Alternative Developmental Math Curriculum Designed to Accelerate the Sequential Coursework by Implementing Quantitative Reasoning (Work in Progress)

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Outline

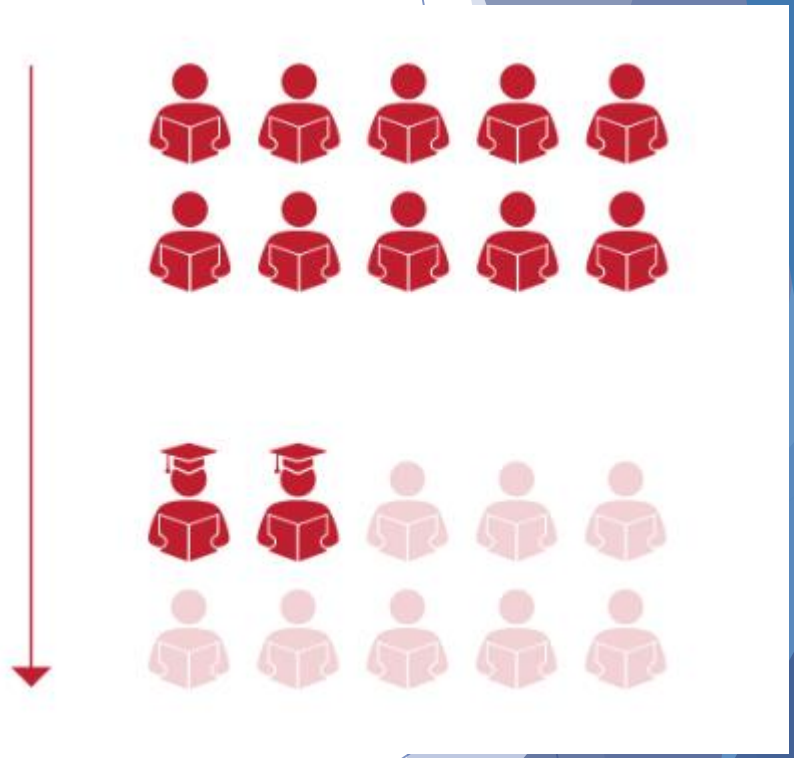
- Background
- The problem
- Approach
- CCCC (Quantway Sequence)
- NHSC (Statway Sequence)
- Preliminary Results and Future Work

North Dakota Pre-Engineering Education Collaborative (PEEC)

- Shared Pre-Engineering coursework over Interactive Video Network.
- Transfer 2 yr Pre-Engineering degree from tribal college to state university.
- 4 North Dakota Tribal Colleges along with a Research University:
  - Cankdeska Cikana Community College (CCCC) – Fort Totten, ND
  - Nueta Hidatsa Sahnish College (NHSC) – New Town, ND
  - Sitting Bull College (SBC) – Fort Yates, ND
  - Turtle Mountain Community College (TMCC) – Belcourt, ND
  - North Dakota State University (NDSU) – Fargo, ND

The problem…

For every cohort of students entering into developmental math classes, **80%** of these students will never complete a college level math course.



Problem Addressed

Traditional Developmental Math Sequence

- 1.7 million students enter the community college system (Snyder & Dillow, 2011).
- Incoming students to tribal colleges have traditionally exhibited a lack of preparedness in Math.
  - 80% of the students entering the tribal college cohort are placed into remedial math courses.
  - Nationally, only 40% of students graduating from high school met the ACT college readiness benchmarks for math (ACT, 2018).
  - 80% of students entering college in remedial math do not complete a college level math course within 3 years (Bailey, Jeong, & Cho, 2010).
- Students' traditional developmental math pathway:
  - Pre-Algebra >> Elementary Algebra >> Intermediate Algebra >> College Algebra
  - For most STEM students this is a recipe for failure.

