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FEATURE ARTICLE

Faculty Input on the Benefits of and Support for Teaching Accelerated Developmental Mathematics

D. Patrick Saxon, *Sam Houston State Univerrsity*

Nara Martirosyan, *Sam Houston State Univerrsity*

ABSTRACT

The redesign of the instructional delivery of developmental mathematics courses is currently commonplace. This study reports the results of a survey of faculty who teach various models of accelerated developmental mathematics (ADM) courses in 2- and 4-year colleges across the United States. Findings reported and described include the positive outcomes encountered by faculty in ADM courses, the training and support offered to instructors to prepare for and teach these courses, the support services believed to work best for students, and the technology applied in conjunction with these interventions. The goal was to address a research gap pertaining to faculty input regarding developmental education (DE) instructional redesign.

Introduction and Purpose of the Study

Reform in developmental education (DE) is widespread as several states and college system administrators seek improved outcomes in serving students who enter college academically underprepared. A primary objective of reform is to accelerate skills development so that students enroll in college gateway courses and experience college-level academic work as quickly as possible in their matriculation. In recent history, accelerating developmental mathematics has become a trend in the field. This trend was noted by Bishop et al. (2018) whereby mandated statewide reform coupled with well-designed instructional models reduced the time students spent in developmental mathematics courses. The authors described a modularized instructional model of mathematics applied in North Carolina colleges that reduced instructional delivery time by at least a third for many students. Several other states have followed suit; however, with varying models of acceleration, and likely with mixed outcomes. Cafarella (2016) explained that major changes to instructional models should be faculty driven and developed. He contended that faculty should be consulted for their professional opinions about reform and implementation decisions prior to moving forward with such changes. Saxon and Martirosyan (2017) emphasized the importance of faculty perspectives on redesigned mathematics courses and discussed challenges faced by practitioners when teaching ADM courses. The purpose of this study was to survey instructors for their thoughts and conclusions about student outcomes, training, academic support, and technology support for teaching ADM courses.

Review of the Literature

Research eliciting faculty input on teaching ADM courses is quite limited. Only two studies (Bickerstaff et al., 2016; Cafarella, 2016) were identified. Therefore, this literature review was expanded to cover the rationale for and conflict about ADM reform, ADM course efficacy, faculty opinions about the intervention, and student support and technology in ADM. These are important considerations that relate to ADM reform and its impact on faculty and students.

Rationale and Conflict About ADM Reform

Bailey et al. (2009) reported that in a select group of colleges, sequences of developmental courses were problematic. With these sequences, students would commonly withdraw from classes, succeed in one course but avoid moving to the next level, or fail to enroll in any developmental course to which they were prescribed. Though the program sample was not random nor the results generalizable, the authors advocated for accelerating the delivery of DE in order to reduce possible student exit points in meeting precollege requirements. Other advocacy groups latched on to this assertion (Collins, 2016; Complete College America, 2012), pushing broad scale reform away from traditional remedial courses and course sequences.

Fong et al. (2013) rendered an alternative analysis of the traditional prerequisite developmental mathematics sequence. They examined success rates at each point in the sequence based on a determination of whether students were actually attempting the particular class they were enrolled in. The authors' sample only included students who enrolled in the course prescribed and remained in the course after the no-penalty drop date. It was noted that a broad consideration (which was not addressed by Bailey et al., 2009) was accounting for students who did not have an intermediate college algebra transfer requirement. The authors' analysis showed similar pass rates in intermediate algebra for students navigating the developmental course sequence from various points (72% at lowest level, *n*=15,106) as students not needing developmental mathematics (73%, *n*=10,344). From this, they asserted "Though only a small number of students make it through to the highest levels, this figure suggests a more nuanced view of the condition of developmental education" (Fong et al., 2013, p. 4).

