Seat Assignment Contribution to Student Performance in an Information Technology Classroom

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Abstract — This work seeks to improve the performance of low-performing students in an information technology classroom through a novel seating assignment methodology. In this study, students at the United States Military Academy were assigned seats in strategic locations within their classroom so as to improve their interaction with their instructor and their peers. Seating is determined by an order-of-merit list (OML) established by ranking students in accordance with their GPA, SAT-Math score, and programming experience. By strategically arranging these students, the authors seek to provide low-performance students with greater opportunities to obtain assistance and improve their performance in the course. Initial results indicate that strategic seating offers improved teacher-student interaction with a marginal improvement to the overall course performance of low-performing students.

Keywords: Seating Assignment, Information Technology, Student Performance

INTRODUCTION

The authors of this paper are junior faculty at the United States Military Academy (USMA) charged with teaching an introductory information technology course (IT105) to the cadet equivalent of college freshmen. The IT105 course is a core requirement for all cadets attending USMA with over 1000 cadets completing the course annually. To simplify our discussion, we will henceforth refer to USMA cadets as students.

The purpose of this study was to investigate the effect of a novel seating assignment technique for low-performance students as determined by their GPA, SAT-Math score, and programming experience. While GPA was used primarily for student classification, SAT-Math scores and programming experience were utilized to better classify which students would need the greatest assistance. These same attributes also helped us to identify which students were best able to give assistance. For the purposes of this study, low-performance students are classified as those students comprising the bottom third of the class based on the determinants listed above. These students were placed in the center aisles of the room where they would be closest to the instructor and paired with high-performing students located in the center columns of three-desk rows situated on either side of the classroom. A diagram of this arrangement is shown in Figure 1. Our research seeks to increase interaction of low-performing students with both their instructor and their high-performing peers seated next to them. The desired outcomes were two-fold. The first is for low-performance students to always have the ability to obtain assistance from someone capable of providing useful assistance quickly during in-class-exercises (ICEs). The second desired outcome was for these students to keep pace with their peers during ICEs and improve their performance on graded events. For the IT105 course, ICEs consist of designing, programming, and implementing Raptor [1] and Java code.

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Studies have shown that seat location and proximity to the instructor [2], [3], [4], [5], student participation and interaction [6], [7], [8], and peer assistance [9], [10], can all affect student learning. Studies have also shown that instructors may need to interact more frequently with some students than with others, particularly in lab-style classrooms [11].

Our strategic seating approach allows us to incorporate the benefits of all of these studies into a single methodology. Similarly, this methodology offers the potential to improve the overall performance of students who might struggle in an information technology course with an emphasis on programming. Our study seeks to evaluate the effectiveness of placing students with the poorest performance records (i.e., low GPA, low SAT-math score) and least programming experience next to students with the highest performance records and greater programming experience in seats that are more accessible to the instructor. The goal is to improve the performance of these students by ensuring that they have greater opportunity to receive intimate and personal interaction with their instructor or with the high-performance student next to them when the instructor is engaged with another student.

**BACKGROUND AND RELATED WORK**

According to Franklin et al., much about the learning progress can be gleaned by the physical arrangement of most college classrooms [2]. Seating is one such factor. Franklin et al. supports this position with studies conducted by Sommer who observed that classroom seating location has an effect on a student’s classroom participation [6]. They note, based on Sommer's research, that there is more participation toward the front and center of the classroom and contribute this observation to the increased involvement and eye contact of students with their instructor. They further conjectured that a student’s choice of seating location is indicative of that student’s goals for the course [2]. In their own research, Franklin et al. found that as the distance from the instructor grew—both toward the rear and side areas of the room—grades decreased as a function of that distance. One explanation for these results, as indicated on student surveys, is that sitting closer to the teacher carries a courtesy obligation to pay attention; however, they also surmised that this obligation is minimized as distance from the instructor increases.