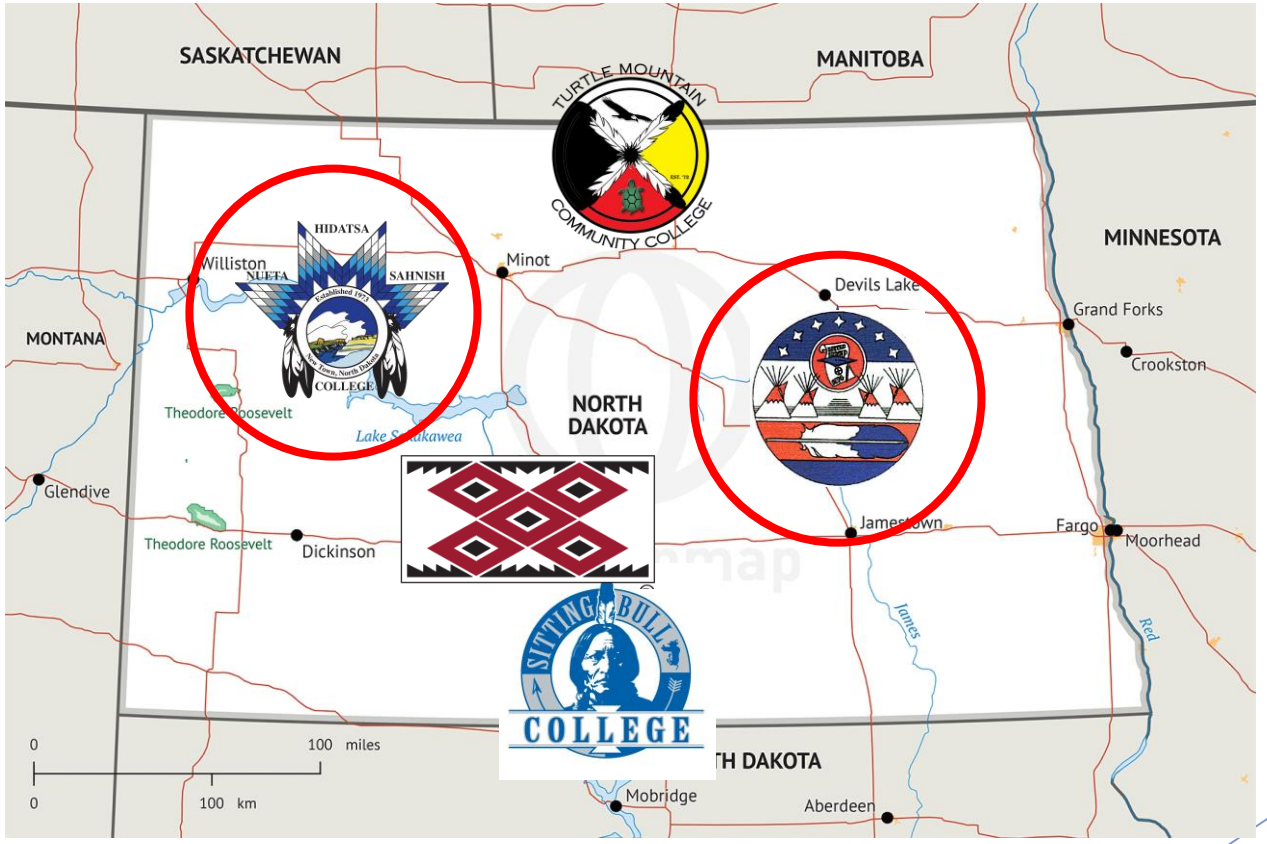
Problem Addressed Cont.

Traditional Developmental Math Sequence

- Time to complete two-year curriculum is increased with each developmental course required.
- The developmental math courses do not count towards the statewide general education requirement.
- These courses are not included in Engineering or other program of studies curriculum.
- The increased time commitment leads to conflicts for students.
  - Confirms the general perception that engineering students need to have an innate initial propensity in mathematics versus an ability that is learned.
  - Leads to a lack of persistence in continuing the curriculum.

One Solution – Carnegie Math Pathways

- Two of the four North Dakota tribal colleges in the ND Pre-Engineering Collaborative, CCCC and NHSC, have introduced two Carnegie Math Pathways approaches called Quantway and Statway.



