Exploring Developmental Mathematics from Faculty Members' Perspectives: How Internal and External Dynamics Influence Student Success in a Community College

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Abstract

Recent studies have shown that successful completion of developmental mathematics can impact students' academic achievement and completion of their educational goals. However, few studies have examined the internal and external dynamics that can influence students' level of engagement in developmental mathematics. The following research question guided the study: what internal and external dynamics influence student success in developmental mathematics at a community college? Exploratory case study using qualitative methods of data collection was employed: interviews with developmental mathematics instructors at a community college located on the east coast of the United States, observations of developmental mathematics classes, and analysis of documents to understand the issue from multiple perspectives. The findings indicated that internal dynamics related to the need for changes in institutional policies and guidelines can influence success in mathematics. In addition, external dynamics such as secondary schooling practices and local business involvement in the curriculum can weaken or strengthen the mathematics pipeline and influence student engagement. Therefore, the importance for institutional leaders and partners to examine practices that may impede student academic achievement is discussed.

Keywords: Developmental mathematics, college readiness, community college structure, community college teaching, student learning

A disproportionate number of students who enter postsecondary education are considered academically under-prepared and are simply not ready for college-level work (American College Testing, 2011). This pipeline issue is particularly acute with respect to mathematics preparation, and as a result, many students must enroll in developmental courses at four and two-year institutions to meet academic graduation requirements (NCES, 2008). For many students, this requirement causes great difficulty and anxiety as they found little success in mainstream mathematics concepts and curricula throughout their academic careers (Bragg, Eunyoung, & Barnett, 2006). In addition to creating challenges for students, there are corollary challenges for those who teach mathematics in postsecondary settings. In particular, developmental mathematics instructors are challenged to employ

"effective" teaching practices (American Association of Community Colleges, 2007) that are sensitive to students' social and cultural contexts, and relevant to their experiences and career trajectories. In addition to in-the- classroom issues, these issues are cumulative in that students come to instructors having had uneven (and often negative) pretexts in the mathematics pipeline as they matriculate through the schooling system (Frankenstein, 1990; Monchinski, 2008; Theoharis & Brooks, 2012).

Further, college administrators and educators must manage and navigate certification institutions and industry standards that influence the developmental math curriculum, which decreases how flexible and accommodating instructors can be. The subsequent sections of this article reviewed extant literature on community colleges, developmental mathematics, and internal and external influences on student success and consider the relationships between these interconnected lines of inquiry.

The research design, data collection procedures, and analytic techniques used in the study are briefly discussed before presenting the findings and discussing the importance of this work for scholars and practitioners.

Literature Review: Community Colleges and Developmental Mathematics

This study is grounded upon the following bodies of literature: developmental education in community colleges; educator perceptions of developmental education; developmental mathematics; and external and internal influences on student success. The former provides a context in which the study explores the structure and practices - both external and internal - that influence learning. The latter provides an in-depth understanding of developmental education with greater focus on developmental mathematics.

Developmental Education in Community Colleges

The definition and purpose of developmental education are contested. Throughout the literature, the terms "remedial education," "remedial," "developmental," "developmental education," and "developmental skills" and other keywords are used interchangeably. One group of researchers defined remedial education as "a class or activity intended to meet the needs of students who initially do not have the skills, experience or orientation necessary to perform at a level that the institutions or instructors recognize as 'regular' for those students" (Grubb et al., 1999, p. 174). Boylan, Bonham, and White (1999) suggested a slight distinction between remedial and developmental education, arguing that remedial education is pre-college level work, somewhat lower-level than the regular college curriculum, while developmental education is college-level work with an emphasis on skills development such as critical thinking. According to the National Center for Education Statistics (2011), remedial education refers to college courses in reading, writing, or mathematics for students in need of skills to perform at the level required by the institution (p. i).

In a practical sense, developmental education is designed to assist students in developing minimum reading, writing, and mathematics skills (McCabe, 2003) and increase access to and completion of postsecondary education among underrepresented populations (Brothen

& Wambach, 2004). Considering the increased numbers of students graduating from high school unprepared for college, the demand for developmental education is high (ACT, 2011). However, while there are clear student benefits, negative perceptions of developmental education abound. Scholars contend that this is at least partially due to the stratification of courses based on socioeconomic status and race—that is, developmental education is seen by many as a lesser program that serves ethnic and racial minorities (Shults, 2000). One study revealed that a large percentage of students enrolled in developmental education classes are from low socioeconomic status (SES) backgrounds and members of racial minority populations (Boylan & Saxon, 1998; Dowd, 2007).

Adelman (2004) estimated that 41 percent of all students were enrolled in at least one developmental course. During the same period, the National Postsecondary Student Aid Study concluded that 43 percent of first- and second-year students enrolled in public two-year colleges were enrolled in at least one developmental course (Horn & Nevill, 2006).

According to recent reports, almost 30 percent of traditional age (18-24 years old) students enrolled in a developmental mathematics course (Attewell, Lavina, Domina, & Levey, 2006). Based upon the data presented by Adelman (2004) and Attewell et al. (2006), along with national studies, a greater percentage of students are enrolled in developmental mathematics at some point during their college experience than developmental courses in any other academic discipline.

Subsequently, developmental education provides the opportunity for students to improve their own lives and the lives of their families (Boylan & Saxon, 1999; McCabe, 2003). Developmental education has outstanding potential to advance student achievement. However, Bailey, Jaggers, and Scott-Clayton (2013) concluded that the current practice of developmental education does not work well. They advocated the importance of continuing to assess, modify, and offer developmental courses.