The work of McCorskey and McVetta [3] identify certain seats as high, medium, or low interaction seats and expands upon Koneya's work [5] on student interaction. They observed that in a traditional setting, where a square room has all desks oriented towards the front of the room and the teacher, the seats closest to the front and center are considered the seats of highest interaction [3]. This connection between seating location and classroom participation is further supported in research by Daly and Suite [7] and research by Totusek and Staton-Spicer [8]. From this body of work, we can infer that the students’ desired level of participation affects their desired seating arrangement. For instance, McCorskey and McVetta [3] found that over half of the students preferred the traditional seating arrangement in required courses while the majority of students taking elective courses preferred a horse-shoe or modular arrangements geared toward participation. They also state that instructors should be careful when arranging students who do not want to interact to seat locations where interaction is high. They state that doing so could potentially cause students to respond negatively to the course. Additionally, Koneya's work [5] demonstrated that low-verbal students would not talk regardless of their seating location. So, while the thought is that traditional seating arrangements support teacher-student interaction and horse-shoe arrangements support student-student and student-teacher interaction, interaction may still not occur if the student lacks a positive regard for the course [3].

In consideration of the above mentioned research, the distinction that we make in our own research is that our class is a lab-based course where students work primarily on their own during in-class-exercises. As a result, we do not
believe that our seating study forces students to interact any more than they would normally outside of requesting assistance from their instructor or peers. Still, as is mentioned above, we should be cognizant that students placed in high-impact seats may feel pressured to interact more with their instructor due to the closeness of their proximity. Thus, we do not force interactions with these students anymore than is necessary to check their work.

Another, benefit of moving students [12] is that it potentially moves students away from friends who may have otherwise distracted them during the course. Benedict et al. [12] found that over 50 percent of their student population preferred to sit near friends and speculated that students may have chosen to sit farther from the instructor because that is where the open seats allowing them to sit together were located. In yet another study [4], authors point out that closer proximity and direct orientations between two students’ seating locations produces greater conversation between them. It is anticipated that our newly structured seating assignment will further encourage students to converse on the academic subject being covered rather than the typical banter that accompanies conversation between close friends. While this is not the primary objective of our research, it could be considered a benefit.

Other researchers have also looked at ways of strategically placing students to improve their performance. Hence, moving students to different seats nearer the instructor is not without precedent. Benedict et al. [12] state that even students in a large classroom who are "forced" forward of their preferred locations are more apt to receive higher grades. They also used previous academic achievement and ability—obtained through GPA and ACT scores respectfully—as one set of indicators for how likely students were to receive good grades. Of course, the other variable they used involved the student’s proximity to the instructor. Our research is similar in that we utilize academic achievement to organize where our test group is placed in regard to the instructor’s vicinity. It diverges from this study in that we have a smaller class of 16 to 18 students, and we utilize academic achievement to organize where our high and mid-level performers will be placed in order to best assist our low-performance students.

Beyond seating assignments, another group of researchers has studied the impact of technology on the interaction between teachers and students. Sills-Briegel [11] examined teacher-student interactions in a computer lab in order to investigate the effects of technology on the learning process. In this setting, researchers found that teachers worked closely with some students and not at all with others; however, they still found that student-teacher interaction was observed to be significantly higher in the lab setting than it was for classroom settings. For instance, researchers observed that teachers worked within an intimate range (i.e., within 1.5 feet) of students and nearly twice as often within a personal range (i.e., 1.5 to 4 feet) of students in a lab setting than they did in a classroom setting [11]. While this study demonstrates that those students needing assistance do get more intimate and personal interaction with their teacher in a computer lab-based course, it does not address the students’ performance as a result of this interaction. Furthermore, it does not consider seating assignments or the possibility of peer interaction when the instructor is engaged with another student. Often, when a teacher in a computer lab stops to assist one student, that teacher is totally engaged with helping that student address his/her issue. While the instructor is engaged in this way, other students can only wait for assistance or question their peers—this may or may not be encouraged in class and that peer may not be the best student for the individual to query.

To address the benefit of peer assistance, many computer science courses have seen a rise in the number of educators opting to use “pair programming” as a means of teaching students and staff [9]. Neha et al. found, in a study conducted at North Carolina State University, that a student’s perception of another student’s skill level significantly influences his/her compatibility as pair partner. Part of the argument for seeking compatibility between students in a pair partner arrangement is that studies have shown that a lack of compatibility can cause high-performance students to stagnate when they are working too far below their ability [9], [10]. Conversely, this same issue can cause low-performance students to become confused because they are working too far beyond their ability [9]. Still, one fortunate observation by Katira et al. [9] is that over 90 percent of the pairs they studied reported themselves as compatible despite the researchers’ attempt to compare skill level, personality types, and self-esteem. This suggests a random pairing may be just as successful when such factors are not known. They further speculated that pairings could be formed by using midterm scores to assess student skill levels prior to the grouping of students [9]. An additional benefit to pair programming, as surmised by David Keirsey [13], is that group diversity brings a set of strengths that complement the weaknesses of any single group member. It also forces students to look at a problem from viewpoints they might not otherwise see and improves upon the students’ understanding of the problem [13], [9]. In our own research, we do not utilize pairs. Instead, we form our students into groups of three with our low-performance students place in the aisles, the highest performing students in the center columns, and the middle range students against the walls of the classroom. This grouping is partially forced on us due to classroom
size and desk layout; however, we anticipate that the order of these groupings will allow our high-performing students to assist our mid-performance students as well as our low-performing students as occasion arises.