Faculty at the "ground level" of working with students are likely well aware of conflicting opinions and results of DE reform. The Bailey et al. (2009) study has been used as evidence of the need for reforming traditional DE sequences. Though their results should not be generalized to the population of DE programs, the gravitas of such a study coming from Ivy League researchers has nonetheless made a major impact on the field. Conversely, the Fong et al. (2013) study shows that when a traditional sequence of remedial courses is navigated by students as intended, DE works as intended. Furthermore, studies by Attewell et al. (2006), Bahr (2008), and Calcagno and Long (2008) also showed the efficacy of traditional DE sequences. Indeed, it is hoped that reform will garner positive outcomes for under skilled students. However, there is conflict across what faculty see in the research versus what they know is working for students. Therefore, the call to totally transform how DE is done may be a source of consternation among the ranks of DE practitioners. This sentiment may be reflected in faculty commentary (perhaps in studies such as this) about DE reform.

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ADM Efficacy

There is a modicum of research suggesting that for some students DE instruction can be accelerated, thereby advancing them to gateway courses a bit sooner. Bishop et al. (2018) studied subsequent gateway math course grades following student participation in an ADM model (eight 4-week modules) versus a traditional (three 16-week classes) delivery model of developmental math. The study involved students (*n*=8,102) from 12 institutions in the North Carolina Community College System. The accelerated, modularized model was designed to enable students to meet requirements and move forward more quickly by achieving an 80% mastery level in a four-week period. The model required an overhaul of the curriculum in order to reduce the redundancy of material, break content into discrete units of study, and align expectations and content with gateway math courses. A comparison of students in traditional developmental mathematics classes (*n*=4,616) and those in the ADM format (*n*=3,486) showed near equal gateway pass rates of 62.93% and 62.88% respectively. The authors described similar findings from other studies and concluded that accelerated courses should be considered to shorten the completion time for students in developmental mathematics. However, it appears that such a model cannot be pitched as a method to increase student success outcomes, but only to speed up skills attainment for students suited for such an intervention.

Bickerstaff et al. (2016) described the ADM redesign in Virginia and North Carolina that occurred during 2012 and 2013, respectively. Their models were described as mastery-based, eight or nine modules of one-credit hour each, and aligned for student diagnostic and placement purposes to a custom skills assessment exam. The authors offered detailed descriptions of content applied and the policies and procedures of administering the courses. They reported on outcomes from Virginia (*n*=20,572) and qualitative data from interviews with students, faculty, and administrators. The authors also reported that 67% of students who placed in level 1 of modularized math also placed out of at least one other module, thereby supporting acceleration.

Faculty Opinions of ADM

Though Bickerstaff et al.'s (2016) research showed that most students were able to place out of some ADM modules (thereby reducing the time spent in developmental math), the faculty expressed views that the modularized delivery characteristic of the model detracted from the holistic approach needed in learning math content. Furthermore, faculty noted the challenges involved in dividing content into "equal" one-hour credit modules. The researchers concluded that modularization did not appear to be a panacea, as many students participating in these courses still struggled to complete a gateway math course within a reasonable time frame.

Cafarella (2016) conducted one of the few studies eliciting faculty input regarding reform involving ADM instruction. He conducted a qualitative study of six instructors teaching ADM classes at three community colleges. The goal was to identify what these faculty believed were the best scenarios for students to succeed in these courses. He made the case that faculty input regarding the transition to accelerated classes had been lacking. In this study, faculty stated concerns about administrative mandates to accelerate courses and how such policies may marginalize students possessing lower levels of math skills. There were mixed responses about whether redesign was mandated or faculty-driven; however, all participants believed that students must possess adequate computer skills in order to benefit from accelerated courses. Other important characteristics cited were student motivation and the ability to work independently (which may be a challenge for some students placed in DE). Participants generally agreed that accelerated courses were not a panacea for all underprepared students.

Student Support and Technology in ADM

Boylan (2002) described a well-documented record of effectiveness for Supplemental Instruction (SI). However, this applies only to the traditional DE model which is documented by Arendale (1998). Among the important characteristics of this model are student self-selection of the intervention, trained SI support personnel, and peer-level involvement of SI facilitators in the content classroom (Arendale, 1998).

In a single institution study addressing academic support for ADM, Altomare and Moreno-Gongora (2018) reported significant improvement in grades for students participating in what they referred to as a modified model of SI. This model was applied to some sections of corequisite accelerated mathematics skills courses. Student placement into classes with an SI component was random rather than elective as in the traditional SI model. Substantial increases in pass rates for students participating in the modified SI sections later led to an increase in support to expand the intervention to all ADM courses. However, there were other benefits likely provided by the accelerated course structure that may not be attributed to the modified SI component. Increased weekly class time, resulting in increased student-faculty student interaction, along with student satisfaction with faculty likely also contributed to successful outcomes.