One Solution – Carnegie Math Pathways

- The engineering cohort aims to provide a pathway for students to transfer to an engineering program at a four year university.
- A multi-semester delay in transitioning from the TCU to the mainstream institution can invoke an increased risk factor for students.
- By introducing these pathways, the institutions (CCCC & NHSC) aim to:
  - Assist the students in preparing for college level math courses.
  - Accelerate the pathway to complete the remedial classes at a faster rate.
  - Provide a learning environment that furnished specific pedagogical approaches.
  - Emulate real-world engineering group work procedures.

Innovative Curriculum

Carnegie Math Pathways

- The Carnegie Math Pathways approach is as a transformational curriculum for developmental math.
- It utilizes a problem-based and collaborative learning method of teaching.
- Statway and Quantway Pathways have been shown to engage students in the statistical and quantitative reasoning concepts increasingly seen as more relevant to many students' educational and career goals compared to those in the traditional algebraic sequence (Huang, 2018).
- Relevant and challenging content that supports career readiness and further mathematics learning.
- Productive Persistence teaching strategies weaved in:
  - Example: Growth Mindset activities

Pedagogy – Facilitated Group Learning

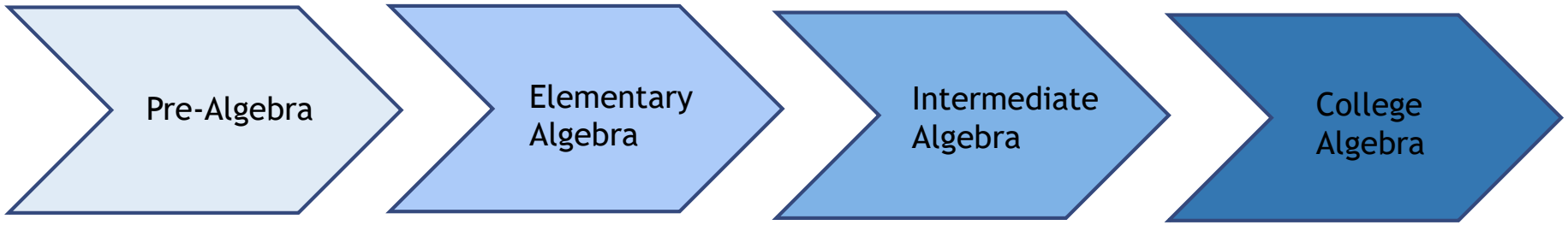
- The main mechanism for teaching involves students working in groups to solve scenarios that may occur in everyday life.
- The groups ideally have four students each with each assigned a role: presenter, monitor, facilitator, and recorder.
- Both extroverts and introverts can become comfortable in their chosen roles as it gives every student a purpose and provides accountability to their group.
- Every phase of the problem-solving path, from initially understanding what the problem is to presenting a solution to the class involves utilizing writing and oral skills to make the process a well-rounded educational endeavor.
- Develops leadership, cooperation, communication, and accountability skills.

