PROMISING PRACTICE

Student-to-Student Support in Developmental Mathematics Courses

Randy L. Collins
Rosemary M. Karr

ABOUT THE AUTHORS

Randy L. Collins *graduated with a M.S. in Applied Mathematics in 2000 from the University of Tennessee Knoxville, and a Ph.D. from the University of Tennessee Knoxville in 2008 with a degree in Teaching and Learning-Mathematics Education. He joined Collin College in 2011, where he soon became the Department Chair of Developmental Mathematics. Currently, he is teaching for the Mathematics Department at Collin College.*

Rosemary M. Karr *graduated with a B.S. in Mathematics, a Master's from EKU, and a Ph.D. from UNT in 1996. After two years teaching high school mathematics, she joined the faculty at Eastern Kentucky University, earning tenure as Assistant Professor of Mathematics. At Collin College since 1990, she has written solutions manuals and textbooks, presented numerous papers, served on the Board of Editors for the JDE, and served associations including Past President of NADE. Her honors include Outstanding Professor by Collin College and national and state recognitions as U.S. Professor of the Year, Minnie Stevens Piper Professor, Lifetime Achievement Award, and Council of Learning Assistance and Developmental Education Associations Fellow.*

During the Fall of 2015, faculty and staff at a large community college district with an enrollment of 55,000 in the Southwest United States were encouraged to apply for Innovation Challenge Grants. The goal of these grants was to allow faculty and staff an opportunity to create, innovate, and share ideas, so that the college could strive to be one of the best organizations by developing an environment for students to learn and grow. The funding of this grant came from the district president allowing 5% of the budget from each division to be funneled into a pool of money, from which faculty and staff could apply for a grant. A committee would review each grant request and make recommendations as to whether to approve the funding.

For developmental mathematics (DM), a group of three faculty members got together to brainstorm ways these innovation funds could be used to assist students enrolled in DM courses. The meeting focus was directed to students taking weekend DM courses as part of the Weekend College Program. The colleges' Weekend College Program offers alternative scheduling for those unable to attend college during a traditional time frame, desiring to augment a traditional class schedule, or add classes to their day, evening or online schedules.

During weekdays (Monday to Friday) students have support resources such as the Math Lab available to them. The Math Labs are centers located on all three campuses staffed with faculty, lab instructors, and student tutors to assist students enrolled in developmental and college-level mathematics courses. While the Math Labs are open on Saturdays, those hours are often limited for weekend students. Since the Weekend College is a major emphasis for the college, the grant would help satisfy both an Innovation Grant Challenge and provide a way to promote student success for weekend college students.

In order to help these students, a proposed program coordinator would hire formerly successful students in specific DM courses to serve as in–class tutors. Having tutors that had previously completed the DM course was essential, since the tutor would understand the struggles students have in a DM course. At times in the Math Lab, there has been a disconnect between the tutor and the DM student, where the student felt intimidated or uncertain how to communicate questions. A pilot was developed for weekend Beginning Algebra (MATH 0305) sections. The goal of the grant was to use best practices from SI programs to increase student learning, success, and retention rates in DM courses. The proposal was approved in March 2016.

... a group of three faculty members got together to brainstorm ways these innovation funds could be used ...

Rational

Supplemental Instruction (SI) was developed at the University of Missouri-Kansas City in 1973 (University of Missouri-Kansas City, n.d.).

> Supplemental Instruction (SI) is an academic support model that utilizes peer-assisted study sessions. The SI program provides regularly scheduled review sessions on course materials outside the classroom. SI study sessions are informal seminars in which students compare notes, discuss readings, predict test items and develop tools for effective organization. The SI program targets traditionally difficult courses at the undergraduate, graduate and professional school levels (para. 2).

Based on the reported success of this support, it was proposed to tailor some of the key practices of this model for use with the Innovation Challenge Grant. SI is normally administered with either teaching assistants or upperclassmen at most colleges *outside* the classroom, but the innovation proposed in this idea was to use a similar concept *inside* the classroom with formerly successful students at this institution, although the tutors were available to tutor before/after class as well.