The use of technology is likely considered as pervasive in developmental mathematics instruction, and that definitely applies to ADM courses. Many of these courses are based on models originating from The National Center for Academic Transformation (2012), which are heavily laden with instructional technology. These are interventions that modularize content, require progression through learning at mastery levels, engage and support students with a laboratory learning component, and/or deliver instruction online. The notion is to accelerate student learning, while reducing student attrition and instructional costs. However, it is faculty that must learn to use and teach effectively using technology tools.

In a statewide survey of technology integration in DE classrooms, the majority of participants reported the application of technology in their courses even though it was not mandated (Skidmore et al., 2012). Half of the participants reported that they had engaged in at least 1-4 hours of instructional technology training during the preceding year. Participants reported that the training was applicable and adequate to support their teaching, and instructors of online and hybrid-style courses seemed more satisfied with the training they were offered than those not teaching these types of courses. Faculty reported that students with low skill levels, limited access to technology resources, and an inclination to engage in off-task behaviors when using technology in the classroom created challenges with regard to effectively applying instructional technology. Though this study did not specifically address ADM, the findings may provide some guidance given that ADM courses are heavily laden with instructional technology. In particular, it seems there is a need for faculty to be trained with regard to technology and for (and likely benefits from) assessing and advising students regarding the challenges that come with the delivery of technology-based courses.

As noted, there is not an abundance of efficacy studies on ADM. What is available showed that ADM can work for some students, however, overall student success rates for developmental math were not improved by adopting ADM. In surveys of faculty opinion on ADM, it was generally agreed that ADM can be an effective solution for some students, but not all. The research also suggested that ADM is heavily dependent on the use of technology and students need the skills and support that align with this style of instructional delivery.

Method

Sample

Participants of this study were developmental mathematics faculty who either participated in the most recent National Association for Developmental Education (NADE) Math Summit, were members of the NADE Mathematics Network, or both. Since this study was conducted, the association was renamed the National Organization for Student Success. An online survey focused on identifying challenges and best practices in teaching ADM was emailed to a total of 523 potential participants. Participation in the survey was voluntary. Of the 523 individuals who received the survey, 137 responded, which indicated a 26.2% response rate. At the time of the survey, 42 of the 137 respondents stated that they did not teach ADM courses and could not complete the survey. Of the remaining 92 responses received from faculty teaching ADM at the time of the survey, 77 were complete and 15 were incomplete. Only the completed responses were analyzed for this study.

Instrument

Data used for this study are a subset of survey data collected from faculty teaching ADM courses (Saxon & Martirosyan, 2017). The survey, which was administered online, was developed by a group of researchers who have expertise in DE. The instrument was pilot tested and minor edits were made. It consisted of 11 items that addressed various questions related to courses that had been redesigned to an ADM model. Demographics such as gender, teaching status, and institutional status were part of the survey as well.

Responses to four of the items included in the survey were analyzed within this study: (a) list up to three positive outcomes that you've encountered in your redesigned math courses, (b) list up to three training and support options offered by your institution to instructors assigned to teach redesigned math courses, (c) list up to three support services that you think works best for students in redesigned courses, and (d) list any technology/computer software (up to three items) used in your redesigned math courses. All four survey items were open-ended.

Data Analysis

Qualitative data were generated for all four items included in this study. Responses from the online survey platform were transferred to Microsoft Excel to conduct data analysis. A content analysis approach (Krippendorff, 2013) was then applied to code the data. From the 77 responses received, 200 data points were present for the *positive outcomes encountered in redesigned mathematics courses* item, 149 data points for *the training and support offered to faculty* item, 164 data points for the *support services for students* item, and 124 data points for the *technology/software* item. One of the researchers acted as the primary coder while the other cross checked the coded data to ensure the accuracy of emerged themes and codes.

Results and Discussion

The majority of the respondents were full time faculty (92%). This is likely the case as full-time professionals are more likely to receive funding to attend a professional development event. Participants consisted of 17% males and 83% females. Of 77 participants, 61 were teaching at 2-year and 16 were teaching at 4-year institutions in the United States. Table 1 displays emergent themes for all four open-ended items included in this study. Data not fitting in any of the themes were identified as outliers, categorized as "other," and later reanalyzed to ascertain fit within emergent themes.

