Hands-on Workshops Improve Learning of Software Engineering Skills

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ABSTRACT

The software industry has been seeing steady growth worldwide. However, the quality of the developed software is tightly related to the supply of skilled and capable software developers who are able to cope with many challenges. Software skills are usually gained in upper-level software development courses in undergraduate IT majors. We have been applying hands-on workshops delivered through an open educational resource (OER) website in these courses. By testing the effectiveness of two workshops on 62 participants who completed both pre- and post-workshop surveys, we found that hands-on workshops were able to teach practical software development concepts.

CCS CONCEPTS

• **Applied computing** → **Education**; *Interactive learning environments*; *E-learning*.

KEYWORDS

software development, software engineering, hands-on workshops, Agile, open educational resources, OER, project based learning, PBL

1 INTRODUCTION

In today's world, run by computer technology, there is a push to produce better software products. The field of software technologies has been seeing steady growth worldwide recently. "The Most In-Demand Jobs of 2023" article from LinkedIn [11] lists "Software Engineer" as the #3 top emerging job in the U.S. list. These job roles may require candidates to know several different programming languages, frameworks, and cloud technologies [9]. These technologies constantly evolve by getting improved or becoming obsolete, which requires educational materials for teaching them to be constantly updated. Even though college education can only do so much and usually strive to provide a general path to prepare students, we believe there are sustainable options to improve software development (SD) education.

It is known that SD education can be improved by exposing students to more critical thinking through the teaching of Agile methodologies and engaging students via real-world projects [7, 8]. Project-based learning (PBL) has been well established in the SD field [4], especially with the *software engineering practicum* [10].

In this paper, we investigate the effectiveness of hands-on workshops to complement our practicum course. We host the workshop materials as open educational resources (OERs) [5, 6]. We augmented an existing OER for software development or engineering courses for undergraduate information technology (IT) majors by adding hands-on workshop slides and videos. Then, we measured the effectiveness of these workshops by conducting surveys with the participants via self- and knowledge-assessment questions.

2 METHODOLOGY

2.1 A highly diverse student population

This study was performed at Georgia Gwinnett College (GGC), which is an *open-access* undergraduate institution that is known for serving an ethnically and racially diverse student population. It has been ranked #1 in ethnic and racial diversity in the Southern Regional Colleges category by the U.S. News & World Report for the ninth consecutive year as of Fall 2022 [2, 16]. Mundie and colleagues [13] concluded that GGC is "an excellent laboratory to investigate gender/ethnicity questions" in a study where they investigated education concepts, such as course repeats, mastery, equity, and institutional STEM culture. Therefore, the results of our study likely present a good case study for highlighting the performance of ethnic and racial minorities in the U.S. [1]. Our student body is non-traditional because there are many who are first generation college students and others who are employed outside of the college as either part-time or full-time, and preoccupied with various family responsibilities.

2.2 External client-led, app building projects

By using the project-based instruction (PBL) method, we aimed for students to improve class engagement and learning satisfaction, to gain experience in working on real-world applications, and to improve student success rate in getting a job in the SD field. Having successfully shown that students can work independently on open-ended projects, we continued to provide students with novel, client-developed challenges requiring a solution in the form of an application [7]. Students chose from a selection of client ideas which presumably provide a level of ownership that leads to

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increased engagement toward completing the project. Through experiential learning (EL) and in particular, through PBL, connection with problems of the real world is achieved.

For the software development and engineering fields, real-world projects and case studies increase the effectiveness of education [4]. Practical knowledge (which experiential learning engenders) is the crucial preparation for Software Development students in their career path in the field, which requires a very steep experience with current tools and computer languages.

Our approach is to develop novel client-led products from scratch, which is a win-win for our students, who experience a real-world project in the field, and also for the clients, who might use these products. Interdisciplinary faculty or other individuals outside the course serve as clients throughout the project. Students work in groups of 3-4 to convert a client-proposed idea into an application usable by the campus community.

In this paper, we use the PBL in our SD course and focus on two web development workshops: one for Bootstrap and another for the React Javascript library. To support the 35 students who used the MongoDB, Express.JS, React, Node.js (MERN) stack development framework, the React workshop provides knowledge not taught in any of their previously taken courses by teaching students to create a custom web app. As a result, students developed various real-world products using React and the MERN stack.