Institutional Approach

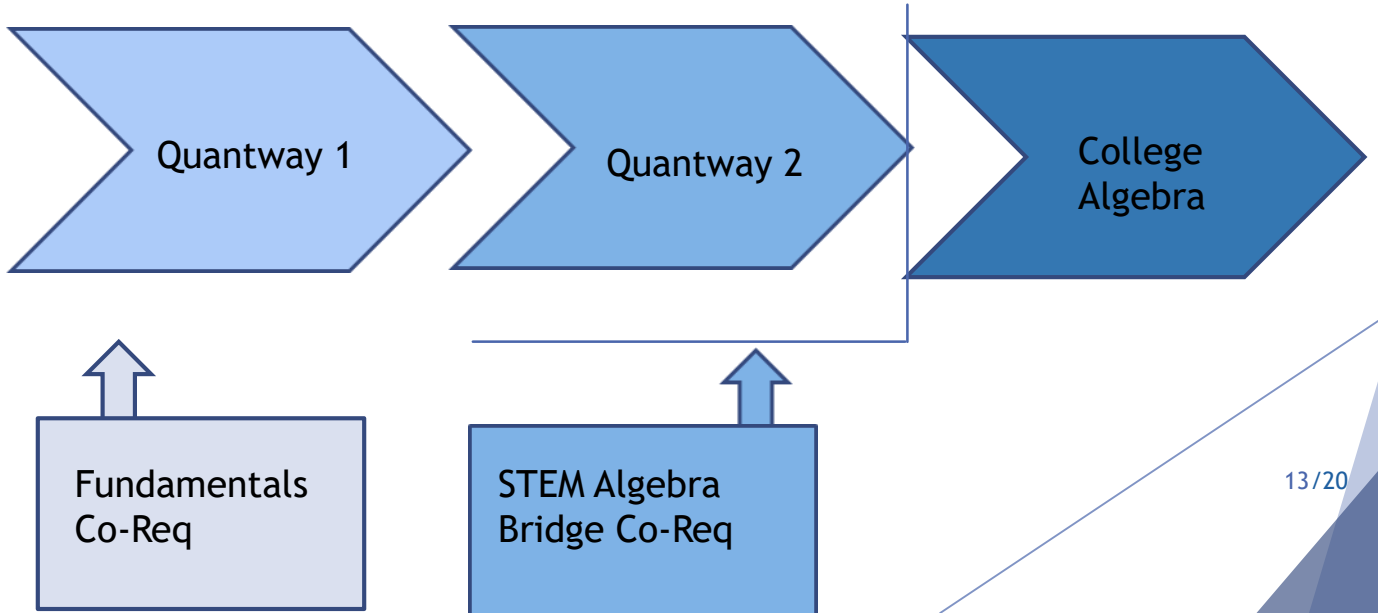
- Two tribal colleges in the engineering cohort have introduced Carnegie Math Pathways approaches.
- Cankdeska Cikana Community College (CCCC) implemented the Quantway sequence Fall 2018.
  - This sequence makes use of quantitative reasoning with algebraic concepts and real-world scenarios integrated into curriculum.
- Nueta Hidatsa Sahnish College (NHSC) implemented the Statway sequence in Spring 2018.
  - This sequence combines the study of college level statistics with algebraic concepts and real-world scenarios integrated into the curriculum.
- Instructors from both institutions undergo trainings and continued professional development several times per year to collaborate and exchange best practices with other tribal colleges that also have implemented the pathways curriculum.

CCCC (Quantway Sequence)