Table 1
Emergent Themes

Survey Item	Emergent Themes
Positive outcomes encountered in ADM courses	Student Success
	Saving Time
	Student Attitude
	Student Retention
	Frequency of Class Meetings
	Student Learning
	Student Engagement
	Pace
	Cost Efficient
	Student Motivation
	Accurate Placement
	Increased Enrollment
Training and support offered to instructors teaching ADM courses	Professional Development
	Sharing Materials
	Regular Meetings
	None
Support services that work best for students in ADM courses	Tutoring
	Access to labs/software
	Advising
	Study groups/Study skills course
	Coaching
Technology/Computer software used in ADM courses	Commercial software
	Smart technology
	Videos

Positive Outcomes Encountered in ADM Courses

Student success. Many participants expressed that student success and, in particular, outcomes were improved in ADM courses. Though many simply stated that "success," "outcomes," or "completion" had improved; most offered no relative comparison to other instructional interventions. Some of the participant comments offering a relative comparison were:

- "Our success rates for accelerated (mathematics) are better than normal semester classes."
- "Grades in the accelerated course are higher than in non-accelerated courses."
- "Success rates were higher (in ADM) than in the average 16-week course."

There were also 11 instances of participants expressing that students who participated in ADM were "more successful" in college algebra or "gateway" math. However, no data to affirm the commentary were sought or offered.

Students save time. Many participants expressed that ADM allowed students to develop their college-level skills in mathematics more quickly. Suggestions were that this occurred about two to four times more quickly, depending on the instructional model. It is assumed that the relative comparison is a traditional semester-length developmental mathematic course. Specific comments were:

- "Motivated students are able to complete multiple courses in one semester. It saves them money and time."
- "Students move through their developmental math content in one semester."
- "Students can finish their DE math sequence more quickly."
- "Students are able to complete two developmental math courses in one semester."
- "Students can complete the course in eight weeks when they might not have been able to complete it in 16."

Speeding up skills development is an obvious objective of ADM. Instructors perceived that this is indeed happening. Perhaps the extent to which this occurred was exaggerated among their perceptions, as their estimations on this did not align with the findings of Bishop et al. (2016).

Improved student attitude. Participants reported that ADM seemed to contribute to positive student attitudes about math courses. Comments from the participant responses follow:

- "Students have a feeling of success in being able to begin their college-level classes."
- "Students are thankful for the opportunity and feel as if they are making progress."
- "Student have increased confidence in math ability."
- "Students feel empowered and gain confidence."
- "Most students are more positive about developmental math."
- "Student participation/interaction is increased. They become more comfortable asking questions and do not feel as isolated."

Bonham and Boylan (2011) described the importance of student attitudes, motivation, and reduced anxiety in their success in developmental mathematics. The faculty here believed that ADM effectively addressed these issues.

Student retention. It seems reasonable that as exit points and time to completion for student math skills are reduced, then so would attrition rates. Instructors were of the belief that ADM contributed to retaining students. Participant comments were:

- "Students have a higher persistence rate."
- "Retention from course to course is higher."
- "Students who are motivated and have the time to devote are able to move through the material more quickly."
- "The retention rate for accelerated classes has surpassed our traditional 16-week classes."
- "More students are now reaching and completing transfer level courses."

A challenge of some remedial education course sequences is student attrition and failure to enroll in prescribed DE courses (Bailey et al., 2009). The faculty in this study believed that ADM has the potential to alleviate these challenges to some extent. However, no data to affirm these assertions were sought or provided.

Increased time on task. As reflected in the responses, accelerated learning interventions require more class meeting and study time on a weekly basis. The student is therefore more deeply engaged and immersed in the learning of content. The commentary from respondents expressed belief that increased class time was a positive characteristic of ADM:

- "We meet four days per week, so we build a strong cohort."
- "Having more time each day with students allows me to break through their fear of math more quickly."
- "Compressed courses immerse students in the content and force them to study more often."
- "Meeting four times a week is beneficial as students have less downtime where they may forget the math they've learned."
- "There's more contact time with students, both individually and in small groups."
- "More class time is available for almost the same learning outcomes."
- "Because the class is four days a week, students spend more time studying."