Educator Perceptions of Developmental Education

Developmental education has become associated with community colleges and is perceived to be an integral educational program. Many of the existing perceptions regarding community colleges are due to their open-access enrollment policies. As Armstrong (2000) noted,

> The open-access philosophy of community colleges practically ensures that the students served will differ in their experiences, education levels, and socioe-conomic status. Open access combined with the growing national emphasis on improving student outcomes is a major challenge facing community colleges (p. 681).

Bailey and Alfonso (2005) argued that developmental education programs are capable of increasing the number of graduates and are crucial to community college students; however, advancing developmental education continues to be met with opposition.

Some educators view developmental education courses as a burden (Parsad & Lewis, 2003). The burdens of developmental education are exacerbated by the arguments of those who oppose developmental education who believe that

necessary skills taught in developmental classes should be acquired in high school or prior to postsecondary schooling (Boylan et al., 1999).

However, supporters of developmental education argue that a skilled workforce is necessary for an immediate economic recovery and future economic competitiveness of the U.S. (AACC, 2010). In the same study, the Association of American Community Colleges (AACC) posited that community colleges are the "engine driving the nation toward renewed and sustained economic prosperity" (p. 8).

Nevertheless, given its value and influence, developmental education contributes significantly to preparing students to be successful in college. Subsequently, success in college positively influences economic growth through lowering the unemployment rate, need for welfare, and rate of incarceration (Aycaster, 2001, p. 404).

In short, Claxton (1994) argued that the cost-benefit ratio for developmental education is about the same. Despite the existing debate among educators regarding developmental education, initiatives that promote developmental education are necessary in light of college readiness issues, and other social issues that corroborate its importance, value, and need within U.S. higher education.

Developmental Mathematics

Developmental mathematics involves a complicated set of variables related to teaching and learning. A review of the literature suggested three themes that have particular influence on student success: enhancing self-efficacy among students (Smittle, 2003); motivating students to apply themselves throughout the learning process (McCusker, 1999); and, employing effective teaching practices (AACC, 2007). In the following sub-sections, the variables are explored in greater detail.

External and Internal Influences on Student Success

College Readiness: Secondary School Influence

College readiness can be understood as an assessment of students' academic and intellectual skills, emotional aptitude, and/or ability to socially adjust to a college environment with relative ease (ACT, 2011; Byrd & Macdonald, 2005; Conley, 2008). Each interpretation of college readiness includes a unique assessment of student preparation.

For this study, college readiness is defined as an assessment of students' preparation to succeed at a college or university without developmental education (Conley, 2008). There can be many interpretations of Conley's use of the term "succeed."

To succeed within an educational environment may imply persistence from one semester to the next, receiving "good" grades, or actual completion of a degree. The ability to persist or complete the degree requires significant emotional balance and social skills to adjust to the new college environment along with the academic and critical thinking skills to manage the intellectual expectations.

Overwhelmingly, a student's level of readiness is juxtaposed against his or her degree of preparation for college. Conley (2008) presented "a broader, more comprehensive concept of college

readiness built on four facets: key cognitive strategies, key content knowledge, academic behaviors, and contextual skills and knowledge" (p. 3). All of these factors can be determined by students' grades and standardized test scores.

The issue of college readiness can be further understood by examining the achievement gap demonstrated throughout secondary education among non-white and white students (Bragg et al., 2006; Duran, 1994). Thus, students who are members of racial minority groups and/or low-income communities are less likely to be prepared for the academic, emotional, and social demands presented throughout postsecondary education (Duran, 1994; Ogbu, 1990).

Different experiences and diverse learning needs of marginalized populations and the related demands placed upon community college instructors are highlighted (Green, 2006; Hooks, 1994; Osborn, 1990). Due to the significant academic disparity between non-white and white students as well as the influence of socio-economic status on college readiness, the literature review presented used a critical perspective to expose systems of inequity within educational structures that contribute to the need for developmental education.

The contributing factors considered in this literature review are those that magnify the lack of college readiness among members of low-income and/or minority populations. These three factors are the process of funding secondary education; challenges relevant to college entry and standardized placement testing; and, the influence of SES and racial identity on student learning.

Funding Secondary Education

State practices of funding public schools based on neighborhood taxes serve as a contributing factor to the increase in numbers of recent high school graduates who are unprepared for postsecondary education. The systemic process of using neighborhood taxes to fund schools produces an inequality among secondary schools.

Neighborhoods with higher tax rates have schools with greater resources and students with a higher probability of readiness for college. Students who attend schools in low-income neighborhoods are more likely to need remedial education prior to entering postsecondary education (Ogbu, 1990). According to Ladson-Billings (1998), critical race theory scholars have argued that "school funding is a function of institutional and structural racism" (p. 20) that is intended to reinforce unequal schooling and social reproduction.

Unequal resources among neighborhood schools are prevalent today just as they were during the segregation of schools. This issue warrants greater attention among educators and policymakers in relation to college readiness and the implications for developmental education. African American students are more likely to attend inferior schools, to be taught by less qualified teachers, and to have teachers with lower expectations (Bell, 1980; Gonzalez, Stoner, & Jovel, 2003). Unfortunately, more than 50 years after the integration of schools, students of color are still more likely to attend schools with limited resources due to the racial and economic segregation that exist among neighborhoods.

Although schooling practices and policies differ from state to state, funding that is based on property taxes is a

shared practice (Ladson-Billings, 1998). As a result, students from low-income families and racial minority groups who come from poor neighborhoods and the under-resourced schools within those neighborhoods are less likely to complete high school, score well on standardized tests, or be prepared for college (Steel, 1992; Walpole et al., 2005), factors that contribute to the growing need for developmental education at colleges and universities to support academic success among underprepared and underrepresented students.