- Traditional Math Pathway

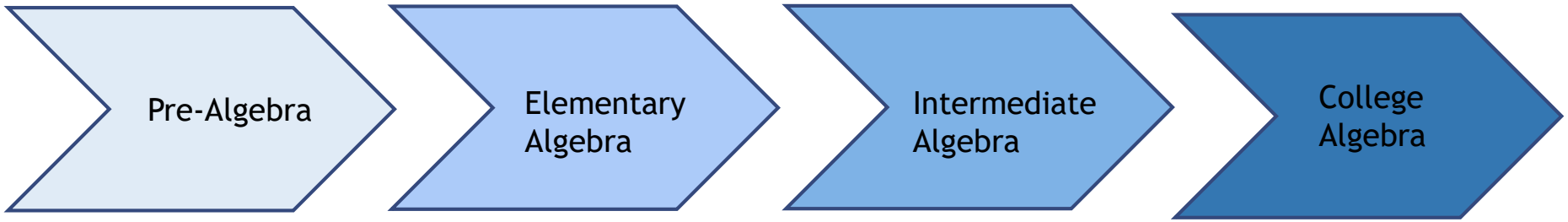


- Quantway Sequence

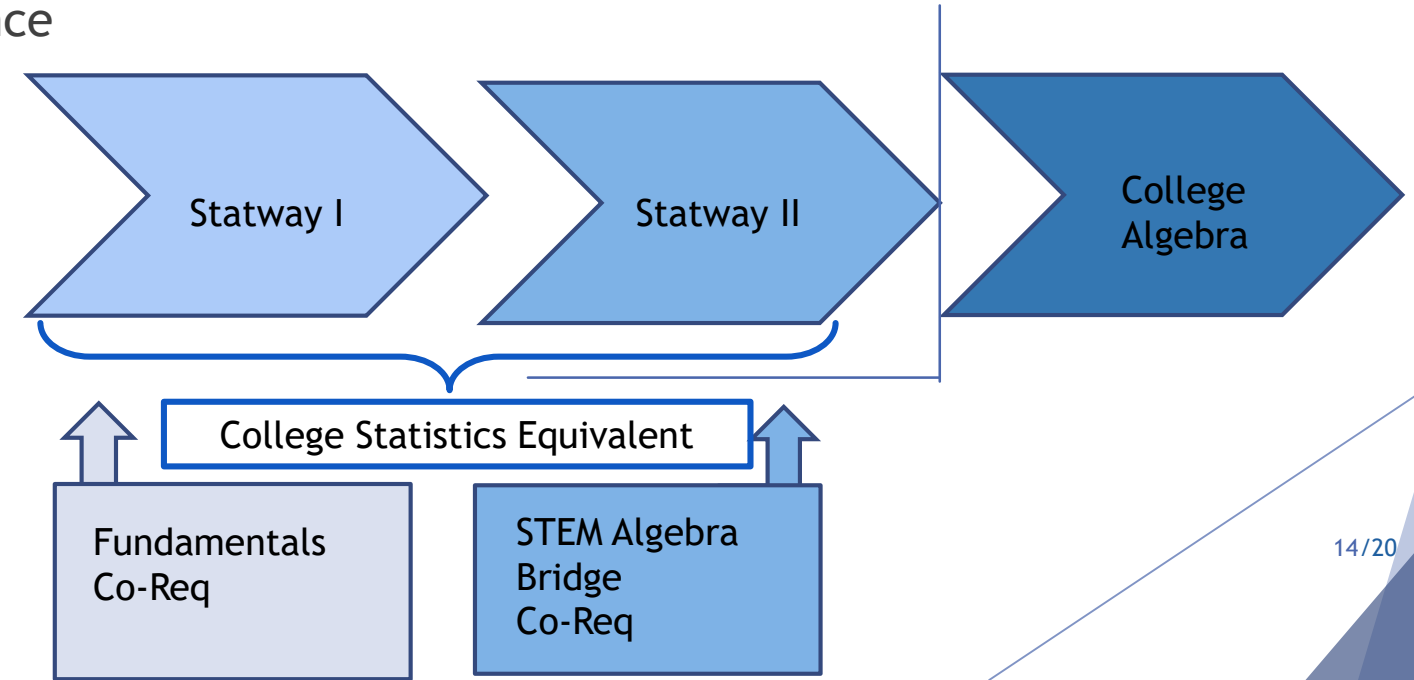


NHSC (Statway Approach)

- Traditional Math Pathway



- Statway Sequence



Preliminary Results

- NHSC implemented the Statway sequence in Spring 2018.
  - In Fall of 2017, the success rate for traditional remedial algebra courses was **21%.**
  - In Spring of 2018, the success rate for Statway was **23%**.
  - In Fall of 2018, the success rate for all Statway courses improved to **43%**.
  - In Spring of 2019, the success rate for all Statway courses improved further to **45.9%.**
- CCCC implemented the Quantway sequence Fall 2018.
  - No preliminary data available.

Preliminary Results

- Course completion rates have improved significantly.
- Collaboration amongst student groups is improved.
- Group members have become friends and worked on coursework from other classes together.
- Group members hold one another accountable, which has had a positive impact on attendance.
- Problem based, collaborative learning has improved student engagement in the material being covered.
- Math faculty have transformed from being traditional instructors to becoming facilitators of learning.

Preliminary Results

Preparing students for **Engineering** through Math Pathways

- Sets up students to be successful in college career and later as an Engineer through development of soft skills (leadership, group collaboration, communication, productive persistence/resiliency).
- Provides Engineering students with statistical groundwork that is often absent in mainstream engineering curriculum, which is important in industry.
- More systems-based approach to problem solving:
  - Not “plug and chug”
  - Reasoned evaluation of problems through group work
- Emulates the problem solving and engineering design process that Professional Engineers utilize in the real world.

Future Work

- Continue to provide professional development for instructors to improve teaching.
- Monitor future student cohorts, evaluate success rates, and search for methods of continued growth or improvement.
- Assess the impact on students entering and completing the Engineering programs at the tribal colleges and monitor their progress when they transfer to North Dakota State University:
  - Enrollment
  - Completion Percentage
  - Rate of Time to Degree Acquisition

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Questions, Comments?