



The Role of Developmental Math in the STEM Degree Pathways

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Abstract

Developmental math serves as a gateway course to STEM degrees for students who place into it at the community college level. The qualitative study conducted explores the role of developmental math in the STEM degree pathway within community colleges and four-year institutions in west Texas. This presentation will focus on findings from this study including the barriers to developmental math success, self-confidence and developmental math, promoting success in developmental math, developmental math for non-native English speakers, and developmental math impact on the STEM degree pathway.

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Introduction & Literature Review

A national need for a qualified STEM workforce

- STEM jobs make up 20% of all jobs in the U.S. (Rothwell, 2013)
 - *Half of all STEM jobs require a bachelor's degree*
- Despite the growth in STEM jobs, U.S. STEM degree earners are lower than other countries (Perna et al., 2010)
- Less than 40% of students who enter as STEM majors earn a STEM credential (President's Council of Advisors on Science & Technology 2012)

STEM Workforce in Texas

- Texas is expected to see an increase in STEM workforce needs with 715,000 STEM jobs by 2018 (The Texas Economy, n.d.)
- 9% of STEM jobs will be located in Texas – the second most in the United States (Educate Texas, 2016)

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Introduction & Literature Review

Developmental Math on National Scale

- 20% of first-year undergraduates in 2007-2008 AY enrolled in at least one development course (Sparks & Malkus, 2013)
 - *Community colleges had largest percentage of students (24% of students in at least one developmental course)*
- On average, community colleges students were required to enroll in developmental math (59%) than in developmental reading (33%) (Bailey, Jeong, & Cho, 2008)

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Introduction & Literature Review

**Developmental Math and the STEM Pathway**

- 75% of students failed to pass developmental math on the first-attempt, but yet the degree completion rates for first-attempt pass students were parallel to peers enrolled in STEM math sequences (Bahr, 2008)
- 94% of STEM degree earners passed developmental math on the first attempt (Lundy-Wagner, 2014)
 - *100% of engineering and architecture students passed*

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Introduction & Literature Review

**Developmental Math in Texas**

- Approximately 40% of Texas community college students in the 2014 cohort did not meet state standards for math skills (Texas Higher Education Coordinating Board, 2015)
- Initiatives such as the Dana Center's New Mathways project seek to promote student success in developmental math in Texas (Rogan, 2014)
 - *One of the pathways under the Dana Center's New Mathways project is a STEM-Prep Pathway*
 - *The New Mathways project partners with the Texas Association of Community Colleges which represents all Texas public community colleges*

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Purpose



The purpose of this qualitative study is to explore how developmental math enrollment impacts persistence through the STEM degree pathway and STEM degree credentials earned from the perspectives of developmental math faculty.

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Methodology



- IRB approval secured through TTU HRPP
- Participants: Developmental math leads and instructors from STEM degree accelerator grant partners
 - *6 community college partners*
 - *University partner*
 - *High School Partner*
- 45-60 minute interviews conducted with each partner consisting of 14 semi—structured interview questions
- Interviews were audio-recorded and transcribed
- Initial coding was done by the researcher who conducted the interview and synthesized on a question-by-question basis
- Three members of the research team then coded all transcripts to confirm and agree upon themes

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Student-Level Barriers to Developmental Math Completion



- **Academic preparedness & math foundation**
- **Self-doubt in math**
 - *"The first barrier is that students who were unsuccessful in math going through high school, feel like they never will be successful. And so a lot of it is just mental. They just have a mental block and they don't want to get past it."*
- **Lack of student motivation**
- **Negative student identity**
 - *"They don't understand what it takes to be a good student, and they have never been a good student, and it's a foreign concept to them."*
- **External barriers (e.g. work, family)**
- **Self-regulation skills (e.g. time management, study skills)**
- **Regional economic constraints**

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Secondary School-Level Barriers to Developmental Math Completion



- **Negative influence of secondary school teachers**
 - *"Over the years, I had a lot of the students that were not successful in their secondary education because at some point, somebody told them that they weren't smart enough. You know, someone would tell them 'You can't do math' and they believed them."*
- **Secondary school "over testing" burnout**
 - *"I think that another barrier because our high schools are so testing/funding oriented - you only get money if your kids can do certain levels on these tests, so because of that these kids are tested out the wazoo."*
- **Adjusting from past teaching styles**

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Postsecondary-Level Barriers to Developmental Math Completion



- **Developmental education stigma**
 - *"If you have students that are struggling in all areas of developmental, you know, not just in math, but also have to have the reading and writing. They don't get to enroll in very many college course credits. And so that kind of puts them at a stigma. You know, as soon as you tell them they have to take developmental ed, they think they're the stupid kid."*
- **Delayed college course enrollment**
 - *"You know the kid that starts out in that lowest level developmental doesn't think they're ever going to get through. You know, they're really nervous about the fact that it could take them 2-3 semesters before they can ever take that college algebra or something like that."*
- **Negative perception of developmental math student**
 - *"So, we have constant training session for our tutors where we emphasize the fragility of the developmental student."*