Standardized Tests

Due to students' participation in a less than rigorous K-12 curriculum and their low standardized test scores, students of color are less represented in postsecondary education institutions than white students. Increasingly, decisions about college readiness and college access are made by standardized assessments and high school grade point averages (Jencks, 1998; Walpole et al., 2005). Standardized test-based admissions and GPA may overlook the historical and cultural background of students of color that might include strengths related to readiness for college such as innate survival abilities and community support (Byrd & Macdonald, 2005; Ogbu, 1990; Yosso, 2005).

Standardized tests are commonly used as a determining factor in gaining admission to college. The demand for high test scores is fueled as competition for admission to selective colleges increases among recent high school graduates (Walpole et al., 2005). However, the literature reveals that a rigorous secondary curriculum and a high-grade point average are better predictors of student success than standardized tests (Adelman, 1999). Considering the study presented by Adelman, one must question the purpose of using SAT scores as a standard for admission.

Given that admissions standards such as high SAT scores support an institution's rankings and contribute to the competitive environment among higher education institutions seeking opportunities for greater exposure (Bowman & Bastedo, 2009; Ding, Jalbert, & Landry, 2007), underserved populations are often denied admission due to selfish motives upheld by politics, institutional gain, and bureaucracy.

In addition to the SAT or ACT tests, which are commonly used by four-year institutions, American College Testing's (ACT) COMPASS and the Educational Testing Service's ACCUPLACER are standardized computer-adaptive assessment instruments used by community colleges for appropriate course placement. According to Medhanie (2012), "most colleges use placement tests designed locally or by an outside agency to determine a student's readiness for college-level work" (p. 334). In a study conducted by Gerlaugh, Thompson, Boylan, and Davis (2007), the authors found that among the institutions studied, 97% used the COMPASS.

According to the U.S. Department of Education's National Center for Education Statistics (2004), 61% of community colleges used some form of placement test to assess students' readiness for college and appropriate course placement.This use of standardized placement tests has been encouraged by state legislators who have begun to urge community colleges to effectively assess and place students in the proper courses based on placement tests scores (Gerlaugh et al., 2007; Russell, 1997).

Although varying placement tests are used by community colleges, the ultimate goal of the tests is to determine whether or not a student can be successful in a particular course (McFate& Olmsted, 1999). Moreover, placement tests are used to assess students' skills upon entry and placing the students in courses that are appropriate, which may be developmental education courses (College Board, 2009).

Family Economic Status

Socioeconomic status also has a significant impact on student learning. Bourdieau and Passeron (1977) posited that cultural capital, which is an accumulation of cultural knowledge and skills possessed and inherited by privileged groups, has a tremendous impact on student success and parental involvement. Lareau (1987) extended Bourdieau and Passeron's position by stating that parents' educational background, their view of schooling, and the available resources in the home, which can be perceived as forms of cultural capital, influence parental involvement, which in turn impacts student learning.

Parental involvement and behavior are directly related to SES. For instance, parents' responses to requests from middle-class schools are much higher than parents' responses at working-class schools (Lareau, 1987). As indicated throughout the review of the literature, students of color traditionally are less likely to gain access to higher education.

As a result, racial minorities are also more likely to be in low-income positions, to be constantly exposed to racial discrimination, and to have limited access to forms of cultural capital that might promote access to higher education, such as precollege preparatory resources that are often absent in low-income communities and schools (Ogbu, 1990; Yosso, 2005).

Along with, and related to, socioeconomic status, quality of schooling and available resources are arguably factors that influence college preparation. Resource differences among schools and neighborhoods are prevalent today just as they were decades ago (Lareau, 2011). There is a significant body of published studies concluding that students of color are more likely to attend urban schools that are resource poor, to be taught by less qualified teachers, to have teachers with lower expectations, and to be tracked away from higher achieving groups (Gonzalez et al., 2003; Lareau, 2011; McLaren, 2007).

Research Questions

Given this context, this particular study was designed to answer the following research questions:

1. Which internal (institutional) dynamics contribute to successful completion of developmental mathematics courses at a community college?
2. Which external (institutional) dynamics contribute to the successful completion of students at developmental mathematics courses at a community college?

Purpose of the Study

To identify the internal and external factors that influence students' success at developmental mathematics courses at a community college based on the opinions of developmental mathematics instructors, class room observations, and institutional documents.

Method: Participation and Procedure

The researchers were involved in a

two - year qualitative case study. Data were collected through classroom observations, interviews with instructors who teach developmental math, and review of documents. During the observations, the researchers focused on the students' engagement with the topics of discussion as well as the teacher-student interactions. Instructors' teaching methods that may or may not enhance learning through the incorporation of culture and social issues were critically looked into.

This study employed an exploratory qualitative case study design, primarily because the nature of the research demanded an integrated and comprehensive examination of multiple perspectives and forms of data throughout a single organization (Creswell, 2007; Fielding & Lee, 1998; Silverman, 2001). The locale of the study was East Coast Community College primarily because of the student racial diversity represented throughout the institution.

The researchers interviewed 15 different faculty members, conducted nine observations, and gathered over 30 documents. In an effort to include a plurality of perspectives, participants were purposively considered based on the following selection criteria: first, the number of years responsible for teaching developmental math at the college; second, the instructors' current teaching responsibilities during the study to create opportunities to interview and observe the same participant.

