Pair Programming: Leveling the Field for Students with Learning Disabilities

PROCEEDING

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Abstract

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Slides

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Pair Programming: Leveling the field for students with learning disabilities

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Abstract: This paper is the report on the findings of a three-year study conducted in undergraduate computer science courses. It also describes the changes made to deal with COVID-19 during the summer and fall of 2020. We collected data on over 800 students with approximately 35 students identified as having learning disabilities (LD). These students were not professional programmers in a computer science department; rather, they were students from a Business College. Our preliminary results show that pair programming improved (a) teamwork and communication between the pairs; (b) confidence in students; and (c) comprehension and learning for all students. Thus, our preliminary results indicate that pair programming improved everyone's performance. Educators should consider the importance of collaboration with other disciplines when creating inclusive environments for students with disabilities.

Introduction

Despite the growing numbers of students with learning disabilities (LD) enrolling in postsecondary institutions, students with LD not only take longer to complete a degree, but also have significantly high drop-out rates (Newman et al., 2019). Their lower rate of college completion (30%-40%) is a great concern because there is a relationship between education and employment opportunities (U. S. Bureau of Labor Statistics, 2020; Cortiella & Horowitz, 2014). Postsecondary education is no longer a luxury, but a necessity for an economically moderate quality of life for working adults. Thus, students with LD are disproportionally affected by the lack of a college education.

In general, students with LD seem to have low self-esteem and low aspiration to pursue postsecondary education (Showers & Kinsman, 2017). Their academic history usually reveals lower performance as compared to their peers without disabilities. This lag in performance often is linked to deficits in cognitive processes (e.g., memory) and executive function skills (e.g., self-regulation) in addition to comorbidity with other disorders (e.g., attention deficit hyperactivity disorder; Fletcher et al., 2019). Although students' attributes known to be somewhat inheritable have been found to have a direct relationship with completion of postsecondary school (Showers & Kinsman, 2017), environmental factors can support students and prevent their failure (Pennington et al., 2019).

The challenging characteristics associated with having LD manifest in the college setting as difficulties with oral and written language, and/or mathematics. As a result of students' LD, low academic performance is observed. Students' inherent executive dysfunctions negatively impact their ability to manage time, organize, focus and sustain attention to tasks, and advocate for themselves. Consequently, all these attributes negatively affect their emotional, academic, and social life (DeDepo, 2009; Yu et al., 2019).

Computing courses can be especially difficult for students with LD. However, the use of accommodations and effective instructional strategies can make learning easier, boost self-esteem, and improve students' educational outcomes (McGregor et al., 2016). Given the importance of a college degree completion, the low rate of students with LD college completion, and the impact of effective instructional strategies, we decided to examine the effects of pair programming, a collaborative type of programming, as an effective strategy used in some college classrooms by computer science professors. Pair programming is an instructional strategy in which two programmers work side-by-side at one computer, collaborating on the same design, algorithm, code, or test, and helping each other solve the

problems. Typically, a programmer acts as the driver who controls the keyboard and mouse and writes the code. Another programmer acts as the observer or navigator, and is responsible for reviewing the code, and, at the same time, preventing and identifying logical and syntactical errors in the code (Estácio & Prikladnicki, 2015). Each programmer takes turn being the "driver" and the "navigator." The literature on pair programming shows an increase in student performance and retention in computer science majors (Lewis, 2011; Sobral, 2020).

The Study

This study was conducted in undergraduate courses offered by the Computer Science Department at a university in the southeast of the United States. Students in those courses were not computer majors; instead, those students were from the Business College. Computer science instructors had been puzzled with the few number of students with LD who were computer majors. With the support of a grant from the National Science Foundation, they decided to collaborate with other disciplines and examine the impact of *pair programming* as an instructional strategy to increase students with LD's as well as other at-risk students' performance in computer courses.

Eight hundred students participated in our experimental study. Out of the 800 students, 35 had LD. Data collection included students' pre-mid- and post-survey. Students were randomly assigned and reassigned to different partners. However, we tried not to pair two students with LD. We thought that by using a random system would avoid unfairly pairing students by ability.

Results

Preliminary data analysis indicates that all students benefitted from pair programming. Most student comments were very positive. Students reported they enjoyed learning something new (i.e., programming) and working with a partner collaboratively. Some students stated that their partners were very helpful, and they really benefitted learning from their peers. A few students expressed they did not like programming, and they felt frustrated learning how to code. However, the majority of the students said they appreciated the opportunity to problem-solve and to acquire new skills.

Conclusion

Pair programming revealed to be an effective educational strategy that helped all students. The collaborative nature of pair programming provided support for students with less technology experience and for those with disabilities. As any educational methodology, pair programming has its advantages and disadvantages. For example, pair programming allows interchange of knowledge between partners. However, some individuals prefer working alone and find tiring helping their less experienced partners.

Many of the barriers affecting the successful performance of students with LD in higher education can be removed by instructors who can create an inclusive learning environment. By using teaching methods that focus on removing curriculum and environmental barriers for students with LD, instructors have the potential of support and accommodate their needs. Collaboration can address students' social integration and academic success.

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