EXPERIMENT

In Spring 2011, a total of 587 students were enrolled in the IT105 course. The sample population from this body of students consisted of 15 sections ranging in class sizes of 16 to 18 students for a total of 258 students. Of these sections, seven sections formed the test group while eight sections formed the control group. These classes met for instruction two to three times per week for instructor-led discussion and in-class exercises (ICEs), which consisted of designing, programming, and implementing Raptor [1] and Java code. For the test groups the seating assignment depicted in Figure 1 was used while control groups were allowed to self-select their seats. The seat assignment for the test group was then determined through the development of a student Order of Merit List (OML) using each student’s GPA, SAT-Math score, and prior programming experience as a means of determining student ranking in the OML.

All students were first allowed to self-select their seats upon entering the classroom. Students were then asked to complete an initial survey regarding their choice of seating location. By lesson three, an order-of-merit list (OML) was developed and seating charts were made for each test group. While control group sections were allowed to remain in their originally selected seat, test groups were assigned seats in accordance with their class’s new seating chart. One issue with the self-selection data obtained from our students involves the order in which they entered the room. Students who entered the room first were more likely to get their desired seat than those who entered later. As stated in the work by Benedict et al. [12], it is disappointing that not all students can sit in the room’s best seats. In our class and many others, we believe those seats are typically situated in the front and middle columns of the room.

To develop our OML list, we first rank ordered the students belonging to the test group strictly by their GPAs. We chose GPA because it has been identified as the best indicator for future course performance in previous research [12]. Once the initial ranking was completed, teachers were instructed to consider each student’s SAT-Math score and programming experience. In cases where students possessed significant programming experience, such as a previous programming course or involvement in a programming project, instructors were asked to evaluate these students and consider moving them higher on the OML. This was done for all students possessing a GPA that fell with a 0.4 range of one another. The SAT-Math score was essentially used as a tie-breaker between to students with nearly the same GPA. Our reasoning for utilizing them is due to previous research by Kruck et al. [14], which indicates that there is a correlation between strong math backgrounds and programming. Once the OML was completed, students were assigned to seats based on their initial ranking. Instructors were also given additional flexibility to adjust seating along the columns for issues such as vision or other needs. Since the goal of this research was to keep high-performing students next to the low-performing students, making adjustments along the students assigned columns did not violate that goal.

Finally, scores for all graded events were recorded and averaged across performance-groups and seat locations for both the test and control groups. Data was then sectioned off to separate low-performing students from their higher-performing counterparts, so that our seating assignment methodology could be evaluated.

QUANTITATIVE RESULTS

Out of the 258 students polled, 23 students did not complete the survey. So, while students were not required to complete the online surveys, over 90 percent of students participating in the study did choose to provide feedback. To facilitate these surveys, we did opt to provide class time for students to complete them, and we coordinated for the last survey to be on the same day students were asked to complete their end-of-course class critique—this occurred prior to students taking their final exam.

Previous research [2], [12] has already confirmed that there is a correlation between seating choice and GPA. We anticipated that our control groups would present lower averages as students moved closer to seats 13 and 18 and higher as they moved toward three and four. For our test groups, we expected to see our center columns leading the averages with our low-performance students showing improved scores along the inside columns. As can be seen in Figure 2, this was not the case in our study. Surprisingly, of those students who chose to self-select the inside aisles, three of those seats averaged the lowest in the class. In fact, they appear to contradict earlier remarks that student
proximity to the teacher is indicative of better performance. Our test group, however, did fair as well as expected. With seat number three representing the students with the worst performance records, we see a very clear distinction from the rest of the seat locations, while the middle-columns are representative of the high-performance students we chose to sit there.

