

Improving Pass Rates for SOLIDWORKS CSWA Exam

Emily Spayde, Shane Brauer, and Dustin Spayde

Mississippi State University

Abstract

Employers are continuing to seek engineering interns and graduates that are proficient with Computer-Aided Design (CAD). Passing the Certified SOLIDWORKS Associate (CSWA) exam provides students with an opportunity to show potential employers they are indeed proficient based on a standardized exam created by SOLIDWORKS. Earning certification as a SOLIDWORKS Associate also provides students with an opportunity to earn their professional certification through the Certified SOLIDWORKS Professional (CSWP) exam. Methodology for adequately teaching SOLIDWORKS to students is sparse, and the variability in student-learning makes a single methodology ineffective for some students. However, an online platform, SolidProfessor, offers an effective suite of learning modules for students to use at their own pace. In only three semesters of using SolidProfessor as the primary method for students learning CAD, a significant increase in the pass rate of the CSWA exam was observed across multiple sections and multiple instructors of the same course. Instructors for each section curate modules into homework assignments for the students to complete on a weekly basis with increasing difficulty for 10 weeks up to their first attempt at the CSWA exam. A second attempt (if necessary) is made during Final Exam Week (Week 17). For the 2017 – 2018 academic year, the overall CSWA pass rate across multiple sections was 59%. For the academic year that SolidProfessor was implemented, 2018 – 2019, the overall CSWA pass rate was 73%.

Keywords

SOLIDWORKS, CSWA, SolidProfessor

Introduction

Engineering graphics or 3D modeling courses are commonly offered in many mechanical engineering curriculums. Several studies have been done investigating different teaching methodologies and their effectiveness. In a study by Kukk and Heikkinen¹, the authors applied Bloom's taxonomy to analyze assignments for two engineering graphics courses. Cozzens² investigated the effectiveness of YouTube as CAD training resource highlighting the fact that YouTube is free to use and free to host content being a large advantage of the platform for training use. Different instructional strategies for teaching SOLIDWORKS and their effect on student strategic thinking was investigated by Toto et al³. The authors asserted that the students' plan for creating a CAD model should be assessed before the student attempted the model using the software when the students would have the opportunity to adapt their plan. Ault and Fraser⁴ studied students' perception of using an online learning management system for learning the modeling software Pro/FICIENCY instead of a tutorial-based textbook. Students favored the learning management system over the tutorial-based textbook. The authors were able to implement a flipped classroom for the course by assigning tutorials and quizzes from the web-

based platform before lab. Both Talley and Talley⁵ and Bubacz et al⁶ presented applications of a hybrid flipped classroom to teach modeling courses using an “e-text”, SolidProfessor, as the instructional service. Talley and Talley used a hybrid flipped classroom to teach a junior level CAD and Manufacturing course which utilized Mastercam software while Bubacz et al used the approach for a sophomore level CAD and numerical methods course with SOLIDWORKS as the software. Both studies found the hybrid flipped classroom with an “e-text” had benefits to the classroom that made the concept worth implementing. Webster et al⁷ studied the effect of free instructional content provided by SOLIDWORKS on passing rates for the CSWA and CSWP compared with the national average. They found that their students had a slightly lower than national average passing rate for the first attempt at the CSWA and significantly higher passing rate average with one retake when compared with the national average. For this work, the authors were interested in studying the effect of implementing SolidProfessor⁸ on the CSWA passing rates compared with previous semesters for a sophomore level CAD and manufacturing course.

Modeling and Manufacturing Course

Modeling and Manufacturing is a sophomore level course in Mechanical Engineering at Mississippi State University. The course includes an introduction to manufacturing methods and an introduction to 3D modeling software, which is SOLIDWORKS⁹ for this course. The course is typically taught over 2 – 3 sections with a total of 90 – 120 students enrolled per semester. The course is comprised of lectures and labs with the majority of the lectures focusing on manufacturing methods and the labs focusing on SOLIDWORKS instruction. An added benefit of this course at the sophomore level is introducing students to a breadth of manufacturing and 3D modeling concepts as they are preparing to find co-op positions with the basic introduction to these concepts intended to make them more prepared and marketable as a potential employee. Making students more marketable to potential employers as co-op students was the primary motivation for adding the Certified SOLIDWORKS Associate (CSWA) Exam to the course in Fall of 2012. The CSWA is a standardized exam offered by SOLIDWORKS intended to evaluate an individual’s proficiency of SOLIDWORKS. People that pass the CSWA get a certificate and a certificate ID number to put on their resume and have the option of being publicly searchable in SOLIDWORKS database of CSWA certificate holders. Originally, the CSWA was added to the course as an optional exam for the students; it was then made a course requirement in the Spring of 2013. Students have two opportunities to take the exam, one at the mid-point of the semester and one for the final exam. If students pass the exam during the first attempt, they do not have to take the second attempt.

