construction companies hiring from your construction management program?

- ○ Not important
- ○ Slightly important
- ○ Important
- ○ Very important

6. How similar were the concepts tested on in this exam to the material taught in your courses?

- ○ Not similar
- ○ Slightly similar
- ○ Similar
- ○ Very similar

7. How useful was the AC Exam Study Guide?

- ○ Did not use the Study Guide
- ○ Not useful
- ○ Slightly useful
- ○ Useful
- ○ Very useful

8. How useful were the AC Exam online learning tutorials?

- ○ Did not use the online learning tutorials
- ○ Not useful
- ○ Slightly useful
- ○ Useful
- ○ Very useful

Examination Process: Indicate how satisfied you were with the items below associated with the examination process.

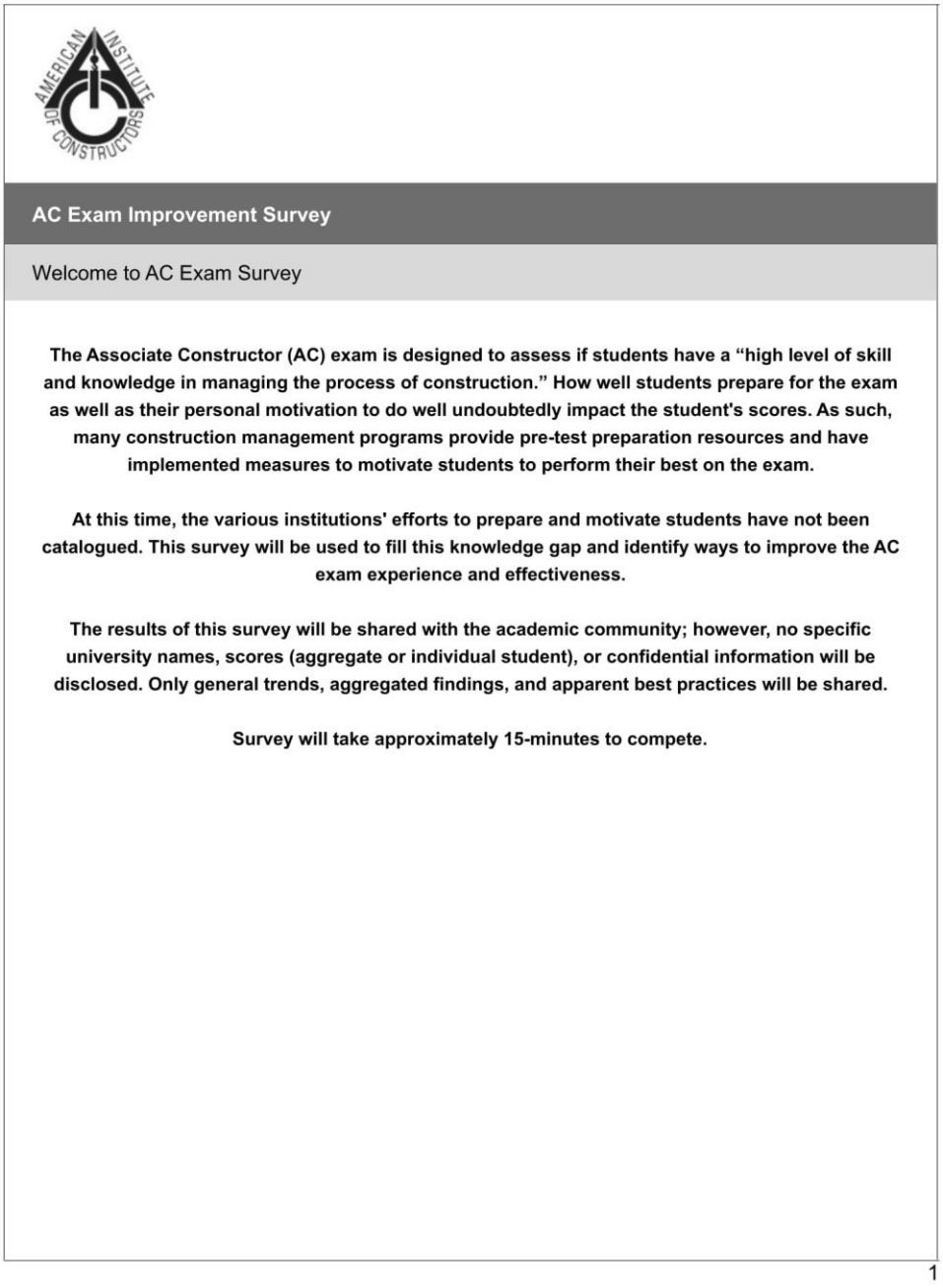
Item	Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied
Examination Registration Process	○	○	○	○	○
Site Location	○	○	○	○	○
Room Conditions	○	○	○	○	○
Proctor Performance	○	○	○	○	○
Overall Experience	○	○	○	○	○