Lastly, faculty included were diverse with respect to:

1. Years of experience. 12 out of 15 interviews included faculty with at least two years of experience.
2. Academic rank. The participants included faculty at the rank of adjunct, assistant, associate, and full professor.
3. Administrative/instructional assignment. Participants included both full-time and part-time faculty teaching positions. The participants included faculty who held positions such as program coordinator, department chair, associate dean, and dean of the social sciences, humanities, and education department.
4. Andragogical orientation. Upon observation, a majority of the students in the classes observed were older adults returning to school. A much smaller percentage of students appeared to be recent high school graduates.

Interviews were one of the most important data sources in the study. Fifteen face-to-face semi-structured interviews with instructors of developmental math were conducted. The interview participants were selected through a form of network sampling (Silverman, 2001). These 15 interviewees were recommended participants as being faculty whose teaching responsibilities experiences made them knowledgeable on the topic of developmental math instruction and student engagement.

The interviews allowed instructors to share their experiences, attitudes, challenges, and perceived opportunities for growth related to teaching developmental mathematics and negotiating various influences outside of the classroom. Through the use of in-depth interviews, participants had an opportunity to provide details relevant to developmental math education, personal beliefs about developmental mathematics, and strategies

used to manage classroom dynamics with external influences that impact the curriculum.

Another form of data collected was documents. The documents examined for the study were end-of-year reports, institutional data such as enrollment, persistence, degree-completion, and transfer data to name a few. Lastly, course syllabi and faculty resources were used to inform course development.

Data were initially sorted into categories, and then within each of these categories, the data were explored using an inductive and iterative process of thematic coding (Miles & Huberman, 1994). After identifying descriptive themes and sub-themes within each of these categories, patterns across categories that might suggest theoretical foci were indentified that could be used to understand these issues as interrelated phenomena (Richards, 2005).

For example, an initial analysis guided by the review of literature suggested that educational practices within secondary education have a direct influence on student engagement and success in postsecondary education. The analyses led to the development of two major emergent categories: external influences and internal influences. Both categories are explained in the subsequent discussion section with sub-themes. The sub-themes related to external influences are: frustration with secondary schools, meeting requirements for transferring to four-year institution, and involvement of local businesses, and state policies. The sub-theme related to internal influences is the need for changes in institutional policies and guidelines.

Research Design

The site for the case study is referred to as the pseudonymous East Coast Community College (ECCC) for anonymity. ECCC was founded in the mid-1900s. It is an urban, public, postsecondary community college. ECCC serves more than 50,000 students, with almost half being full-time degree-seeking students. ECCC offers a comprehensive selection of courses and educational learning opportunities.

Due to the purpose of the study, developmental mathematics courses were used as focus of the study. Developmental mathematics courses by course descriptions and call numbers that appeared in the online course catalog and schedule of classes were identified. In addition, the researchers asked the department chair to identify developmental mathematics courses to ensure that the published descriptions were interpreted correctly.

Data Sources and Collection Procedures

Three forms of data collection were employed: observations of developmental mathematics classes, interviews with developmental mathematics instructors, and review of documents. By using three data sources, triangulation was practiced to enhance the trustworthiness of the data collected (Maxwell, 2005; Merriam, 2002; Yin, 2009).

The initial list of faculty to be interviewed was developed from information gathered from the college's website. Instructors who are responsible for teaching developmental mathematics were selected and invited to participate via email. In addition, interview participants were asked to recommend others who met

the criteria. Through this use of snowball sampling, potential participants for the study were identified (Patton, 2002). The interviews allowed instructors to share their experiences, attitudes, challenges, and perceived opportunities for growth related to developmental mathematics courses.

The researchers interviewed 15 instructors for the study. The number of instructors interviewed was dictated by the time available to conduct the study, the instructors' availability, and point of saturation. The participants provided variety in years of experience and number of developmental mathematics courses taught. The researchers sought to interview as many instructors as possible with the intent to collect a significant amount of data.

The data did not include demographic information about the participants although the researchers were aware that demographic characteristics influence experiences. Demographic data were not collected from the instructors in order to keep the focus on their experiences as instructors who taught developmental mathematics. Challenges encountered by instructors were identified and subsequently offered solutions that would promote student engagement in the classroom. Any identifiers from the participants were collected or identified, which eliminated the need to transform the data to protect confidentiality (Wolcott, 1990).

Data Analyses

Three stages of data analysis were used to uncover themes and categories from the data. In stage one, the researchers began by coding data collected from interviews, observations, and documents based on the analytic framework that looked at internal and external dynamics that influence developmental mathematics (Saldana, 2009). Following the initial stages of coding, analyzing data were continued to begin developing categories (Merriam, 1998). Memo writing was used, which is the practice of noting and reflecting upon codes used, to organize the data (Saldana, 2009). The following discussion provides more detail about the data analysis procedures.

The content analysis involved an examination of transcripts, field notes, and various institutional documents. Memo writing was employed throughout the study. According to Saldana (2009), the purpose of memo writing is to document and reflect on codes and the coding process, the emergent patterns, categories and subcategories, and concepts that are beginning to develop from the data analysis. Memo writing was useful during the process of tracking thoughts, putting the data back together, and organizing it into themes.

Findings

External Influences

Participants explained that external entities influenced the curriculum and goals for developmental mathematics at the college. Pseudonyms were applied to each of the participants to retain anonymity. Participants defined external influences as those entities outside of the mathematics department that were given thoughtful consideration when implementing or modifying policies and practices related to the developmental math curriculum at the college. The external influences identified by several participants were frustration

with secondary schools, meeting requirements for transferring to four-year institutions, involvement of local business, state policies, and need for institutional changes in policies and guidelines.