2.3 Open Educational Resource (OER)

Previous work [5, 6] introduced our online OER textbook. Here, we are presenting the results of our study on the effectiveness of the newly added (in Spring 2022) hands-on workshops to the textbook.

To maximize student engagement and minimize the amount of reading needed for the class, we opted to include course content as slide presentations in our OER textbook. This allowed us to keep the content in one place for reading assignments and lectures. To host slide content without requiring a download or plugin (as in PDF or PPT files), we adopted a web-native system of Reveal.js.[1] In Hugo, it is supported with the `reveal-hugo`[2] theme. We are in the process of generalizing our setup to share it as a general textbook authoring template.

Our current OER (https://soft-eng-practicum.github.io/softdev2-resources/) includes seven chapters for students and additional materials and guidance for instructors intending to adopt these materials. Some of these chapters contain introductory materials to review software engineering concepts, Agile development principles, Scrum and Kanban, requirements analysis and user stories, version control with Git and social computing on Github, project management in JIRA, instructions for leading student project phases in class, and finally, software intellectual property and licensing.

2.4 Hands-on Software Development Workshops

The two hands-on workshops that we focus on are for teaching introductory skills in Bootstrap and React. Each workshop fits into a 1 hour and 45 minute class period, so there was a limited amount of activity that could be completed during that short period of time. Workshops begin with an introduction to the respective OER textbook chapter and workshop [3]. A pre-survey was given to assess participants' prior knowledge about the computing concepts before we began to teach those concepts. The participants were then given an introduction to the software skills and the final product of what are they developing. Following that, they were guided through the workshop slides that contained hands-on code snippets and explanations, a practice module where participants were given time to implement the concepts to develop the working product, and then to complete a post-survey. Both pre-and post-surveys were anonymous and had the same knowledge questions to assess the learning of the software skills. All of the pre and post-workshop surveys were administered using the Qualtrics software [14]. We only considered the data from consenting participants. Statistical analysis was performed on both pre-and post-surveys to eliminate those answers that could be considered wrong due to the time spent on the test (interrupted, not finished, too short, etc.); the correct time is estimated to be between 5 to 15 minutes per survey. Each workshop was delivered to the same Software Development 2 course students either in-person or online using the Discord online platform. Results from these pre and post-workshop surveys and statistical analysis are presented next.

3 RESULTS

For each workshop, the first question was a self-reported assessment of the knowledge about the workshop subject. However, as shown before, self-reporting indicates confidence but it is not evidence of a deep understanding of the knowledge [15]. Thus, we objectively assessed the ability to implement the knowledge gained from the workshop via several knowledge-based questions. We present the results obtained for each of the two workshops next.

3.1 Results from the Bootstrap Workshop

This workshop teaches how to use Bootstrap and jQuery for creating a web-based form where one can add or remove courses from a table as shown in Figure 1. While the workshop introduces students to Bootstrap, it also provides the necessary skills for HTML/CSS, Javascript, and JSON (see [3] under `Workshops/Web Basics`).

A total of 35 participants completed the pre-survey (16 on-site and 19 online) and 32 (16 on-site and 16 online) completed the post-survey for this workshop.

Self-reported knowledge of Bootstrap. 21 out of 35 participants (60%) had no prior knowledge of Bootstrap, 12 (34.3%) self-reported as "newbies", 1 (2.9%) reported themselves as having "intermediate" knowledge, and 1 as "proficient".

Results from the Bootstrap skills assessment. We asked 7 multiple-choice knowledge questions related to the Bootstrap skills that participants learn from our workshop. The questions and their choices are shown in Table 1.

Figure 2 shows the statistical summary of student success for each Bootstrap workshop knowledge question (in the same order shown in Table 1) for both pre- (in blue) and post-surveys (in orange). The bars show the mean and the black lines show the standard deviation of the success score (0 being the wrong and 1 being the correct answer) across all students for each question.

The "Bootstrap" and "Bootstrap classes" questions received more correct answers in the post-survey on average, which suggests that these new concepts were learned during the workshop (Figure

[1] https://revealjs.com/
[2] https://themes.gohugo.io/reveal-hugo/

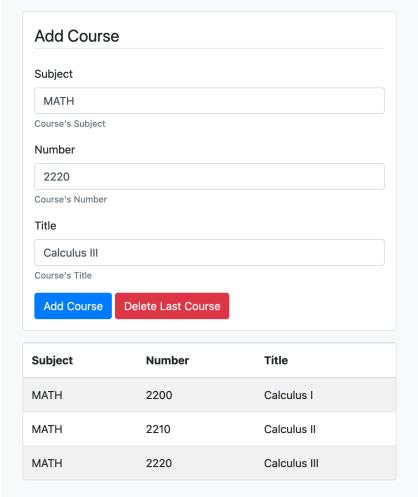

Figure 1: Final Product of the Bootstrap Workshop: A Form for Adding and Removing Items from a Table.