Comments: If you responded to any of the above items with Very Unsatisfied or Unsatisfied, please explain why below. Also provide any suggestions you have for improvements or other general comments. If you want to be contacted regarding this survey, please enter your Student ID Number in the space provided above.

Return this form to your examination proctor. Thank you.

Appendix C

AC Exam Improvement Survey



AC Exam Improvement Survey

Welcome to AC Exam Survey

The Associate Constructor (AC) exam is designed to assess if students have a "high level of skill and knowledge in managing the process of construction." How well students prepare for the exam as well as their personal motivation to do well undoubtedly impact the student's scores. As such, many construction management programs provide pre-test preparation resources and have implemented measures to motivate students to perform their best on the exam.

At this time, the various institutions' efforts to prepare and motivate students have not been catalogued. This survey will be used to fill this knowledge gap and identify ways to improve the AC exam experience and effectiveness.

The results of this survey will be shared with the academic community; however, no specific university names, scores (aggregate or individual student), or confidential information will be disclosed. Only general trends, aggregated findings, and apparent best practices will be shared.

Survey will take approximately 15-minutes to compete.

1

AC Exam Improvement Survey

1. Please provide your name?

* 2. What university are you affiliated with?

* 3. By who is your program accredited? Please select all that apply.

- ABET
- ACCE
- ABET & ACCE
- Not Accredited

Other (please specify)

4. On average how many undergraduate students are enrolled in your program?

- Less than 100
- Between 100-200
- Between 200-300
- Between 300-400
- Between 400-500
- More than 500

5. Are students required to take (or penalized for not taking) the AC exam?

- ◯ Yes
- ◯ No

3

AC Exam Improvement Survey

6. What is the primary reason why your students sit for the AC exam?

- [ ] Perceived value to employers
- [ ] Independent study course credit
- [ ] Personal achievement-status

Other (please specify)

7. How strongly do you encourage students to take the AC exam?
Please select on the scale of 1 to 5, where,*1 represents "not encouraged at all"* and *5 represents "highly encouraged."*

AC Exam Improvement Survey

8. Do the students in your program need to earn a minimum score on the AC exam to **graduate**?

- ◯ Yes
- ◯ No

5

AC Exam Improvement Survey

9. What is the minimum percentage required on the AC exam to graduate?

6

AC Exam Improvement Survey

10. Are the AC exam scores incorporated into a course grade?

- ◯ Yes
- ◯ No
- ◯ Other (please specify)

7

AC Exam Improvement Survey

11. Please describe how the AC exam scores are incorporated into a course grade? Please select all that are applicable.

- [ ] Incorporated as the final exam
- [ ] Passing exam is a requirement to pass the course
- [ ] Score accounts for a percentage of the course grade

Further Explanation/Other

12. If you selected "score accounts for a percentage of the course grade", please indicate the percentage it accounts for.

AC Exam Improvement Survey

13. Does your program assist students in preparing for the AC exam? Examples include exam review during class or optional outside the class exam review study sessions.