Prior to fall 2018, SOLIDWORKS homework was assigned from a CSWA prep textbook¹⁰ and labs times were used for students to create parts or assemblies from a problem in the textbook or from SOLIDWORKS tutorials. Beginning in Fall 2018, the online subscription service, SolidProfessor, was required for the course. SolidProfessor is an online service that provides courses, tutorials, and videos for various subjects including SOLIDWORKS. Within SolidProfessor, Modeling and Manufacturing students were enrolled in a course named *SOLIDWORKS Beginner to Certification* where the utilized content was instructional videos, practice exercises, and quizzes. The students were assessed in lab using quizzes based on quizzes provided by SolidProfessor for a predefined section of the course and also submitted the practice exercises for a homework grade. Students could attempt the quiz in SolidProfessor once

prior to taking the lab quiz. SolidProfessor would email scores to the students stating which questions were correct and incorrect, but SolidProfessor would not give the correct answers for incorrectly answered questions so students would need to go back and review material regarding the missed question to prepare for the lab quiz. Students were introduced to SOLIDWORKS concepts in the homework using SolidProfessor and then they would attempt parts and assemblies in the lab that used the concepts introduced in the previous homework. Each lab consisted of a quiz based on the SolidProfessor videos from the previous homework, which accounted for 70% of the lab grade and the SOLIDWORKS assignment, which was the remaining 30% of the lab grade. The part/assembly component of the lab was graded as 0 or 30 with the SOLIDWORKS model being evaluated on the mass and/or center of mass.

After attempting the first CSWA exam at the midterm, students were given the option to sign up for a second SolidProfessor course, *Certified SOLIDWORKS Associate Prep* to help prepare them for the second attempt at the CSWA. Enrollment in this course was optional and did not affect their course grade. After the first attempt of the CSWA, a project was assigned where students must model individual parts from a given lawnmower engine using SOLIDWORKS. This project required a significant amount of time therefore limiting further formal lectures or labs. The project gave the students ample opportunity to practice a breadth of SOLIDWORKS techniques, however, the SolidProfessor course was specifically designed toward CSWA preparation.

Results

Data was collated on a semester basis from spring 2014 to fall 2019 and analyzed using several metrics. An initial metric was looking at the pass rates over each academic year (Figure 1). For all academic years before using SolidProfessor, the highest overall pass rate for the CSWA exam was 59% during the 2017 – 2018 academic year, which encompassed five sections and 205 students. For the 2018 – 2019 academic year, the first year SolidProfessor was implemented, the overall pass rate for the CSWA exam was 73% across five sections and 211 students. In comparison, the CSWA education exam passing rate national average is 49.69% and worldwide the average is 57.98% (R. Koehler, private communication, November 7, 2019).