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Promoting Developmental Math Success



- **Willingness to achieve**
 - *"There's people who are successful; those are the people who are willing to do their homework, people who are willing to study, people who are willing to come to class; people who are willing to learn."*
- **Goal-oriented**
 - *"They need a goal. The student's that tend to stop out, that we see, are the ones who are just testing the waters of college... and so, the ones who typically have a real clear vision."*
- **Regular attendance**
 - *"We find that the students who are behind on their online homework or somebody who's just not attending class, coming to class regularly, those kinds of issues are going to be people who are not nearly as successful."*

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Promoting Developmental Math Success



- **Hard work and practice**
 - *"But if you are working hard and you are consistent, we see a lot of success from those students."*
 - *"They have to attempt the homework, not pass it, but attempt it. If you are practicing you are getting better, period."*
- **Seeking positive affirmations**
 - *"I think that they do have more self-confidence because we believe in them. You know when a student believes that the teacher believes in them, they are going to try that much harder because they don't want to let the teacher down."*
- **Persistence and perseverance**
 - *"It's that student who isn't afraid of failure, 'I'm gonna get back up, I'm gonna do this until I get it, I am gonna keep going' ... the persistence and perseverance, they have to have that."*

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Promoting Developmental Math Success



- **Being Driven**
 - *"A student who successfully completes developmental math is somebody who's going to be driven, confident..."*
- **Inquisitive Nature**
 - *"A completer is someone who asks questions, they are the most inquisitive person ever to the point they are driving me crazy...they are gonna pass."*
- **Building relationships with students**
- **Developmental education course integration to decrease time to credit-bearing courses.**

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Impact of ESL on Developmental Math Success



- **Language skills may not negatively influence math skills.**
 - *"We have had many students come, their math skills are wonderful. It's just their reading skills or their native language, and they do fine."*
 - *"...but as an ESL student the language barrier is not as big of an obstacle in mathematics as compared to other subjects."*
- **Math is a universal language.**
 - *"One is mathematics, there is not that language barrier in math and science as much as there is for other things. You know, because we're doing a lot of things with numbers."*
- **Language skills do matter**
 - *"Although math should be universal, you should know a plus sign, a multiplication sign, it's not always the same. So depending on how they were taught in whatever country they come from, sometimes even the examples throw them off."*

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Impact of ESL on Developmental Math Success



- **The necessity of ESL courses.**
 - *"We have the policy that they do their literacy course first for that reason because we do want them to be able to understand better, to be able to read and write...you know, it is just numbers but it helps them to read their book and understand, you know, what's going on there."*
- **The role of ESL peer support.**
 - *"We don't have a large number of ESL, and they tend to flock together which helps us. Typically, it's like our baseball team. We get several guys from Puerto Rico that come in but you at least got one that can speak enough English that they can kind of translate to try to help the others."*

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Self-Confidence Impact on Success



- **Belief in oneself is key to success**
 - *"Because once they get to a place where they believe in themselves, and they have the time and the effort talking about those other challenges - those external challenges, then they can succeed. But that's one of the biggest barriers that they run into because they're already struggling. That's why they're in the place that they're in."*
- **Developing perseverance in math**
 - *"I think students who are self-confident tend to persist more and perform better in their classes. They have higher persistence rate."*

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Self-Confidence Impact on Success



- **Changes the perception towards math**
 - *"If you made a hundred on this quiz, you can do other math quiz easily, saying you have to change their mind, That's their biggest problem...it is changing their perception and once they realize, 'hey I can do this,' the confidence level goes up and then there's no stop[ping] with them."*
- **Instilling Confidence in Student**
 - *"It's huge. It is absolutely huge. If you can give students some self-confidence either way, as soon as they come in with self-confidence, they're going to be successful no matter what."*
- **Promoting help-seeking and personal responsibility**
 - *"We emphasize in class that it is not embarrassing to ask for help. I hope the class gives students an idea of what they do when they start to struggle."*

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Developmental Math & the STEM Degree Pathway



- **Confidence**
 - *"After successfully completing the developmental math classes, many students seem more confident in their skills and abilities. Therefore they may be more persistent to finish their STEM degree"*
- **Motivation for Long-term Goal**
 - *"They want to be accepted into the [major] program."*
- **Critical and Foundational**
 - *"Students have to have a basic developmental foundation if they are pursuing a STEM pathway."*
- **Accelerated Pathways Influence Motivation**
 - *"Students do not get discouraged with Fast Track."*
 - *"Curricula change encourages students to get through the [developmental] pathway quicker."*

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Next Steps & Conclusion



- Presented findings to regional STEM degree accelerator grant partners and workshopped how information could benefit their institutions
- Interviewing/surveying students in developmental math to gain insight into the student perspective

Questions?

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