- ◯ Yes
- ◯ No

AC Exam Improvement Survey

14. Is preparing for and taking the AC exam *a stand alone course* with a unique course number?

- ◯ Yes
- ◯ No

Additional Comments

15. Is there time devoted during an *existing course* to prepare students for the AC exam?

- ◯ Yes
- ◯ No

AC Exam Improvement Survey

16. How many hours of class time of an*existing course* are devoted to preparing students for the AC exam?

0 50 100

AC Exam Improvement Survey

17. Does your program provide *outside the classroom*, instructor lead, exam preparation classes?

- ◯ Yes
- ◯ No

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AC Exam Improvement Survey

18. How many hours of *outside the classroom*, instructor lead, preparation session is available to students?

0 50 100

19. Is the outside the classroom, instructor lead, exam preparation class(es) required?

- Yes
- No

AC Exam Improvement Survey

20. What other resources are provided by your program to help students prepare for the AC exam?

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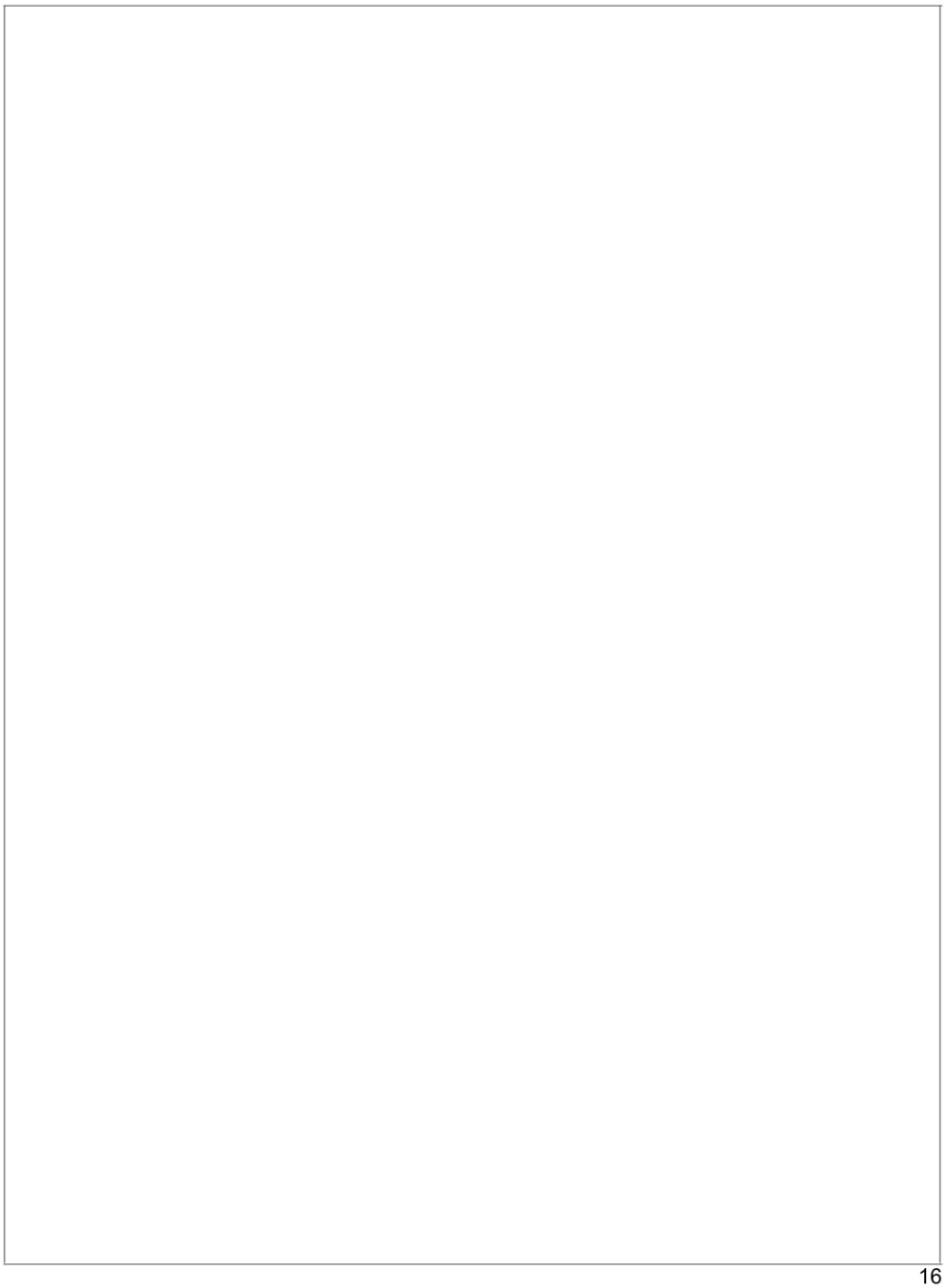
AC Exam Improvement Survey

21. How satisfied are you with the new Study Guide?
Please select on the scale of 1 to 5, where *1 represents "not satisfied at all"* and *5 represents "very satisfied."*

22. How can the new Study Guide be improved?

- [ ] No suggestions

Suggestion (Please type in)



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AC Exam Improvement Survey

23. Does your program make students aware that the AIC provides online learning tutorials on AC exam topics?

- ◯ Yes
- ◯ No
- ◯ Not familiar with it

24. How satisfied are you with the online learning tutorials provided by the AIC?
Please select on the scale of 1 to 5, where*1 represents "not satisfied at all"* and *5 represents "very satisfied."*

25. How can the online learning tutorials be improved?

- ◯ No suggestions

Suggestion (Please type in)

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AC Exam Improvement Survey

26. Who pays the examination fee to take the AC exam?

- ◯ Program pays the examination fee
- ◯ Program pays a portion of the examination fee
- ◯ Student pays the examination fee

Please specify how much percentage of the fee is paid for by the program.