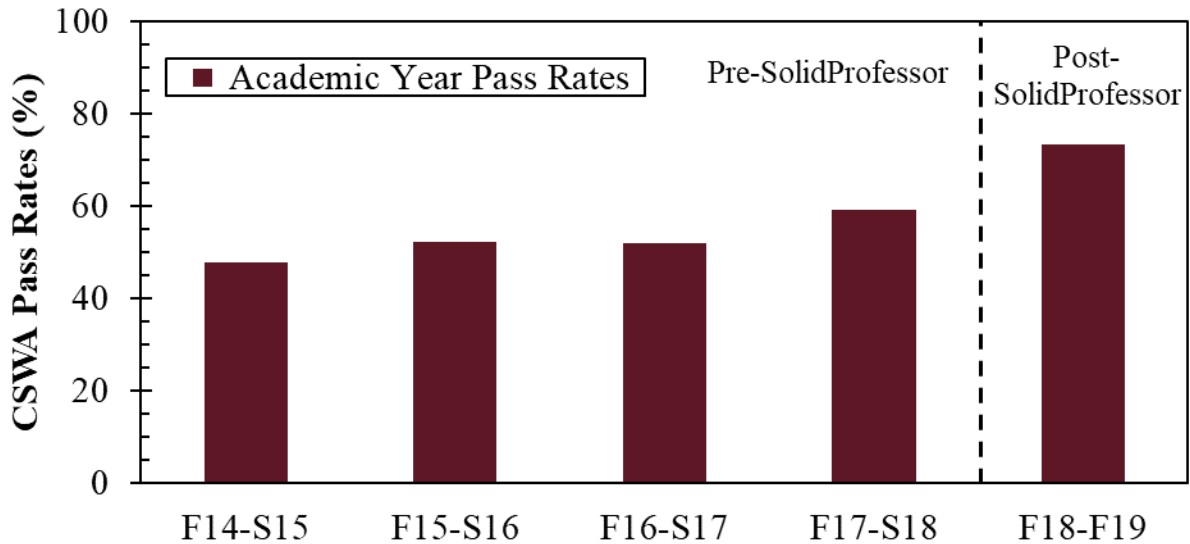


Figure 1. Pass rates for all whole academic years from pre- to post-SolidProfessor usage.

Figure 2 illustrates the pass rates for the first attempt, second attempt, and overall CSWA exam results per semester from spring 2014 until fall 2019. It should be noted that the CSWA results data from fall 2014 to spring 2016 were incomplete. This was due to the results data not being available from every section taught during those semesters. Even so, an increase in the pass rate was evident when comparing the pre- to post-SolidProfessor courses where each had an average overall pass rate of 50.6% and 73.4%, respectively. The average pass rates for first and second attempt for pre-SolidProfessor were 30.5% and 29.1%, respectively and for post-SolidProfessor were 53.4% and 44.2%, respectively. The average overall pass rate increased by 45% after SolidProfessor was implemented.

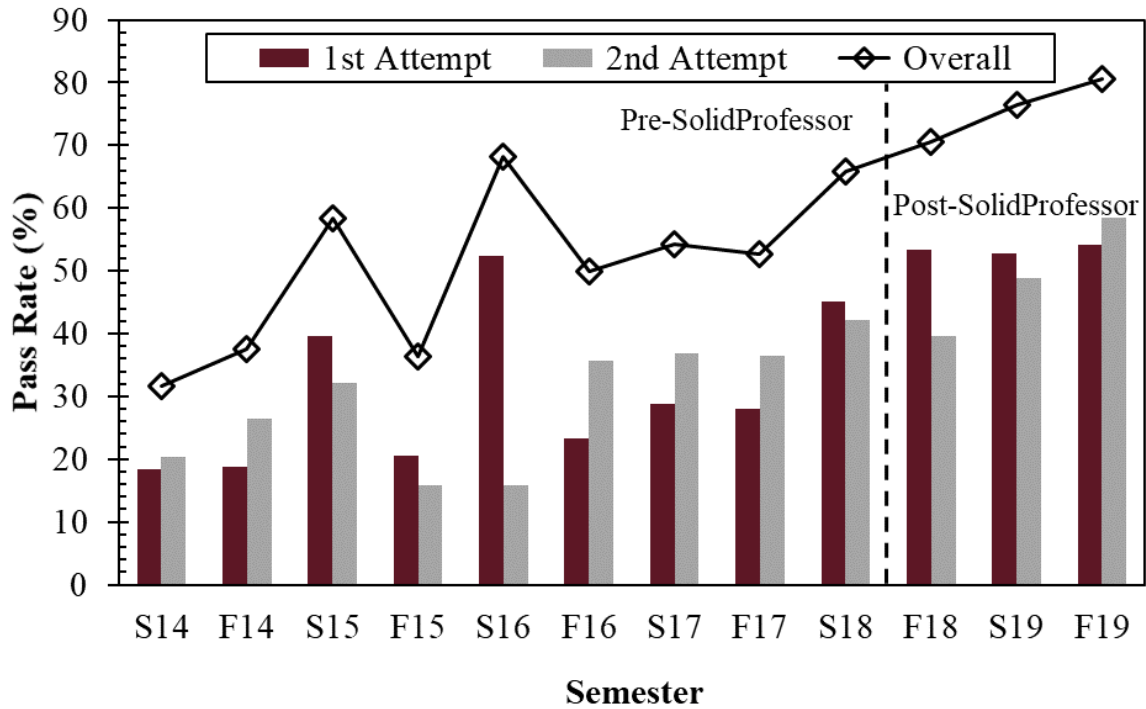


Figure 2. First and second attempt with overall pass rates.