Frustration with Secondary Schools

Throughout the interviews, participants addressed the need to strengthen the forms of communication between secondary and postsecondary schools throughout the state. The data were saturated with phrases that reiterated the need to connect secondary and postsecondary education such as: "a disconnect somewhere," "needs to be a stronger link," "two groups need to coordinate better," "dialogue between the decision makers," and "needs more coordination."

The need to strengthen communication between secondary and postsecondary school reinforces the definition of developmental math as mathematical concepts that should have been learned in high school. Instructors suggested that if communication was strengthened, interventions could be implemented to prepare students for college-level work prior to completion of high school.

In addition, Mr. Hall expressed a desire for less demand for developmental math courses as such, "I would really like to see it (developmental math) have smaller and smaller numbers. I don't want it to be undervalued, but I wish that more students wouldn't need to be placed there. Either coming out of high school with this knowledge or if they came to us we could get them out quickly."

Ms. Knight stated, "K-12 schools do not influence what we teach here, except that we teach a lot of stuff they had, but that's everywhere." Although practices and policies relevant to K-12 schools have minimal influence on the College's curriculum, as explained by several instructors, underlying practices within K-12 schools were discussed with moderate to high frustration based upon comments and non-verbal cues. Ms. Young commented on K-12 practices that were disconcerting and often referred to as a disconnection between secondary and postsecondary schools:

> I think having a stronger link between the high schools and community college would be in the students' best interest. It would better prepare them for life at the College. Because I think many students are expecting a pretty similar experience and it's not at all. We don't talk to parents; the school system has a 50 percent rule that as long as you make a significant effort on a test, the minimum score you can make is a 50 percent. So I have students who are right out of high school who have gotten a 24 percent on a test and they'll ask me, "Can I at least get a 50?"

While participants stated that K-12 schools did not influence the developmental math curriculum, upon closer examination of their comments, several factors emerged that do influence practices and policies at the college as well as teaching demands within the classroom.

Four factors related to secondary school practices emerged: (a) operating under a political system and being forced to manage the demands that stress the importance of getting more students to pass state standards, (b) limiting the

students' critical thinking and basic understanding of math concepts through use of calculators, (c) giving students 50 percent credit in K-12 schools for simply writing their name on the paper, and (d) providing excessive partial credit on assignments, which generates expectations for similar treatment in college.

According to the College's 2011 end-of-year report, nine out of ten students (90 percent) were from within the county. In addition, the college's draw rate among public high school graduates reached approximately 25 percent over the past two years. Moreover, according to the same report, the draw rate was expected to increase slightly over the projection period of 5 years, 2011-2015.

Meeting Requirements for Transferring to Four-Year Institutions

Several participants stated that designing a curriculum that prepared students to transfer and be successful at a four-year institution was important. Ms. Knight explained, "We have to look at where our students transfer, so we do need to look at what courses will transfer, which of our courses will transfer for credit. And we need to offer those."

Many of the instructors highlighted a leading institution in the state more than any other four-year institution in the area. It was evident throughout the review of the transcripts that this institution was a guide for the curriculum and had an influence on the College and more importantly the developmental mathematics curriculum. For example, Ms. Lacey stated, "We take a lot of our guidelines from what they [referring to the leading institution] do; what our transfer students are expected to know."

Ms. Lacey went on to say that many of the students transferred to this leading institution that demands that East Coast Community College provides the best course offerings and course content to enable students to transfer with ease and to be successful in a university environment. Overall, many of the participants expressed the importance of knowing what four-year institutions expect in order to create a curriculum that is effective and prepares the student for success after they leave the College.

Mr. Hall mentioned an internal policy requiring that the college be cognizant of four- year guidelines and requirements in order to design the right courses. Ms. Knight stated, "We need to make sure before any courses are approved in the curriculum, that five transfer institutions will accept those courses or else our curriculum committee will not approve them." Ms. Knight did not describe the process of identifying the five institutions or the subsequent process to gain the institution's approval however.

While participants indicated that four-year institutions had an influence on the developmental math curriculum, participants also noted that they had minimal conversations with students at the developmental level about transferring to a four-year institution. Ms. Lacey stated:

> I think that the transfer issue is less on the radar screens of our instructors in the developmental classrooms; it's more getting them to that college level course. And then we start to ask the question, and we probably should focus more, earlier, but then what do you want us to do? And for us, that

> ends come after … this math prep course.

Instructors appeared to be more concerned with getting students to credit courses and at that stage would begin to engage in advising and having conversations about transferring to a four-year school.

Involvement of Local Business

While many of the instructors were unfamiliar with the influence of local businesses on the developmental math curriculum, a greater percentage of participants were able to identify the involvement of local business owners and leaders. They articulated interest in gaining greater involvement from business leaders to inform the curriculum. For example, several instructors, including Ms. Ladner, mentioned involving members of the business community in the redesign of Math 094–the math preparatory course.

> In terms of the business community, when we set up a task force to do this redesign of our developmental courses, one of the groups that we wanted to bring in were local businesses. You know, what do you need students to know when they walk out our door? What do you want them to be able to do quantitatively? We had one big, sort of, advisory meeting with a couple of people from the industry.

Mr. Hall noted the involvement of business and industry: "They definitely had an input for what a student knew when they left here [The College]." Mr. Hall further explained their involvement in this way:

> Local businessmen don't really understand the distinction between college level and pre-college level and probably a lot of businessmen have never taken those developmental math courses, and so they didn't have anything specifically to say about developmental math education, but have very useful things to say about education in general.