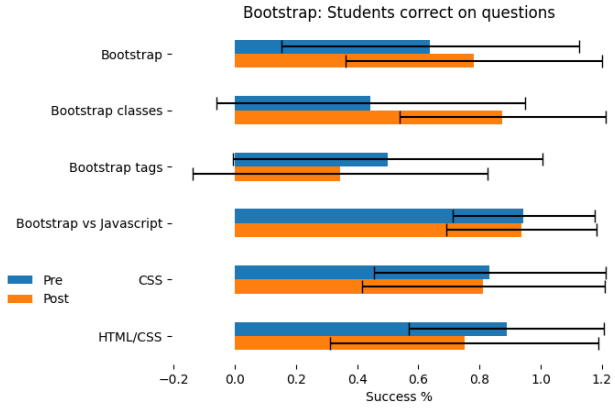

Figure 2: Statistical Summary of Student Success Change from Pre- to Post-survey in the Bootstrap Workshop.

2). The "Bootstrap tags" question shows the opposite (although with a large standard deviation), i.e. more correct answers in pre-survey than in post-survey, suggesting that this concept was not well understood and needs improvement of the workshop slides. The rest of the questions show almost similar correct answers for both pre and post-surveys. The HTML/CSS concepts were learned by students in previous classes and thus were not the subject of our investigation; these concepts have to be present in the workshop slides for the final product to work, but during the workshops, we did not insist on presenting them in detail.

We used the Mann and Whitney's U-test or Wilcoxon rank-sum test [12] as the non-parametric statistic hypothesis test to analyze the difference between two independent samples of ordinal data (pre and post) for each question. The p-values were obtained using the `mannwhitneyu()` method from the `scipy.stats` Python package (with two-sided, default asymptotic method). Only the "Bootstrap classes" question showed a statistically significant change from the

Table 1: Knowledge Questions for Bootstrap Workshop (*correct answers).

Question and Options
What is Bootstrap? A. A standardized system like HTML that describes websites. B.* The most popular CSS framework for developing responsive and mobile-first websites. C. The web does it all; it is magical.
Which one of the following is a Bootstrap class for setting the background color to red? A. .bg-info; B.* .bg-danger; C. .bg-student
Bootstrap uses JavaScript tags to allow defining new classes. (yes/no*)
Bootstrap can be said that gives the look of a nice website, while Javascript makes components of the website to be interactive (yes*/no)
What is CSS? A.* Used for describing the presentation (color, graphics, animation) of an HTML document. B. It is no longer used for web pages. C. Used for describing structural elements of an HTML page. D. I'm not sure.
What is HTML/CSS? A.* HTML: A standardized system for tagging text files to achieve font, color, graphic, and hyperlink effects on World Wide Web pages; it is associated with a style sheet (CSS) used for describing the presentation of an HTML document. B. HTML: A standardized style sheet for tagging text files to achieve font, color, graphic, and hyperlink effects on World Wide Web pages; it is associated with a document (CSS) used for describing its presentation. C. The web does it all; it is magical.

pre- to post-survey ($p = 0.000239$, which is less than 0.01). This result shows that the workshop can increase students' practical knowledge of the subject. The rest of the questions had p-values greater than 0.1 meaning that the difference between the pre and post-results was not statistically significant.

Comparing the results among the 6 questions (Figure 2), we can observe that the worst success (as total pre and post) was obtained for the newly introduced concept of Bootstrap (top 3 questions). Questions regarding concepts learned in previous classes (bottom 3 questions) received, as expected, more correct answers. However, what is of concern is that some students still failed to answer the previously learned HTML/CSS questions (bottom 2 questions) although this workshop refreshed their usage via practice.

