

Using the CS2013 Exam for ABET Student Outcome Assessment

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ABSTRACT

In anticipation of an ABET accreditation visit, our computer science department contracted with an independent external testing organization to perform an assessment of our students' proficiency in computer science. We used this external assessment to supplement our own internal assessment. The exam was easy to administer and covered multiple student outcomes. In addition, our analysis of the exam results showed high correlation between course performance and exam performance.

CCS CONCEPTS

- Social and professional topics → Accreditation
- Social and professional topics → Computational science and engineering education
- Social and professional topics → Student assessment

KEYWORDS

ABET, Accreditation, Student Assessment, CS2013

1 INTRODUCTION

In its general criteria for accreditation, ABET states that a computer science program applying for accreditation “must have documented student outcomes that prepare graduates to attain the program educational objectives. There must be a documented and effective process for the periodic review and revision of these student outcomes.”[1] ABET offers suggestions for the instruments that might be used to gather the necessary data: responses to in-class exam questions, homework assignments, and senior projects, to name a few [2]. When the people who create the assessment instruments are the same people who evaluate the results, however, we end up asking what can we really conclude from the results about what our students have learned [3]? To address this question, and to provide some external validation of the claims we make about our students' learning, our department employed the services of an external testing organization to offer our students a comprehensive and independent assessment of their learning.

2 BACKGROUND

We used the Institute for Certification of Computing Professionals (ICCP) Computer Science Curricula 2013 (CS2013) exam. The ICCP CS2013 exam was developed to assess the curricula

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developed by ACM and IEEE-Computer Society. The ICCP CS2013 exam tests 15 knowledge areas in varying depth with a total of 166 questions representing the 166 hours of knowledge from the ACM/IEEE CS2013[4].

3 RESULTS

The exam was given to a total of 80 volunteer students from the Senior Design course over two consecutive years. The questions on the CS2013 exam have been mapped to the ABET Computing Accreditation Commission (CAC) Student Outcomes (SO) a – k that were in use until 2019. We used the individual results of the students to determine if they had approached, met, or exceed the particular SO. The standard was met or exceeded 86% of the time. Combining the exam results with the students' prior course performance found high correlations between related course performance and exam knowledge area performance. Several methodologies were developed to correlate the course performance to exam knowledge scores. The results appear to indicate that the material covered in our courses aligns with that of the CS2013.

4 CONTRIBUTIONS

The methodology used to correlate exam performance to SO achievement allows for multiple SOs to be assessed with a single external examination. When combined with the correlations of course performance, the CS2013 exam can highlight courses that may be failing to prepare program graduates. This methodology can be applied to any program that has access to their students' past course performance and this poster provides insights into what was done and how to repeat it for another program.

ACKNOWLEDGMENTS

Thanks to the 80 student volunteers that took the CS2013 exam.

REFERENCES

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ADDITIONAL CONTEXT

Our university offers two majors overseen by our department: Computer Science and Engineering (CSE) which is ABET accredited and Computer Science (CSI) which is not. The CSE students are required to take a two term Senior Design course (ECS 193A/B), where the CSI students may opt to take the course as an elective.

The CS2013 exam was offered to students of the ECS 193B course, in the second week of the course's second term in 2018 and 2019. Taking the exam was not mandated by the ECS 193B instructor but encouraged through additional participation credit. The exam was held from 6P – 9P at night, and dinner was provided for the students that took the exam. Each year 40 students took the exam, 47% and 51% of the students enrolled in 2018 and 2019 respectively. To incentivize the students, each year a prize was given to the highest scoring student, and the students were notified that if they passed the exam, they could later apply for the certification from ICCP.

Overall the students at our institution performed quite well on the CS2013 exam. The assessment of the exam performance for nine of the CAC SOs were broken down into exceeds, meets, approaches, or does not approach the standard. The standard was set to passing, which is 50% as specified by ICCP, with exceeding the standard set at the honors level of 70%. Those scoring at least 45% were considered to be approaching the standard, and those below 45% did not meet or approach the standard. The students on average met or exceeded the particular criteria 86% of the time. Unfortunately, some of the criterion only had a few questions leading to fairly polarized results.