AC Exam Improvement Survey

27. Are there any conditions that the student must meet for the program to pay the examination fee? Select all that apply and/or write in additional conditions.

- ◯ Sit for exam only
- ◯ Above a 50% score
- ◯ Above a 60% score
- ◯ Above a 70% score

Other (please specify)

20

AC Exam Improvement Survey

28. Are students required to retake the AC exam if they don't obtain an acceptable score?

- ◯ Yes
- ◯ No

AC Exam Improvement Survey

29. Will the program pay the examination fee if retaking the exam?

- ◯ Yes
- ◯ No

Additional comments

AC Exam Improvement Survey

30. Does your program use the AC exam as a measure to access ACCE Student Learning Outcomes?

- ◯ Yes
- ◯ No
- ◯ Unsure

Please describe how are ACCE student learning outcomes measured at your program.

31. How supportive do you think your local industry and advisory board are of the AC exam?
Please select on the scale of 1 to 5, where *1 represents "not supportive at all"* and *5 represents "very supportive."*

Additional comments

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32. How often do potential employers ask students about the AC exam?

Please select on the scale of 1 to 5, where *1 represents "never" and 5 represents "very often."*

Additional comments

24

AC Exam Improvement Survey

33. How well do you feel the AC exam preparation materials provided by the AIC aligns with the fundamental skills and knowledge needed to manage the construction process?
Please select on the scale of 1 to 5, where *1 represents "not at all"* and *5 represents "very well."*

Additional Comments

34. Considering the issue for *"cognitive fatigue"* in taking two 4-hour long sections of an exam on the same day, which day of the week would you think would be most effective to schedule the exam.

- [ ] Monday
- [ ] Tuesday
- [ ] Wednesday
- [ ] Thursday
- [ ] Friday
- [ ] Saturday
- [ ] Sunday

Additional comments

35. How supportive would you be to administering the two 4-hour sections of the exam on two separate days instead of both sections on the same day to reduce cognitive fatigue as a potential factor influencing exam scores?
Please select on the scale of 1 to 5, where *1 represents "not supportive at all"* and *5 represents "very supportive."*

Additional comments

36. How supportive would you be to changing the exam format from paper based to computer based?
Please select on the scale of 1 to 5, where *1 represents "not supportive at all"* and *5 represents "very supportive."*

Additional Comments

37. Does your institution have access to the facilities needed to administer a computer based AC exam?

- ◯ Yes
- ◯ No

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38. If you selected 'yes' to previous question. Please indicate all of the following facilities your institution has access to.

- [ ] Proctored computer testing site
- [ ] 2 monitors per test taker
- [ ] Capacity for all students for an 8-hour period

Other limitations to computer based testing

39. What is your overall satisfaction with the AC exam?
Please select on the scale of 1 to 5, where *1 represents "not satisfied at all"* and *5 represents "very satisfied."*

40. How can the AC exam experience be improved?

- ( ) No suggestion

Suggestion (Please type in)

41. Any additional comment you wish to share with the AIC?

○ No comments

Suggestion (Please type in)

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AC Exam Improvement Survey

Thank you very much for completing the survey. Your feedback is very important and will be used to improve the exam experience. The results of the study will be published in the Professional Constructor Journal of the AIC.

If you have any questions or would like to provide additional feedback please contact:

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Appendix D

Confidentiality Statement

Confidentiality Statement

I, Abhya Sinha, understand that the AIC AC examination scores are confidential and will be used only for my research project in order to conduct various statistical analysis. Furthermore, by my signature to this Statement, I agree not to divulge the scores by student name to anyone nor will I include the scores by name in any research-related document pertaining to the project I am working on.

If the scores by name are shared orally or in writing with anyone, the results will negatively impact graduating from the MCSM program.

Abhya Sinha

12/08/2016
Date

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