![Figure 2 Comparison Of Control Group And Test Group Final Course Averages By Seat Location.](image)

One caveat to our observation is that students in the control group may not have actually had the opportunity to choose the seat they would have preferred. This is due to limited seating. Late arrivals to class may have only found inside seats available. Additionally, we should point out that once students selected their seats at the beginning of the semester, they were permanently assigned to it for the rest of the semester. Another possible explanation for these control group results is that West Point has an active program for assisting students to improve their grades. Many of these students are coached on where they should sit and the military environment lends itself well towards encouraging students to do the things that will best help them to succeed. It is also possible that the students the control group chose to sit next to were not as helpful.

Our research sought to determine whether strategically assigning seats to our students will improve the level of performance achieved by our low-performing students within the course. To this end, our results show that across 15 sections taught by four instructors that strategically seated, low-performance, students achieved higher averages in all graded events than their control group counterparts. The comparisons of graded event between our control group and our test group are shown in Figure 3. For the graded events called labs, these are exercises where students must design, program, and execute Raptor [1] and Java programs to meet a provided problem specification. Students have up to two hours to complete these exercises. While the results obtained were consistent, the averages show only marginal improvements for the bottom third of the test group when compared to the control group. The largest difference between the bottom third of the test and control groups occurred during the third lab where the test group outperformed the control group by two percent. Still, the consistency across all graded events causes us to be optimistic that strategically seating students can be beneficial.

While there was a marginal improvement in the performance of the low-performing students, Figure 3 also shows a disparity between the control and test groups for the mid-performance and high-performance groups. With the exception of one lab, the control group’s mid-performance and high-performance students consistently outperformed their counterparts from the test group. This did not match our expectations. We anticipated that high-performing students would develop greater proficiency by assisting the low-performing students. The disparity, much like that of the low-performance students, is marginal.

Student surveys further indicate, as shown in Figure 4, that students who are strategically seated ask their instructor for assistance more often than their counterparts in the control groups by a factor of 28 percent. This substantiates at least one other desired outcome for our research, which was to improve teacher-student interaction with low-performance students. Although we sought to improve peer-peer interaction, our survey results indicate that our test group students actually asked their peers for assistance less often than did our control group students. This could simply be that, for our test groups, asking the instructor for assistance was considered more convenient due to the bottom third’s close proximity to the instructor. Conversely, it could also mean that these students did not feel comfortable asking their peers for assistance. Unfortunately, our surveys did not directly ask students to rate their comfort in seeking assistance from peers.
Additionally, our control group may have just been more comfortable with their peers than our test group. Since the control group was allowed to select their own seats, it is possible that these students were more likely to be sitting with friends and acquaintances than our test group. As a result, our goal of ensuring that our low-performance students had a greater opportunity for interaction with the instructor and high-performance peers was only partially satisfied.

**CONCLUSIONS AND FUTURE WORK**

This work represents the first step toward identifying a seat assignment methodology for improving the performance of students with an established low-performance history. Prior work has focused on seat assignment and pair programming as a means of predicting and/or improving the overall performance of students in the classroom. Our work takes a novel approach by combining both of these concepts to improve the performance of low-performance students in an information technology classroom where programming and in-class-exercises are fairly common. Our results indicate that, by strategically placing students in assigned seats, we can improve student-teacher interaction and marginally improve these students’ average performance.
While our work does show a consistent improvement in the performance of our test group’s low-performance students over their control group counterparts for all graded events, we do acknowledge that the benefit of our seating assignment methodology is limited. Our strategic seating assignments did not appear to improve the number of times our low-performance students asked their peers for assistance compared to their control group counterparts. It is possible that greater interaction with their peers, coupled with improved interaction with their teacher, may provide for an increased improvement in our low-performing students. Neha et al. [9] already pointed out that too large a gap in performance levels of students can potentially hinder student involvement and interaction in peer group settings. It may be of value to replace or shuffle the high-performance students in the center aisles so that students with the lowest performance record are not paired with the students possessing the highest.

With the shortage of students opting to study science, technology, engineering, and math (STEM) type courses, we hope to follow up on this work to determine if strategic seating can be utilized to improve a student’s overall experience, satisfaction, and confidence with the course. Many entry-level students arrive at college undecided as to which major they want to pursue. Our assertion is that if we can improve these factors for all of our students, then we can improve the percentage that chooses to pursue a STEM-based major. We further seek to learn whether seating assignments can affect a student’s interest and perceived level of difficulty within the course.

REFERENCES
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