Despite the limited insight from business leaders in the community, many instructors commented on and expressed a strong desire to continue engaging with the "right" business leaders to ascertain information that would inform the developmental math curriculum. Ms. Lacey expressed her sentiments and others as:

> I would love to bring in some sort of front line people from the industries in the area and say: "What are your workers doing quantitatively? Are they pulling up and having to do stuff and what kind of stuff? And what are the shortcomings; what do you find they can't do?" Discovery Channel, we have a partnership with them, and they did a fabulous panel discussion here this spring directed at students who wanted to get into media, communications, and that sort of thing.

Ms. Lacey continued to elaborate on the subject of business influences on the curriculum:

> Where are the gaps? What can we fill? So that you are not having to spend your money, because that's

> supposed to be our [developmental math instructors] job. That's how this is supposed to work. We host a science bowl each winter and somebody from the business community spoke. He gave a wonderful address, again talking about what people, employees, needed to know on different levels. I would love to sit down with him or somebody he might direct me to. And then really go after our curriculum and let that guide the kinds of problems that we might infuse [into the mathematics curriculum].

State Policies

Based on the participants' comments, it seems apparent that the curriculum and the related guidelines are influenced by four-year institutions and local businesses. The college faculty and staff had the option of infusing information garnered from four-year institutions as well as local businesses. However, participants noted that the state imposes policies that are non- negotiable and applicable to all postsecondary institutions. For instance, Mr. Erwin explained:

> Yeah, the state requires that in order to get an academic degree you must have a math foundation course, which is a college course above Intermediate Algebra, so by that definition anything below the foundation math course, we'll consider developmental.

Moreover, participants commented on three state policies: to get an academic degree one must have a math foundation course that is a college-level course above Intermediate Algebra; community colleges must use the Accuplacer or Comer placement exams or SAT scores to determine placement into appropriate courses; and, postsecondary institutions must require pre-requisite materials before students enter college courses. It was evident that most of the instructors were familiar with and adopted the state guidelines.

The college uses the Accuplacer placement exam to determine the appropriate math sequence for students. Ms. Lacey explained the use of the Accuplacer test, "So, we basically, the state allows us to use either the Accuplacer placement test or Comer. The college before my time chose Accuplacer. Based on the score students get on Accuplacer, they are placed into an appropriate course."

However, the college did use SAT scores to determine appropriate placement. Scholastic Aptitude Test scores were used in place of the Accuplacer if available. Ms. Anderson noted that SAT scores were used similarly to Accuplacer scores, "Well, I mean, the whole state uses the same cut-off scores for Accuplacer and so that particular score tells you where you are going to start, and we use the same SAT scores if, you know, if the kid happened to have taken SAT."

Completion of placement exams upon entry into the institution was widely upheld. However, the associated prerequisites toward degree completion after assigned placement were met with some disagreement. Mr. Hall expressed dissatisfaction with the prerequisite requirement, "We have to say, 'Here is all the prerequisite material. Why would you care about this, I can't tell you. Just learn this and then, later on, we will show you where it all comes back in.' That is backward to

me. These current state regulations really change our curriculum."

Internal Influences

In addition, participants explained that internal practices had an influence on the developmental mathematics curriculum. The internal influence identified by several participants was the overarching need for changes in institutional policies and guidelines. The institutional policies and guidelines that need to be changed are outlined.

Need for Changes in Institutional Policies and Guidelines

Changes in institutional policies and guidelines may be more of an internal influence than external. However, the institutional policy changes are outside of the mathematics department. Also, some of the policy changes suggested by the participants were indirectly connected to external influences that needed to be enforced by the state.

Instructors highlighted the need for changes in institutional policies and discussed why making changes can be difficult at the college. In explaining the need for policy changes relevant to developmental math, participants stressed a large number of students who were not persisting on to college level courses. Ms. Pearson stated the urgency to implement changes:

> Can we effect change on that? Doing what we still have been doing, for 50 years? No, it's going to stay; we had to do something radical; we have to shake up the entire system to change the outcome. Our outcome that we're really hoping to see down the road is that students will persist.

Fortunately, the math department was able to implement a modified self-paced version of developmental math in order to address the low persistence and retention rates among students.

Moving beyond validating why policies and guidelines should be changed and acknowledging the difficulty in making changes, the recommendations from participants that were salient to the study included: requiring students to take developmental math courses early; incorporating a process to weed-out students who are not serious; modifying the curriculum or curriculum design to strengthen learning and the students' foundation; and providing early and ongoing academic advising.

The suggestion that students take developmental math courses early was a resounding recommendation from several participants. The instructors interviewed strongly advocated a policy requiring completion of developmental math early be implemented immediately. The participants indicated that they observed students who waited until the end of their programs to complete their math requirements. Participants stressed that such students, if they experienced difficulties with comprehending math concepts, were likely to dropout when they were closed to completion. Mr. Hall expressed disappointment upon observation of students who were struggling with math concepts at the end of their program, "It's hard for me to see people who have spent two years here and then finally decide to take their math and science courses" and had trouble passing them.

Also, participants pointed out that students potentially did not make the highest grade possible in earlier courses while in college because they had not developed the necessary critical thinking skills associated with math education. The participants strongly recommended taking math courses early in their course sequence in order to develop critical thinking skills that will support academic success in other courses. As a result, students might receive a higher grade resulting in a higher grade point average that would positively influence acceptance to a four-year institution of choice.