There is no substitute for time on task in the learning process (Chickering & Gamson, 1991). As noted by some respondents, time on task decreases the likelihood of math skills atrophy.

Mastery of content. Generally, in environments that allow for learning at an individual pace, achievement at a mastery level can be attained by all students. As noted from respondents, ADM models are based on principles of Bloom's (1968) Learning for Mastery:

- "Overall, students attained a higher level of mastery of the course concepts."
- "They learn to make sense of mathematics and start to care if it makes sense."
- "Because of the mastery component students are learning at a deeper level."

Instructional models designed to require mastery of content ensure that students learn in discrete units and demonstrate proficiency in a particular unit prior to moving forward to new content. As a benchmark, Boylan (2002) suggested a minimum mastery level of 85% for underprepared students.

Training and Support for Instructors of ADM Courses

Local professional development. Some instructors reported various means of localized training and support for ADM instruction. These were their descriptions:

- "The developmental math lead faculty provide training, mentoring, and support. We do not offer official training for this particular course."
- "Adjunct faculty assigned to these courses get a lot of support from full-time faculty members, but there is not a formal structure to this support."
- "There are scheduled conference calls with those teaching the accelerated courses and the chair."
- "We do train the first time a course is offered but never again, and anyone who has come in new after a course has been running isn't given any training."
- "My colleague and I meet with the prospective teacher and work with them as they teach it the first time. This is better than what we do with most. Usually our teaching chair just hands them a book and says good luck."
- "Two hours of observations in classes are required before being assigned to teach."
- "Our lead modular instructor has a session with each new faculty member before they teach the course."
- "An instructor's manual is available for all instructors of the course."
- "A workshop on teaching conceptually and contextually is offered."

Given these responses, it seems that peer-based training and development is important and, in some cases, the only means of supporting ADM instruction. The transition from traditional classroom instruction to ADM requires somewhat of a change in roles for the teacher (Stern, 2012). This, therefore, requires substantial thought and training as to how instruction changes and the teaching methods that are appropriate and effective to use in an ADM environment.

Sharing of instructional materials. Respondents noted the sharing of instructional materials as a primary means of support for teaching ADM courses. Their examples were:

- "The course coordinator prepares computer homework, proposed course schedule, and sample activities."
- "The schedule, outline, and materials are given to all instructors and are available in Blackboard."
- "A syllabus and course are made for the faculty member, including all exams and assignments."
- "New instructors are given a binder full of materials, including a list of instructors who have taught these classes before and can assist."
- "Phone conversations and course materials (are provided) from another instructor who is experienced in teaching the course."

Davis (2009) described the sharing of instructional materials as part of a mentoring relationship among veteran and new faculty. A teacher that is new to ADM may experience quite the disruption from traditional class planning and delivery. Given the nature of ADM models, the standardization and sharing of instructional materials may be necessary. This would aid in the consistency of delivery and pace of instruction required to achieve acceleration while maintaining gateway course alignment.

No training or support offered. Unfortunately, some respondents reported that there was no training or support offered for ADM. These descriptions were offered:

- "No additional training and support options have been developed for adjunct professors teaching the accelerated math classes beyond what the college requires of all adjunct professors."
- "No training is offered for new faculty."
- "My campus does not offer any training."

Boylan (2002) described a relationship among successful DE and the training and development of the faculty therein. As noted earlier, Skidmore et al. (2012) reported broad application of technology in developmental courses, though many reported minimal amounts of instructional technology training. Differences in the role of instructors and pace of course delivery required by ADM classes likely compound the need for faculty training and support.

Regular course redesign meetings. Some instructors reported communication and collaboration through the means of regular meetings of ADM faculty. These descriptions were:

- "We have bi-weekly meetings throughout the semester."
- "Regular meetings are held with colleagues at same college also currently teaching the course."
- "There are biweekly meetings of our local New Mathways Project Core Leadership Team."

Boylan (2002) noted the importance of tapping local campus expertise and using faculty meeting times to share instructional strategies and discuss how DE instruction may be improved.