Rating of workshop materials. Because there were few students who have used the OER textbook before this workshop, we asked for feedback about the workshop and its materials in both pre-and post-surveys via a set of 8 Likert-scale statements. These "workshop statements" asked to be ranked between the numerical values of −2 to +2 which corresponded to the range: "Strongly disagree", "Somehow disagree", "Neither agree nor disagree", Somehow agree", and "Strongly agree". We show these results in Figure 3. Questions are shown on the left side and their survey responses are on the right side, with colored bars, blue for pre-survey results

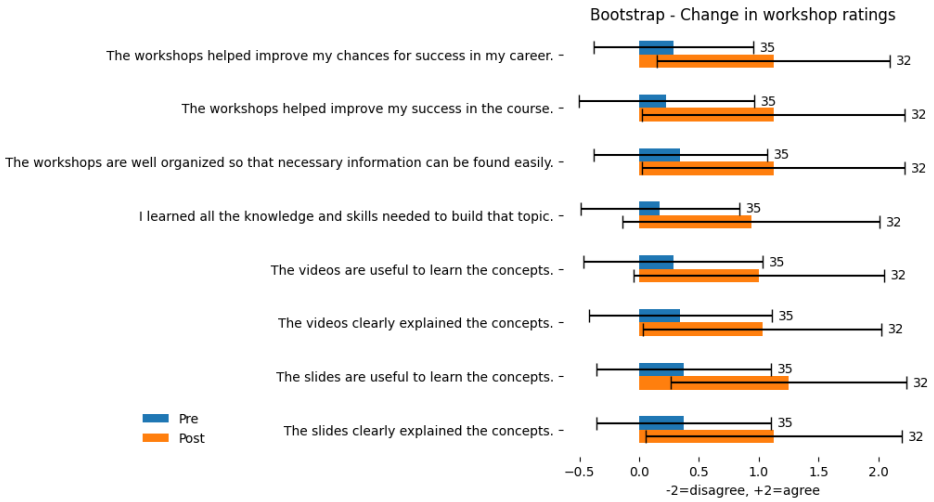

Figure 3: Ratings of the Bootstrap Workshop Materials by Students.

and orange for the post-survey results, as before. Numbers next to the bars show the total number of survey participants, 35 for pre-survey and 32 for post-survey. Bars show the mean and the black lines indicate the standard deviation for each statement.

In the pre-survey, no workshop statement received a "strongly disagree" rating. So, the majority of the students who have seen these materials prior to the class workshop agree that the workshop and its materials are useful. The only negative comments were that one student somewhat disagreed that these are useful to them, and 2 other students reported that the videos and slides were clearly explaining the concepts, but they do not agree that these materials are helping them in learning the concepts.

In the post-survey, one student "strongly disagreed" with all workshop statements (3%). 5 of the workshop statements received 1 or 2 students (3% - 6%) who "somewhat disagreed", and 3 statements received no such answer. Between 4 and 9 students (1.2% - 2.8%) still "neither agree nor disagree" with all these questions. This shows a significant change from the pre-workshop survey. Further, 8 to 10 students "somewhat agreed" (25% - 31%), and 12 to 17 students "strongly agreed" with all these workshop statements (37.5% - 53%).

Results shown in Figure 3 indicate a significant improvement in knowledge skills of this workshop as self-reported by students. In the pre-survey, 20% – 28% of students had a positive answer towards the workshop materials, with the majority of students being neutral since they have not participated or seen this workshop before the course. In the post-survey, the neutral answers were changed mostly into positive answers for these workshop statements, and between 68.75% and 78% of students had positive answers.

We used the same test (Mann and Whitney's U-test) [12] as before to analyze the differences between the pre-and post-survey data for each question. The p-values obtained were statistically significant for all statements ($p < 0.01$) indicating that all outcomes were significantly improved from the pre- to post-survey. In other words, the majority of students found this workshop and its materials useful in learning Bootstrap skills.

3.2 Results from the React Workshop

The goal of this workshop is to learn how to use React to implement a web-based login system that authenticates users via the serverless Firebase cloud service. The workshop introduces students to React and Firebase skills (see slides at [3] under `workshops/react/authentication-with-firebase`).

A total of 35 participants completed the pre-survey (18 on-site and 17 online) and 30 (17 on-site and 13 online) completed the post-survey for this workshop.

Self-reported knowledge of React skills. 16 out of 35 participants (44.4%) had no prior knowledge of React, 15 (42.8%) self-reported as "newbies", and 4 (11%) reported themselves as having "intermediate" knowledge.

Self-reported knowledge of Firebase skills. 24 out of the 35 participants (68.5%) had no prior knowledge of Firebase, 6 (17%) self-reported as "newbies", and 5 (14.2%) reported themselves as having "intermediate" knowledge.