A second suggestion recommended by Ms. Hernandez was to incorporate a weeding-out process for those students who were not serious about learning. While it is somewhat disconcerting that an instructor would be in favor of intentionally "weeding-out" students when the vision of the institution is to increase retention and support students in becoming engaged learners, the instructor's frustration with some students' behavior is evident in her statement:

> I think that students in some situations are given too many chances and students sort of sign up cavalierly, not having any idea or not having any intention [of making an effort to pass]; those are the students I don't want in class, the ones who don't have any intention on doing the work.

Another suggested policy modification was related to the developmental math curriculum. Several instructors expressed the need to modify the curriculum in order to strengthen basic math skills development and support academic success in higher level math credit courses. Two instructors strongly suggested the need to teach mathematics concepts at a slower rate on a "need to know" basis. For example, Mr. Hall stated:

> If I had my choice, I would say here is the college level math we are interested in. Oh, we can't do all that? Well, here's what we need to learn. Kind of backtrack out and say here's a little math, we need to teach them that, then go on to the next topic, we need to teach them that, and it's a need to know.

Although interviewed separately, two instructors shared similar sentiments about the need to decrease excessive coverage of concepts and to focus on what the students need to know to excel in the current course and to be prepared for the next course. Their recommendations were couched in the importance of instructors consistently assessing learning to ensure that a large number of students were learning mathematical concepts that were relevant. Lastly, the suggestions alluded to creating courses with a focus on specific topics such as math basics or advanced math.

In addition, other participants indicated the need to be more intentional about course content that was applicable to the students' everyday lives, such as the construction and context of word problems. This suggestion regarding modification of the curriculum included the need for word problems that made sense to the students. Ms. Lacey stated that word problems are:

> …sort of standard contrived kind of word problems: a farmer needs to fence a pasture, classic sort of the train leaves the station, the things that everybody hates. My

> favorite was the compass that falls out of the weather balloon; I mean, they call this the real world. There is a little bit of a stretch unless you do a lot of farming.

According to several instructors, word problems commonly created obstacles for students in developmental mathematics due to the reading and critical thinking skills that were needed. The data suggested that developing word problems that resonate with students would be helpful to support engagement, learning, and overall academic success. For instance, Mr. Hall stated:

> Yeah, and I can tell you right now, the word problems are the ones that take the longest and are the most missed. It doesn't necessarily mean these are the ones we have to get rid of or change them, but it does mean that we have to think, "Is that the perfect place for them? Are we noticing that when students get to those, are they dropping out?" That data is really important for us.

In addition to changing course content to be more applicable to the students' daily life experiences, some instructors suggested two major modifications to the curriculum design. The suggestions were not to require students who were not interested in the sciences to take upper-level mathematics, and to offer courses that were more focused and provide time for students to fully understand the concepts. Mr. Zales proclaimed, "I think it would be okay if somebody is not going into science and engineering. Maybe you should not require them to take these classes," referring to higher level math courses. Mr. Zales further explained what he would do to support learning: "I would design courses in such a way there would be one class which teach the basics, one class which could be more advanced, and maybe a third class where we can put the whole picture together." Both suggestions imply a strong critique of the current curriculum and a desired major overhaul of the current curriculum to support learning among students in developmental math courses.

The various suggested changes to institutional policies and guidelines related to developmental mathematics included instituting a requirement to take developmental math courses early, incorporating a process to weed-out uninterested students, and modifying the curriculum.

If implemented, each modification would require clear communication among the campus community with greater attention to students. Unfortunately, Ms. Lacey indicated that communication with students needed to be enhanced, "We tend to be a little sloppy [with] language, in terms of credits, credit hours, or content hours, and other things," which led to an additional institutional change to improve communication with students regarding the curriculum.

Discussion

Many educators and researchers agree that providing developmental education is important and needed. In addition, the struggle to design and implement a developmental education curriculum within the community college setting continues to be challenging. This study uncovered both external and internal influences that contribute to the ongoing challenges that community college faculty

and administrators encounter when providing developmental education, particularly developmental mathematics.

External Influences

External influences identified from the study were frustration with secondary schools, meeting requirements to prepare students to transfer to the four-year institution, involvement of local businesses, state policies, and need for institutional changes in policies and guidelines, and frustration with lack of communication between secondary and postsecondary schools which minimized the opportunities to implement interventions. In addition, practices within the secondary schooling context impacted the classroom environment at the college. The factors identified were focusing more on state testing guidelines, failing to develop critical thinking schools while in high school, and offering credit for mediocre work while in high school.

Meeting the requirements to prepare students for four-year institutions generated another external influence. Participants mentioned that designing a curriculum that equipped students to transfer is important and challenging. Most students entered the community college with the intent of transferring which required a consistent examination of transfer requirements. The participants stated that at least five four-year institutions must approve courses before inclusion into the curriculum. It is important to note, developmental courses are not transferrable. However, the need to complete developmental courses before enrolling in college-level courses requires additional time at the community college. Therefore, getting students to college level courses becomes one of the challenges for faculty.

Many participants encouraged involvement of local businesses to inform the math curriculum. Participants expressed that including business leaders in the conversation would inform the curriculum and help the faculty to prepare students for employment. In previous experiences with local business leaders, the participants suggested, the information shared helped to determine what students needed to know upon departure from the college.

Lastly, state policies have an influence on the developmental math curriculum. For example, participants discussed three state policies that influence the curriculum: students must complete a math foundation course above Intermediate Algebra in order to get an academic degree; the college is required to use placement exams to determine appropriate course placement; and, the college must require students to complete pre-requisite materials before students enter college.