Given the external exam results, we were interested in determining if student performance in our courses was correlated with performance on the CS2013 knowledge area. Looking at the detailed knowledge area information we were able develop a set of courses that we believed should correlate with the particular CS2013 knowledge area. When considering the students grades for the analysis, a question arose: should the grade points or the percentile of the student be used? In addition, what should be done if the student had not taken the course yet: should the grade be considered zero, should the sample be ignored all together or should the average over the other classes be used? There is useful information in the fact that the student has not taken the course, so we did not want to ignore that. We decided to run all of the analyses and to provide the range of performance using the different methodologies. Since exact student percentiles could not be determined for each course, the middle point of the grade range was used. This allowed for easy vs. hard fought A's to be distinguished from one another. Using the range of methodologies, we calculated p-Values for each knowledge area and corresponding course(s).

Overall, we found that using student percentile with an average percentile standing in for not taking the course provided some of the best correlations. Figure 1 shows the p-Value ranges with the CS2013 knowledge area and the group of related courses for that knowledge area. The dot is the p-Value using the percentile methodology, and the error bars show the range of the other methodologies. You will notice that all are able to reject the null hypothesis, though the SP (Social Issues and Professional Practice)

had the weakest correlation. This is primarily due to the fact that ECS 188 Ethics is required for the CSE students, but not the CSI students. Class sizes of ECS 188 are kept to 24 students, it is challenging for the CSI students to take ECS 188. One may think that there should be strong correlations between any course and the score on a particular knowledge area; however, Figure 2 shows that there is not a strong correlation between other courses and the SP knowledge area. Not surprisingly, we found the strongest correlation between overall CS2013 test score and overall CS course performance.

The ICCP CS2013 exam is remarkably easy to administer, and the time between giving the exam and receiving the results from ICCP is relatively brief. The information we received from the exam provided some validation of what we already believed were our strengths, and also confirmed some areas in which we knew we were weaker than we should be. While there was much to be gleaned from the exam results, ICCP was unable to give us everything we asked for; we hope that will change for the better in the future. Our correlation of the exam results to student Grade Point Averages led to valuable insights about our program. We will be offering the CS2013 exam again in the immediate future, and we will continue to pursue answers to the questions that our accreditation efforts have raised.

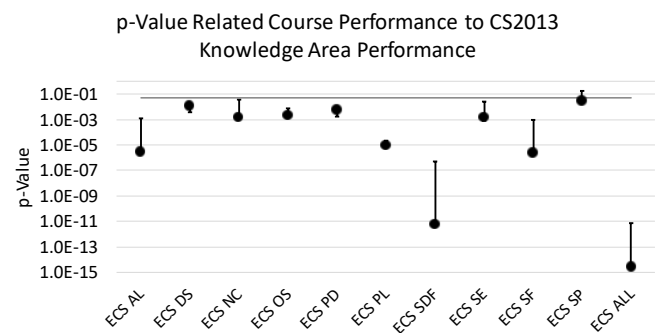


Figure 1. Related Course Performance to CS2013 Knowledge Area Performance

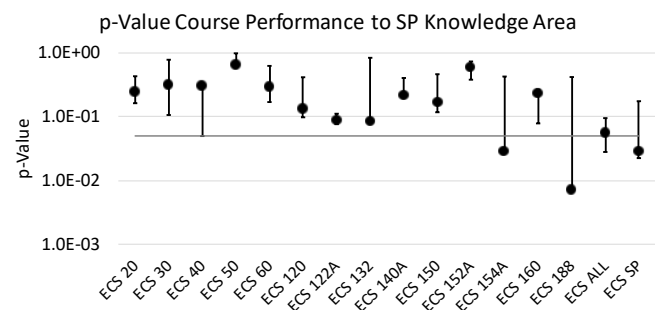


Figure 2. Course Performance to ICCP SP Knowledge Area Performance