Most Effective Support Services for ADM Students

Tutoring. Several respondents described tutoring as an important support for students in ADM classes. Their comments were:

- "Embedded tutors are in the class to help those who are most at risk of failing."
- "There is a math tutoring center."
- "Our Academic Coaching and Tutoring Center has been a great resource for our students. Students can get tutoring, help with homework, and coaching as needed."
- "Peer tutoring from tutors who have completed a similar course."
- "We are still trying to figure this out. We have drop-in tutoring available."

Integrated academic support through tutoring has shown success in DE (Vick et al., 2015). Tutoring can be an effective means of support especially if coordination occurs among faculty and tutors regarding the course and related assignments (Boylan, 2002; Casazza & Silverman, 1996).

Labs and software. Computer labs, software, and online programs were listed as support for ADM courses. These were the descriptions:

- "Supportive software in combination with instruction."
- "Software with a study plan."
- "Computerized lab practice outside of class."
- "We have a math lab."
- "Online software to practice."

Software and computer labs are integral to ADM courses as they enable more time on task and a focus on problem solving for students (Twigg, 2011). They assist with differences in student learning rates and in achieving mastery learning benchmarks (Kulik & Kulik, 1991). A list of specific software products that have been used by respondents in the delivery of their ADM courses is provided later in this work.

Advising. Advising was also described as a means of support for ADM courses. The following were comments from respondents:

- "There is mandatory advising."
- "A strong connection to Student Services for advisement and financial aid assistance."
- "Up-front advising about how this course is different."
- "A dedicated academic counselor is available."
- "An active (intrusive) advisor is offered."

Documented evidence exist that advising aids in student success and retention, especially with underprepared students (Boylan & Saxon, 2012). Regarding ADM courses, students should be advised as to the pace at which the course proceeds. Advisors can also assess the level of ability and desire of students to engage in learning through technology-based instruction.

Mandatory study groups or study skills courses. Study groups and success courses were listed as a requirement by some respondents. They were described as follows:

- "Student success courses require students to study in a group for three hours a week as part of their grade."
- "Assigned study groups meet in the math lab consistently once per week."

Cooperative learning has been cited as a top instructional consideration for ADM courses (Saxon & Martirosyan, 2017). This instructional pedagogy provides the opportunity for students to engage in active learning, to spend more time on task with the content, and to learn and apply test-taking and learning strategies from their peers.

- ***Coaching to assist with challenges and study skills.*** Coaching is another method of support that respondents noted for ADM students. Their descriptions were:
- "A success coach works one-on-one with students to assist them with overcoming challenges when possible."
- "A study skills/life skills coach is provided for time management and prioritization."
- "Coaching is provided by the instructor."

Academic coaching has emerged as a means of advising students regarding personal and professional goals in conjunction with the development of academic skills. The goal is to identify barriers that may inhibit student success and to assist in developing skills to overcome them. Examples of such skills are time management, test taking, note taking, goal setting, and strategic learning (Capstick et al., 2019). Intuitively, these types of skills are important in accelerated learning environments.

Technology/Computer Software Applied in ADM Courses

Computer software. Participants listed the following commercial products as those used in the delivery of ADM courses: MyMathLab®, ALEKS®, MyLabsPlus®, Hawkes math software, MyFoundationsLab®, MyOpenMath, MyStatLab®, Microsoft Excel, Powerpoint, and Blackboard®, and Desire2Learn Learning Management Systems. In a study of technology integration in DE, Martirosyan et al. (2017) reported that faculty generally had positive opinions on the use of specific software products in developmental mathematics classes. Tong et al. (2012) described the state of the research on technology-based instruction in mathematics, and reported that there were few experimental efficacy studies and that the results therein were characterized as mixed. Cost savings, however, were noted as a reason for the broader application of mathematics instructional software.

Smart technology. Respondents reported the use of smart technologies in conjunction with the instruction of ADM courses. A sample of their responses was:

- "A Smart Board is used."
- "I use a Smart Board and post notes online so students that miss class can see what we did."
- "A Smart Board that allows students and instructors to follow along in the workbook and show solutions."
- "Graphing calculators are used, TI83 or TI84."