Self-reported knowledge of implementing a Login system skills. 13 out of 35 participants (37.1%) had no prior knowledge of Bootstrap, 16 (45.7%) self-reported as "newbies", and 6 (17%) reported themselves as having "intermediate" knowledge.

Results for testing React, Firebase, and Login system skills. We asked 6 multiple-choice knowledge questions related to the skills that participants learn from our workshop. The questions and their choices are shown in Table 2.

Figure 4 shows the statistical summary of student success for each React workshop knowledge question (in the same order shown in Table 2) for both pre- (in blue) and post-surveys (in orange). The bars show the mean and the black lines show the standard deviation of the success score (0 being the wrong and 1 being the correct answer) across all students for each question. Three questions (rows A, E, and F) had multiple correct answers (as shown in Table 2) and the rest (rows B, C, and D) had only one correct answer.

The questions related to the Firebase skills received more correct answers in the post-survey than in the pre-survey (rows C and D in Figure 4). However, only the definition question (row C) had a p-value less than 0.05 indicating a significant difference between pre

Table 2: Questions for the React Workshop (*correct).

Question and Options
What is React? A. React (also known as React.js or ReactJS) is a free and open-source platform and framework for building single-page client applications using HTML and TypeScript. B.* React (also known as React.js or ReactJS) is a free and open-source front-end JavaScript library for building user interfaces based on UI components. C. The web does it all; it is magical.
Select all that are correct about ReactJS: A.* In a model view controller architecture (MVC), react is the "view" which is responsible for how the app looks and feels B.* It is an open-source, reusable component-based front-end library C.* Every React application has at least one component known as the Root/App Component D. The App component represents the entire application and is where all the child components are displayed E. It is an open-source, JavaScript framework written in TypeScript.
What is Firebase? Select all that apply. A. Firebase is a SQL help platform for working with web apps. B.* Firebase is a noSQL help platform for working with web apps. C.* Firebase is a platform developed by Google and provides developers with a variety of tools to help them develop quality apps.
Which are key features of Firebase? Select all that apply. A.* Real-time database. B.* Authentication. C. SQL database access. D. UI/UX components for the app.
What is a login system? A. A login system is a process that kicks an individual out once it identifies him/her or authenticates themselves. B.* A login system is a component of an app that allows an individual to gain access to a computer system by identifying and authenticating themselves. C. A login system comes as a default in the system and does not need to be implemented by the developer of the app.
A login system includes only the login page: (yes/no*)

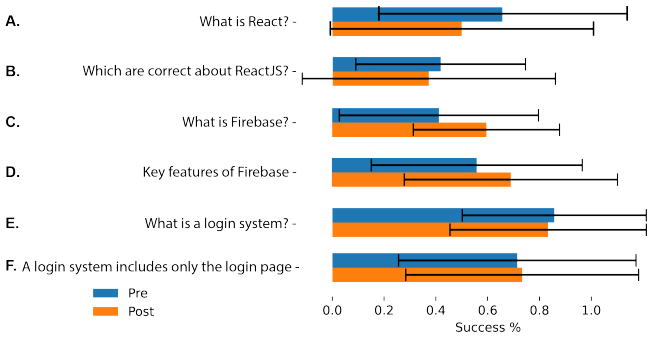

Figure 4: Statistical Summary of Student Success Change from Pre- to Post-survey in the React Workshop.

and post-data. The questions in rows A, B, and E show a decrease in the number of correct answers between pre and post-surveys, while the question in row E shows a slight increase. However, all the p-values for these questions are bigger than 0.1 and show that there is no significant difference between the respective results between the pre and post-surveys. We also notice that many students (85.7%) had good answers for the pre-survey to begin with for the login system questions, and the study shows they had nothing to improve upon. We conclude that from this workshop our students learned new Firebase skills, and solidified their login system knowledge. Our students seem they had difficulty understanding the React skills, and thus these need our attention in future workshops.

Rating of workshop materials. We conducted the same inquiry as in the Bootstrap workshop to ask for feedback about the React workshop and its materials in both pre-and post-surveys. We display these results in Figure 5 under the same format as the one used for the Bootstrap workshop feedback.