Project Dynamics

The tutoring program would allow tutors to help students in multifaceted ways. Those various aspects are the following:

- The tutor will encourage positive student study skills in conjunction with the classroom instructor.
- The tutor will engage with students before and after class to assist with mathematical understanding.
- The tutor will also, upon request, demonstrate study skills and mathematical concepts in front of the class.
- During classroom instruction, the tutor will quietly circulate among students to assist in the use of effective note-taking skills and to provide quick mathematical tips to allow a stuck student to quickly move on, if possible. More detailed follow-up with that student can occur at break or during subsequent group work.
- During classroom group work, the tutor will circulate among the groups to assist and help ensure deep understanding of the mathematical concepts.
- Students who fail the first exam will be required to meet with the instructor individually and a customized intervention plan, most likely involving the class tutor, will be developed to help ensure each student quickly gets back on track and improves the likelihood of success in the class. Having set out these parameters, it helped guide the type of tutor needed.

Personnel and Responsibilities

In order to facilitate the program, a tutor coordinator position was needed. The tutor coordinator needed to:

- Develop classroom tutoring requirements.
- Engage actively with all faculty who are assigned tutors (before the semester and periodically during the semester to assess progress and issues).
- Develop tutor training materials, including tutor time management and appropriate student assistance (e.g., tutors should *not* work the exercise for the student.)
- Recruit, interview and hire tutors.
- Train the tutors.
- Schedule the tutors.
- Supervise the tutors, including time clock approval, absences, etc.
- Develop and collect program metrics, and submit a formal report to the Dean to evaluate program success and identify expansion plans (i.e., scaling up), if appropriate.

It was important to select student tutors who were students in good standing with the college. Student tutors must have earned an A or B in the course they would be tutoring and be nominated by a mathematics faculty member. Other qualities included: being familiar with the graphing calculator, if it is required in the course; being familiar with mathematical vocabulary; and being familiar with effective study skills. The student tutor would have various responsibilities including:

- Attend tutor training sessions.
- Be present for all class sessions.
- Be available before and after class to assist students as required.
- Meet with the instructor, when requested, to coordinate classroom activities, including study skills strategies to be implemented in the classroom.
- Meet with the tutor coordinator when requested.

Development

The project team leaders—two faculty members who wrote the proposal—planned and developed documents needed to implement the student tutor position. An announcement was created to find potential tutors. All full and part-time DM faculty members received the announcement. Faculty were to nominate students they felt would be great matches for the needs of the program. Once the tutor coordinator obtained the students' names, an interest email was sent to potential tutors. Interested students were encouraged to fill out an application on the college's Human

Resources (HR) website. Once applications were submitted, the tutor coordinator set up interviews. The project team leaders developed interview questions based on the parameters set forth on the type of student tutor needed for the program.

To train tutors, a tutor handbook needed to be prepared. Fortunately, the office of disability services (ACCESS) already had a tutoring handbook. Permission was granted to make modifications to this handbook for this innovation grant. To assess the effectiveness of this project, the project leaders met with the Institutional Research Office (IRO) to determine what data should be collected. It was important to track those students who attended any tutoring sessions offered before and/or after class. To track those students a sign-in sheet was developed.

In addition to these documents, the Project Team worked with HR to develop the job posting for the HR online application. There were limitations based on policies as to the official title of the tutors and their pay. The college had already established a definition for the role of a student tutor. It required students to be in a credit course. Since DM tutors would more than likely be developmental education students, HR suggested a title change to student assistant. Although the official title was Assistant, the term tutor continued to be used because it was a clear definition of what the position entailed. Also, the pay was pre-established for the positions. Once the details were worked out, the position was posted in the HR system.

The payroll office had to be involved because student assistants would be filling out time sheets requiring tutor coordinator approval. This required the tutor coordinator to include, as part of the tutor training, important topics of how tutors would fill out paper time sheets, due dates for the time sheets submission, and how to use the online program to document.