Average CSWA exam scores per semester for first and second attempts are shown in Figure 3. From fall 2018 until now, the average score is consistently higher than previous semesters where the average exam scores for pre-SolidProfessor were 115 ± 16 and 126 ± 19 for first and second attempts, respectively. Post-SolidProfessor average exam scores were 157 ± 12 and 149 ± 16 for first and second attempts, respectively. On average, an increase in overall test score of 27% was observed after implementing SolidProfessor. Of note, both spring 2016 and spring 2018 had higher than average CSWA scores when compared with the other pre-SolidProfessor data; this was possibly due to the use of incomplete CSWA data for spring 2016. The authors were not able to explain the higher than average score for spring 2018 as the class structure was largely unchanged from previous semesters. Uncertainty bounds for each semester were determined using 95% confidence intervals for a normal distribution, which demonstrate the confidence that the true mean lies within the bounds.

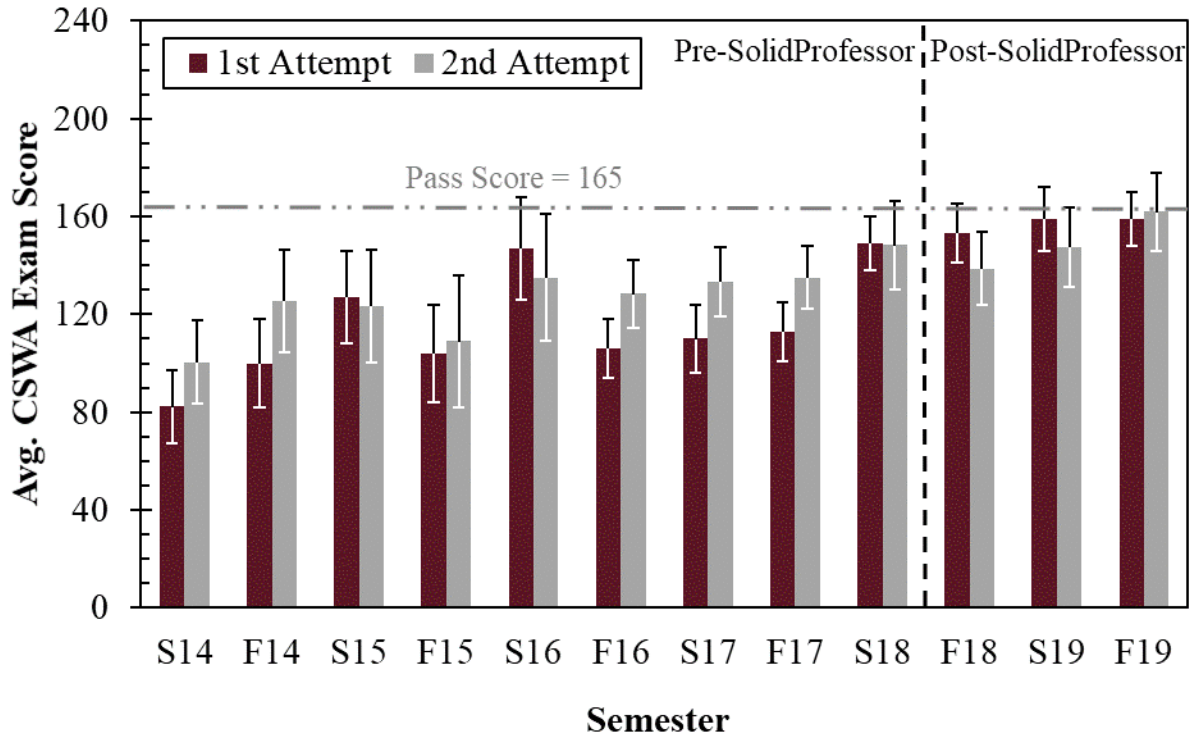


Figure 3. Average CSWA exam scores per semester.