The p-values obtained using Mann and Whitney's U-test ([12]) were statistically significant for all statements ($p < 0.01$), except for the "The slides clearly explained the concepts.", "The videos are useful to learn the concepts.", and "The workshops are well organized so that necessary information can be found easily." statements indicating that all except 3 outcomes were significantly improved from the pre- to post-survey. In other words, the majority of students found this workshop and its materials useful in learning React skills, but the materials need to be a bit better organized, and maybe the slides need to provide more explanations. We are considering this students feedback in re-designing the materials for the next semester's React workshop.

4 DISCUSSION AND FUTURE WORK

In this paper, we tested the effectiveness of two hands-on, software development workshops for undergraduate students. We had previously established that student success and critical thinking abilities were improved via a hands-on, project-based learning approach as opposed to a lecture-only format [7, 8]. As we had moved away from the lecture-only format, we refrained from employing it only for the sake of comparison and instead focused on evaluating the workshops. We conclude that from our React workshop, our students learned new Firebase skills, and solidified their login system knowledge. However, the React skills taught were more difficult to understand by our students, and thus they need our attention in future workshops.

The success of at least one of the knowledge questions in the Bootstrap workshop suggests that our hands-on workshop is capable of teaching these practical skills. However, this workshop needs to be further improved and the assessment may need to be better aligned to observe improvement in the other questions.

We have included questions with multiple correct answers in our surveys for the React workshop. We observed that students had more difficult time answering these questions than the questions with a single correct answer. Particularly, the question related to selecting all the characteristics of ReactJS was by far the most difficult question, and it received the lowest correct number of correct answers (in both pre-and post-surveys). This indicates that our students have more difficulty with these types of questions and we need to be careful when assigning them for assessment.

We also asked open questions related to the OER textbook. Even though our OER was designed to provide all materials online in a mobile-friendly and accessible format [6], at least five students

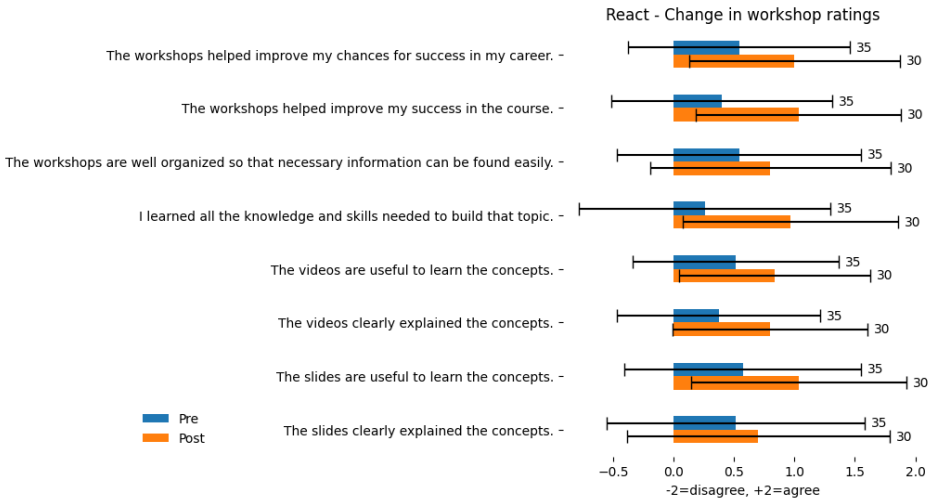

Figure 5: Ratings of the React Workshop Materials by Students.

indicated that they would also like to have offline versions of the workshop slides. There was also a request to improve the navigation by adding links between chapters. Students preferred to have a confirmation step before entering into full-screen slideshow mode after selecting a chapter. The "How did the availability of No-Cost-to-Students Learning Textbook and Materials help improve your learning?" question received a lot of positive feedback and praise. "Very nice to not have to pay and it is very to the point.", "I had the material readily available to use and didn't have to worry about affording anything extra", "I was more engaged with the textbook", "very helpful as learning is more focused on relevant topics" were a few of the students' answers.

More than 80% of Bootstrap participants and 83% of React participants agreed that the OER materials improved their success in the course, which was the ultimate purpose of our efforts. We plan to continue to improve both the content and the assessment methods for these and future workshops using the feedback received.

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REFERENCES

[1] U.S. Census Bureau and American Community Survey. 2018. ACS Demographics and Housing Estimates. Online public dataset. https://data.census.gov/cedsci/table?tid=ACSDP1Y2018.DP05&vintage=2018 Retrieved on June 12, 2020.