Implementation and Findings

To find potential tutors, the tutor coordinator sent an announcement to all full-time and part-time DM faculty members during the Spring 2016 semester asking that the faculty encourage their students to participate as tutors. Students who were interested were encouraged to fill out an online application through the HR system. Disappointingly, few names were submitted. Additionally, reducing the applicant pool, the tutor coordinator was in contact with students that seemed interested; however, when students were told to fill out the HR application most students did not complete this step. For the Fall 2016 pilot, four students were interviewed for the position. Unfortunately, one student, who had previously worked for the college, did not submit a 2-week notice when resigning from the former job, so HR said the student was not eligible for employment. Another student lacked good communication skills. Only two students were hired for the Fall 2016 semester. Since the hiring process took time, the students were hired a week prior to the fall classes starting. Both tutors were hired to work with the same DM course.

On August 26, 2016, a 2-hour orientation was held with the tutors, the professor of record, and the tutor coordinator. At the meeting, tutors were given a copy of the tutor manual. They also received copies of the paper timesheets, and a personalized lanyard, which they were to wear when tutoring. During the orientation, program goals and the tutor manual were discussed with tutors and questions were answered. Time was spent on how to complete the paper copy of the timesheet. It would take a couple of weeks before they would be able to do the electronic timesheet.

The program started on August 27, 2016 and ran each Saturday that the MATH 0305 class was in session until the last day of class, December 3, 2016. During each session, tutors arrived at 8:00 a.m. They helped any students requesting help before the class that started at 9:00 a.m. Tutors were also available for tutoring after class. During class time, tutors floated around the classroom to help students during individual and group work. One of the tutors had a more engaging personality and students tended to prefer that tutor over the other one. For the report, this tutor will be called Tutor A. Tutor A often spoke with the professor of record to make sure concepts were being explained correctly to the students. The other tutor, Tutor B, was helpful, but at times the professor of record indicated that the tutor, while explaining the work correctly, was doing so in a confusing way. Tutor B was more reserved. It should be noted that Tutor A was a previous student of the instructor of record. Thus, it is reasonable that Tutor A and the professor had a closer relationship. After the Fall 2016 semester, both tutors stated they could not tutor for the Spring 2017 semester. Tutor A was getting married and Tutor B could not due to family obligations.

Table 1 contains the data from the sign-in sheets for the Fall 2016 tutoring sessions. For this course there were 17 students enrolled by census date. The census date is the 12th class day of a regular 16-week semester; it marks the official class enrollment for the college. Two students withdrew by the withdrawal date. Test dates were noted to see how many students took advantage of the tutors before the test.

During the Spring 2017 semester it was again difficult to find students willing to serve as tutors. The program planned to hire four tutors so the project team leaders looked at changing the parameters to get potential tutors to apply. The expanded search included students in credit math courses that had taken DM at some point. Unfortunately, it was too late to find additional tutors.

Table 1
Fall 2016 Tutoring Data Before/After Class

Date	Number of Students	Before/After Class	Tutor
08/27	0	NA	NA
09/03	0	NA	NA
09/10	2	Before	A
	1	After	B
09/17*	1	Before	A
10/01	0	NA	NA
10/08	0	NA	NA
10/15*	1	Before	A
10/22	0	NA	NA
10/29	1	Before	A
	1	After	B
11/05	0	NA	NA
11/12*	1	Before	A
11/19	0	NA	NA
12/03*	1	Before	A
12/10*	1	Before	A

Note. Class enrollment of 17 on Census Date with two withdraws by the Withdraw Date.

**Test Dates*

Two students did fill out the application and were interviewed. Again, hiring the tutors took place a week before the Spring 2017 semester started. For the Spring 2017 semester there was only one tutor, Tutor C, for the entire semester. Tutor C was hired to help with a DM course with the same professor of record from the Fall 2016 pilot. Since there was only one tutor, the professor of record indicated the flow during class was not as great as when two tutors were in the classroom. Tutor C often would spend too much time with one student and thus was not able to help many others during individual and group work. Tutor C was helpful but not as engaging as Tutor A from the fall semester.

Table 2 contains the data from the sign-in sheets for the Spring 2017 tutoring sessions. For this course, there were 19 students enrolled by Census Date. Three students withdrew by the withdrawal date. Test dates were noted to see how many students took advantage of the tutors before the test.