Li et al. (2015) described a course model applying Smart technology, among multiple technology applications, in which students made substantial gains in critical thinking. Graphing calculators have a history of usage and effective application in developmental mathematics (Akst, 1995; Martin, 2008; Testone, 1998). However, no research was located that described their use in ADM courses.

Video content. Respondents noted the use of video content in ADM as well. Their descriptions were:

- "Study skills videos are embedded in course materials."
- "YouTube is used to watch videos on 'just in time' support material."
- "Instructor-created YouTube lecture videos are required."

- "Videos are provided, some open-source, and some through the book publisher."

Video content provides another means of student engagement with course content. Comprehensive software platforms for delivering developmental math courses typically offer video-based lectures. Some are commercially developed and provided, and faculty may also have the option of creating their own (Byrnes, 2015). These platforms can also measure the level of student engagement by showing the extent to which students watch the videos provided, and by assessing the level of learning that takes place as it relates to the video delivered content (Byrnes, 2015).

Limitations and Recommendations for Future Research

This study had several limitations. First, it relied on self-reported data. It is important to consider the bias of self-reported data and apply caution when making conclusions. Moreover, because the questions were open-ended and the qualitative data collected were limited to a certain group of faculty taking part in a professional development activity, the results cannot be generalized. Therefore, a quantitative study focusing on longitudinal data on ADM courses is recommended.

Second, the sample included in this study might not be fully representative to those teaching ADM courses. As noted, the majority of participants (92%) were full time faculty teaching primarily in 2-year institutions (79%). Traditionally, DE in community colleges has heavily relied on adjunct faculty (Boylan & Saxon, 2012). They are "an important resource for developmental education programs" (Datray et al., 2014). Therefore, conducting a similar study where adjunct faculty are well (perhaps equally) represented is recommended. Comparing the opinions of part- and full-time faculty would offer additional information on the type of support available for both groups teaching ADM courses.

Finally, although participants reported a number of benefits in relation to student success, they were not asked to provide data to support their assertions. Many participants simply stated that "success," "outcomes," or "completion" had improved. For future research, it is recommended to explore the long-term impact of ADM courses on student success, not only in ADM but also in gateway mathematics courses. Currently, there have been mixed results reported in the few studies available on redesigned developmental math courses. Therefore, more research is encouraged.

Conclusions

Compared with traditional math classroom instruction, ADM courses move at a more rapid pace, require more student time on task, and rely more heavily on the application of instructional technology. It appears that teachers in this study believed there are some benefits for ADM students, both cognitive and affective. But the ADM model is reliant on learning support. Regarding support services, several academic and peer methods were offered with advising support as the most consistent response. Advising seems very important to the success of an ADM model. The goals of advising in this regard are to inform students of the instructional pace of the class and to assess the fit of ADM courses for particular students. In other words, given that ADM (or no other model) is not a panacea for student success, it is important to try to ascertain for whom it will work. The faculty suggested that students need to be advised up front of the pace at which an ADM course proceeds. This suggestion from faculty also turned up as a recommendation for improving ADM courses in another part of this study (Saxon & Martirosyan, 2017). Respondents elaborated that ADM students also need advising with regard to class work schedules, the increased time on task that will be required, and in assessing "a realistic portrayal of the time and effort needed to succeed" (Saxon & Martirosyan, 2017, p. 26).

> Increased weekly class time, resulting in increased student-faculty student interaction, along with student satisfaction with faculty likely also contributed to successful outcomes.

Participants listed various commercial products and a few means by which instruction may be varied (also using technology) from the typical computer lab setting. But with a reliance on instructional technology, mastery level benchmarks, and the varied pace at which learning will occur among students, it is apparent that ADM substantially changes the role of teachers. They become facilitators of learning. As Stern (2012) notes, "...the teacher sometimes stands back and lets students figure out the answer and sometimes intervenes and offers assistance. No longer is the teacher the focal point of learning as instruction relies heavily on technology" (p. 15). With these changes, teachers will need training and professional development. They need assistance in planning and developing course content and/or support in accessing and using technology-based learning applications. Perhaps they need training in learning support and coaching, as they are no longer the central focus of the classroom. The good news is that several instructors reported various means of sharing materials and peer support for planning and teaching ADM courses. However, an area of concern is that several instructors reported that they receive no training or support whatsoever.

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