[2] Georgia Gwinnett College. 2022. Georgia Gwinnett College tops ethnically diverse southern regional college list for nine consecutive years in U.S. News & World Report rankings. Online news article. https://www.ggc.edu/about-ggc/news/georgia-gwinnett-college-tops-ethnically-diverse-southern-regional-college-list-for-nine Retrieved on June 20, 2023.

[3] Anca Doloc-Mihu and Cengiz Günay. 2022. Intermediate Agile Software Development. *Computer Science and Information Technology Open Textbooks* 13 (2022). https://oer.galileo.usg.edu/compsci-textbooks/13

[4] Kirti Garg and Vasudeva Varma. 2007. A Study of the Effectiveness of Case Study approach in Software Engineering Education. In *20th Conference on Software Engineering Education & Training, CSEET'07*. IEEE.

[5] Cengiz Günay and Anca Doloc-Mihu. 2021. An Open Educational Resource for an Agile Software Engineering Course. In *Proceedings of the 22nd Annual Conference on Information Technology Education* (SnowBird, UT, USA) *(SIGITE '21)*. Association for Computing Machinery, New York, NY, USA, 51–52. https://doi.org/10.1145/3450329.3476849

[6] Cengiz Günay and Anca Doloc-Mihu. 2021. A Sustainable, Accessible, and Standards-Compliant Hosting Method for OERs that Provides Easy Maintenance and Adoption. In *OERcamp.global Conference https://www.oercamp.de/global/*. https://oercampglobal2021.sched.com/event/rgj2

[7] Cengiz Günay, Anca Doloc-Mihu, Rahaf Barakat, Thomas Gluick, and Catherine A. Moore. 2020. Improving Critical Thinking in Software Development via Interdisciplinary Projects at a Most Diverse College. In *Proceedings of the 21st Annual Conference on Information Technology Education* (Virtual Event, USA) *(SIGITE '20)*. Association for Computing Machinery, New York, NY, USA, 206–212. https://doi.org/10.1145/3368308.3415411

[8] Cengiz Günay, Anca Doloc-Mihu, Thomas Gluick, and Catherine A. Moore. 2019. Project-Based Learning Improves Critical Thinking for Software Development Students. In *Proceedings of the 20th Annual SIG Conference on Information Technology Education* (Tacoma, WA, USA) *(SIGITE '19)*. Association for Computing Machinery, New York, NY, USA, 105. https://doi.org/10.1145/3349266.3351362

[9] Fatih Gurcan and Cemal Köse. 2017. Analysis of software engineering industry needs and trends: Implications for education. *International Journal of Engineering Education* 33 (Jan. 2017), 1361–1368.

[10] E. P. Katz. 2010. Software Engineering Practicum Course Experience. In *2010 23rd IEEE Conference on Software Engineering Education and Training*. 169–172.

[11] Greg Lewis and Manas Mohapatra. 2023. *The Most In-Demand Jobs of 2023*. Retrieved May 23, 2023 from https://www.linkedin.com/business/talent/blog/talent-strategy/most-in-demand-jobs

[12] H. B. Mann and D. R. Whitney. 1947. On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other. *The Annals of Mathematical Statistics* 18, 1 (1947), 50 – 60. https://doi.org/10.1214/aoms/1177730491

[13] Thomas Mundie, Charmita Burch, Michael Saum, Sherly Abraham, Charles Pibel, and Rudy Jackson. 2018. Gender and Race/Ethnicity Differences in Student Persistence after a STEM Course DFW. In *2018 Transforming STEM Higher Education*. Association of American Colleges & Universities. Talk presented at meeting.

[14] Qualtrics. 2020. *Qualtrics.com*. Retrieved June 23, 2020 from https://www.qualtrics.com/

[15] Cindy Robertson and Anca Doloc-Mihu. 2021. Assessing the Effectiveness of Teaching Programming Concepts through Online Interactive Outreach Workshops. In *Proceedings of the 22nd Annual Conference on Information Technology Education* (SnowBird, UT, USA) *(SIGITE '21)*. Association for Computing Machinery, New York, NY, USA, 123–128. https://doi.org/10.1145/3450329.3476861

[16] U.S. News & World Report. 2018. Campus Ethnic Diversity Regional Colleges South. Web page. https://www.usnews.com/best-colleges/rankings/regional-colleges-south/campus-ethnic-diversity Retrieved on June 20, 2023.