Table 2
Spring 2017 Tutoring Data Before/After Class

Date	Number of Students	Before/After Class	Tutor
01/21	0	*NA*	*NA*
01/28	1	After	C
02/04	1	After	C
02/11*	2	Before	C
02/18	0	*NA*	*NA*
02/25	0	*NA*	*NA*
03/04*	0	*NA*	*NA*
03/18	0	*NA*	*NA*
03/25	1	Before	C
04/01	0	*NA*	*NA*
04/08*	0	*NA*	*NA*
04/22	0	*NA*	*NA*
04/29	1	Before	C
05/06*	0	*NA*	*NA*
05/13*	0	*NA*	*NA*

Note. Class enrollment of 19 on Census Date with three withdraws by the Withdraw Date.

**Test Dates*

Discussion

With so few tutors as well as few students taking advantage of the opportunity for extra help, the outcome was not as significant as the developers had envisioned. The major obstacles for the program were the lack of students interested in becoming tutors and the lack of student attendance during tutoring sessions. This could be because of restrictions placed on tutors requiring them to have previously completed the DM course they were tutoring. This parameter was broadened, but it was done on short notice. Thus, no additional tutors were found.

The lack of interested students could be due to the times they were needed to work. At most, the position offered a tutor five hours per week which may deter students from applying. Most of the college's students work 20+ hours a week. Whereas some institutions require tutoring, the project team leaders and the instructor of record decided to make it available but not required. Future pilots could investigate mandatory tutoring options and programs.

For the sections that did have the tutors, students usually did not make use of the tutors before and/or after class. For Fall 2016, tutors were utilized for only 50% (7 class days out of a total of 14) of the class sessions. For Spring 2017, tutors were utilized for only 33.3% (5 class days out of a total of 15) of the class sessions. The majority of that time was one student attending the out-of-class tutoring sessions. One would think that many students would take advantage of the tutoring sessions on the day of the test but that was not the case. For Fall

2016, there was one student attending the tutoring sessions before class during each test. For Spring 2017, there was only one test where two students attended the tutoring session before the test. It might be that students went to the professor of record during office hours to obtain help.

Tutor A had an interesting perspective on why students did not take advantage of the tutoring sessions. Tutor A said of her experience,

> I think a lot of the help has to come from the students wanting to use it. You can have tutors in class willing to help but if the students do not partake in the assistance then it is a waste. My only thought would be having "undercover" tutors. This generation does not like asking for help; whereas, if it's from their fellow classmates it is easier to get guidance from. This is a personal opinion. I do not know how well it would work. As well as it would be limited to those only seated around the "undercover" tutor. I also felt like not sitting with the classmates made them feel intimated by us. Even if the tutors are not undercover they should sit with the other classmates and not off to the side, separated from them. Being a tutor was a positive experience for me. I greatly enjoy helping others especially with something that I love.

Part of the design of the grant by the original developers included a discussion of how the tutor may benefit as much as the students in the program. Teaching certainly reinforced subject content and had the potential to strengthen the tutors, a part of the same college community. Thus, although paid for the five hours per week, the reward could be more intangible.

Although few students took advantage of the tutoring sessions, there were positive comments from students. A student said of her experience,

> During the Fall of 2016, I found it extremely helpful to have the student teaching assistants. Before attending college, math was a problematic subject. Thankfully, taking 0305 changed that for me. I took advantage of the hour before class prior to every test to study the material that most confused me. Having the student help allowed for extra time to get clarification, and gave way for more students (taking advantage of the opportunity) to succeed. This also instilled study habits that have carried me through my first year of college with a 4.0. I'm extremely grateful and hope the college continues to implement student teaching assistants in the classroom.

This schedule prevents a student from registering for another class that conflicts with the scheduled T-section.

Another student said of her experience, "I went to him for help and he did great showed [sic] me different ways till I found one that made since [sic] to me. I think the tutor project is great."

This project was successful since some students did gain help and saw the value in the tutors. However, it did not have the impact expected. Due to a lack of student interest in tutoring resources, the grant was terminated.