The overall completion rate for the first required SolidProfessor course, which was expected to be completed before the first attempt at the CSWA, was 81% based on SolidProfessor's progress percentage reporting. However, participation in the additional SolidProfessor course was evaluated and found to be low. A total of 45 out of 149 students enrolled in the additional CSWA prep course across three semesters and eight sections. None of the 45 students completed all of the course assignments, and only 22 of the 45 passed the second attempt at the CSWA.

Conclusions

After implementing the online subscription service, SolidProfessor, the authors were interested in how the new teaching software affected SOLIDWORKS CSWA scores. CSWA pass rates did increase overall by 45% compared to passing rates from previous semesters. The average CSWA score increased as well from 115 to 157 for the first attempt and 126 to 149 for the second attempt. It should be noted that before SolidProfessor was implemented the average score increased from the first attempt to the second attempt, however after requiring SolidProfessor the average CSWA score decreased from the first attempt to the second attempt for the 2018 – 2019 academic year. This could be due to several factors; one being that a higher number of students were passing at the first attempt. From this, it appears that students who take the second attempt at the CSWA were not performing as well on it as students who passed the CSWA the first time, which may be related to the participation in the created SolidProfessor courses. The first course, *SOLIDWORKS Beginner to Certification*, was a required course with homework and lab quizzes based on the course material while the second course, *Certified SOLIDWORKS Associate Prep*, was an optional course with no graded assignments based on the course. The overall completion rate for the required SolidProfessor course was fairly high, 81%,

while participation in the optional course was low where only 45 of 149 students taking the CSWA again participated in the course and none of the students completed the course. In the future, the authors would like to investigate using an incentive to increase participation in the second SolidProfessor course to see if higher participation and completion rates would increase the passing rates and scores of the CSWA second attempt.

References

1. Kukk, P. & Heikkinen, S. Assignments and Grading in Engineering Graphics Courses. *Int. J. Eng. Pedagog.* **5**, 8 (2015).
2. Cozzens, R. *AC 2012-5246: YOUTUBE: AN EFFECTIVE CAD TRAINING RESOURCE YouTube: An Effective CAD Training Resource.*
3. Toto, R. *Advances in Engineering Education instructional Strategies to Promote Student Strategic thinking when Using Solidworks.* **1**, (2014).
4. Ault, H. K. & Fraser, A. Use of Technology Solutions to Improve CAD Instruction. *Eng. Des. Graph. J. Copyr.* **76**, (2012).
5. Talley, A. P. & Grau Talley, K. P. *Work in Progress: Teaching Design Theory and Mastercam in a Hybrid Flipped Classroom Environment.*
6. Bubacz, M., Washuta, N. & Bass, P. *2018 ASEE Southeastern Section Conference A Flipped-Classroom Format Applied to a Software-Based Course.*
7. Webster, R., Dues, J. & Ottway, R. Industry Supplied CAD Curriculum: Case Study on Passing Certification Exams. *Eng. Des. Graph. J. Spring* **81**, (2017).
8. SolidProfessor. Available at: <https://www.solidprofessor.com>. (Accessed: 11th November 2019)
9. SOLIDWORKS. (2018).
10. Planchard, D. *Official Guide to Certified SOLIDWORKS Associate Exams: CSWA, CSDA, CSWSA-FEA (SOLIDWORKS 2015 - 2017).* (SDC Publications, 2017).

Emily Spayde

Emily is an assistant clinical professor in the Mechanical Engineering Department at Mississippi State University. She obtained her Ph.D. in Mechanical Engineering from Mississippi State University in 2017. She has a high interest in undergraduate education and teaches a variety of mechanical engineering courses.

Shane Brauer

Shane is an assistant clinical professor in the Mechanical Engineering Department at Mississippi State University (MSU). He graduated with his bachelors from MSU in Mechanical Engineering in 2010 then began working as a graduate research assistant at the Center for Advanced Vehicular Systems. He graduated with his Ph.D. from MSU in Mechanical Engineering in 2017 where his graduate studies focused on characterization of structure-property relationships for various materials. His clinical interests are in integrating curriculum content across all years of undergraduate studies. His research interests are in characterizing metals and additive manufacturing.

Dustin Spayde

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Dustin Spayde is an instructor in the Mechanical Engineering Department at Mississippi State University. He obtained his M.S. in Mechanical Engineering from Mississippi State University in 2013. He has a high interest in undergraduate education and focuses on laboratory-based curriculum courses.