There are three areas that were uncovered as a result of conducting this study: an overlap when examining community college practices from an external and internal perspective; instructors have varied levels of awareness of students' pretext, context, and post-text; and state policies do not always align with the student nor the instructor.

1. There is overlap in thinking about things as external and internal. The overlap can be demonstrated using a chart.
2. Instructors have varied levels of awareness of students' pretext, context, and post-text. This just means that instructors do not really know their students and that they are content to make assumptions about them rather than learn who they are. Now, they

may just have too many students, but it seems likely that developmental mathematics demands an engaged kind of culturally relevant teaching that these students are not getting.

3. Policies in community colleges and states are not always in line with student and instructor realities.

Internal Influences

Participants identified the need to change institutional policies and guidelines as an internal influence that impacts the developmental math curriculum. The specific changes suggested by the participants were to require students to take developmental math early, to incorporate a process to "weed-out" students early who were not serious about education, to modify the curriculum design to enrich learning, and to provide early and ongoing academic advising. In order for the suggested changes to improve student outcomes, the participants mentioned the need to enhance communication with students in order to ensure understanding and gain their agreement in course enrollment.

Conclusion

The guiding question of the study sought to uncover the specific internal and external dynamics that influenced student success in developmental mathematics at a community college. Based upon the findings, internal and external dynamics are very important to consider when structuring developmental mathematics courses and when seeking to engage students who are enrolled in developmental mathematics.

Understanding the impact of internal and external dynamics on developmental mathematics should be of great importance to practitioners and scholars. It is important for practitioners to obtain a greater understanding of the need to accurately assess student readiness in order to prepare students for higher level courses. The need for practitioners to understand occurrences and challenges within secondary school environments before students enter the community college will provide greater insight and potentially lead to developmentally effective services to support students.

Secondly, it is important for practitioners in order to support student completion of mathematics courses which will subsequently promote degree completion rates. If students' complete developmental mathematics, they require less time to completion, more likely to graduate, and more likely to transfer to a four-year institution. Also, raising practitioners' understanding of internal and external dynamics will promote the inclusion of professional development opportunities to support instructor classroom management and infusing culturally relevant content into the learning experience. In doing so, the student-instructor relationship has greater potential for positively impacting student engagement and her or his ultimate success in developmental mathematics.

Lastly, practitioners will have the information and resources to assist employers with applying thoughtful strategies to positively infuse their organizational philosophy on the developmental mathematics curriculum. In addition, it is important for scholars to understand the impact of internal and external dynamics on developmental mathematics. As a result, scholars will have the working knowledge to make effective modifications to instructional design that prioritizes

inclusion of the students' experiences and culture into the learning experience. It is important to use "effective" teaching strategies that are sensitive to students' social and cultural contexts, and relevant to the students' daily lived experiences and career pathway.

Also, scholars need to be aware of the challenges and implications when internal and external dynamics are compounded with race and SES in order to adopt a holistic approach to student engagement and classroom instruction.

Therefore, the importance of managing the internal and external influences appropriately to promote success will, in turn, increase the number of low-income and/or racial minorities who complete the developmental math course and ultimately more likely to achieve their educational goals. In short, the importance of practitioners and scholars understanding the internal and external influences on developmental mathematics can lead to supporting student success. Ultimately when the internal and external influences are managed completion rates among students enrolled in developmental mathematics will increase and allow students to pursue their educational goals with greater probability of success.

Recommendations

Four important recommendations are given for future practice. Because the recommendations were based upon conversations with participants, some of them may not come as a surprise to the instructors at the college. However, the recommendations confirm what is known regarding internal and external dynamics and support the advancement of services to promote students' completion of developmental mathematics and overall accomplishment of educational goals.

It is recommended to modify the developmental mathematics curriculum to address basic skills development, math anxiety, and math applicability along with math content knowledge. Modification of the developmental mathematics curriculum to incorporate basic skills development and strategies to overcome math anxiety and math applicability are not skills that are often enforced by internal or external influences. Incorporating basic skills as part of the curriculum will teach students how to be "good students" and support student retention and ultimate success. Dembo and Jakubowski (1999) suggested offering "Learning to Learn" courses that teach students strategies on how to self-regulate themselves, which would support their completion of academic goals directly connected to the developmental mathematics curriculum.

The second recommendation is to develop partnerships across disciplines and divisions to generate opportunities to combine resources and implement strategies that can better serve students who are underprepared for college-level work. Partnerships within the institution have potential to be very effective; however, partnerships can create another form of an internal influence that can have negative repercussions on student learning and success. Therefore, it is recommended infusing developmental mathematics content into certain majors in order to strengthen the applicability of mathematics concepts in students' professional careers.

Another recommendation is academic advising services and practices be expanded to incorporate a stronger focus on students enrolled in developmental

education. It is important that academic advising is flexible and authentic with minimal external influences that allow advisors and instructors to work collaboratively to holistically support students. Unfortunately, this study did not include an assessment of academic services; however, several instructors indicated that the students enrolled in developmental mathematics were in need of mandatory and ongoing academic advising.

With regards to the discussion on the external and internal influences on developmental mathematics, partnerships with secondary and postsecondary educational institutions with area businesses may be developed. Equally important, the discussion should include an assessment of basic skills that students need as well as their emotional challenges related to mathematics education. If implemented, many of the issues and findings would be addressed and have a positive influence on student success. Consequently, students would master mathematics on the secondary level, which would minimize the need for developmental mathematics on the postsecondary level, particularly at community colleges.

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