A group of DM faculty and administrators did use the findings from this grant to develop a SI and tutoring program for the college's corequisite courses, which paired DM courses with credit courses. The corequisite courses are state-mandated course pairings to accelerate underprepared students to college-level courses. In order to support the students, SI was a component of the corequisite courses. In April of 2018, a grant was awarded to the institution from the Texas Higher Education Coordinating Board. This grant allowed full and part-time faculty to be used as SI tutors. For the Fall of 2018, 25% of DM students were to be enrolled in a corequisite course as mandated by the state. As expected, the attendance rate was low once again. Unless tutoring is mandatory, it seems to have low attendance regardless of structure.

For Spring 2019, tutors were hired for each of our three campuses and were scheduled to attend corequisite college algebra classes. They served as floaters during the class session. Tutoring for students in the corequisite courses was available both on campus and online. Analysis of the results of this tutoring program is in the process of being compiled. This data will be discussed as a part of the state grant report. Some preliminary data indicated that at one campus there were 350 visits to the SI/tutoring program. This represents 90 students. This means that 70% of the students in the corequisite courses at that campus attended at least one SI/tutoring session.

Future Work

There is overwhelming evidence that students who participate in tutoring opportunities have significant improvements in grades and increased pass rates. Overall, the results of this study demonstrated significant improvements in grade performance for students that took advantage of out-of-class SI

sessions, as well as for students who only had in-class interaction with an SI Leader. For all semesters included in this study, students in SI-assisted sections performed better than students without an SI Leader. Furthermore, students who participated in out-of-class SI study sessions passed at a higher rate compared to non-attendees. (Altomare, p. 23)

However, during this pilot program, the difficulty was getting students to participate amid research evidence that shows it would help them succeed. Educators may need to help students develop the skills toward a more engaged classroom experience (Weinerman, 2016) by addressing the students' reasons for lack of involvement. Additional research is needed in developmental education in general where the focus is bringing students to action by accessing all the opportunities for college success support. Kosovich (2019) stated, "Fostering perceptions of value for students is helpful because it relates to positive attitudes toward the course material in the short term and long term" (p. 8). Philosophically encouraging the attitude "I cannot do math YET, compared to I have always had difficulty with math" may be necessary to increase engagement.

Another study (DeFeo, 2017), observed that students who need the most help often times do not ask for it. During the student observations by DeFeo (2017), the researchers found a lack of vocabulary skills and other metacognitive strategies. Understanding, by the students and the tutors, of procedural questions versus understanding of why math works as it does is essential to the learning process. The instructor, the tutor, and the student need to work together to create an environment where mathematical understanding is the focus rather than rote memorization of de-contextualized solution algorithms. DeFeo further noticed that students do not "regard one another as resources" and do not access that form of support (2017, p. 21). Future research could include ethnographic studies of why some students seek outside support, collaborate with classmates, or are simply passive learners. Additionally, measurable factors of motivation, metacognitive behavior, and support services could be studied.

Conclusion

SI in community colleges, especially in DM, is a fairly new concept. There have been mixed reviews on its use. A two-year research study involving SI in DM showed that SI did have a positive impact on DM students' academic performance; however, no impact was indicated on retention (Dias, Cunningham, & Porte, 2016). As the movement for DM to be accelerated increases, programs such as SI may be a way to support those academic endeavors. More research needs to be conducted so that students can get the support that they need.

References

Altomare, T. K., & Moreno-Gongora, A. N. (2018). The role and impact of supplemental instruction in accelerated developmental math courses. *Journal of College Academic Support Programs, 1*(1), 19-24.

DeFeo, D. J., Bonin, D., & Ossiander-Gobeille, M. (2017). Waiting and help-seeking in math tutoring exchanges. *Journal of Developmental Education, 40*(3), 14-22.

Dias, O., Cunningham, A. W., & Porte, L. (2016). Supplemental instruction for developmental mathematics: Two year summary. *MathAMATYC Educator, 7*(2), 4-9.

Kosovich, J. J., Hulleman, C., Phelps, J., & Lee, M. (2019). Improving algebra success with a utility-value intervention. *Journal of Developmental Education, 42*(2), 2-9.

University of Missouri Kansas City. (n. d.) *Academic support and mentoring*. Retrieved from https://www.umkc.edu/asm/umkcsi/

Weinerman, J., & Kenner, C. (2016). Boredom: That which shall not be named. *Journal of Developmental Education, 40*(1), 18-23.