Online Tutoring Data as a Guide to Student Pathways

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Abstract
This paper reviews online tutoring session data from seven Achieving the Dream community colleges from 2015 to 2017 with a focus on sessions conducted by students enrolled in the Ivy Tech math courses in particular the MATH 136, College Algebra, course. The analysis presented in this paper demonstrates the availability of data and the uses of these data to assist institutions in supporting students to persist and achieve success along their guided pathways.

Colleges have increasingly looked to the Guided Pathways model to ensure that students have clear plans and necessary supports to achieve their goal of completing college degrees. The most significant factor in reaching this goal is each student’s ability to master the academic content, which requires that institutions understand and address each student’s academic as well as socio-cultural and socio-emotional development. Tutor.com researched both the content and non-cognitive components of academic success through analysis of over 7,000 math sessions conducted for Ivy Tech Community College. Math was selected due to the considerable number of sessions compared to other domains and because of mathematics’ foundational role in many program pathways. Central to the research was assessing the usage patterns to identify what subjects, topics and sub-topics are receiving the most usage throughout the semester, pinpointing areas of student struggle. The non-cognitive elements of learning were analyzed using quantitative and qualitative student feedback gathered through standard post-session survey responses to identify factors which influenced students’ motivation and persistence in striving to achieve understanding. Through this analysis the researchers found key factors that contribute to student confidence levels following a tutoring session.
Introduction

Tutor.com was started in 1999 and to this day has conducted over 16 million tutoring sessions for a large population of students with diverse academic backgrounds. The online tutoring company conducted over 255,000 sessions with higher education institutions in 2017. Students have access to an expert tutor in over 60 subjects 24 hours a day, 7 days a week. Students reach out to a tutor for a variety of learning needs. Some seek answer validation, others are stuck on a problem or struggling to develop their thesis, while others are just lost and frustrated. Tutor.com captures students’ needs and the outcomes of the tutoring learning experience through session data and post-session data for every session conducted. As a part of Achieving the Dream, we wanted to explore how we could make our enormous amount of data valuable to higher education institutions. Our goal for this paper is to provide institutions with a glimpse of the data available that provides insight into student’s academic success that might help these institutions as they design, implement, and/or support students in their Guided Pathways Model.

Background

Many factors contribute to student success or lack thereof within the community college setting. One of the most significant factors is each student’s ability to master the academic content which requires that institutions understand and address each student’s academic as well as socio-cultural and socio-emotional development.

For years or perhaps centuries, academic success has been perceived to be essentially related to innate intelligence. However, various research efforts including the work of Carol Dweck and Angela Duckworth conducted over the last several years have indicated that academic success and indeed success in general is the outcome of an intricately woven connection of cognitive abilities combined with certain academic behaviors and their underlying psycho-social beliefs. According to the research, one’s underlying beliefs, also known as mindset, about one’s ability to succeed influence one’s motivation to exhibit the kinds of academic behaviors such as self-discipline, persistence, grit, help seeking, trying and failing as well as other similar behaviors. Students who have been found to demonstrate a growth mindset, which is a belief in their ability to succeed as well as a belief in the efficacy of effort and persistence, have been shown to surpass in achievement students who view themselves as limited by their intelligence or by external factors (Blackwell, Trzesniewski, & Dweck, 2007).

Furthermore, the research points-out that the attributes of a growth mindset can be taught and nurtured by educators through the provision of scaffolded experiences of academic success, the development of supportive personal relationships, praise for effort rather than grades, recognition of failure as a path to learning and other techniques. A review of this non-cognitive research by Farrington, et al. (2012) states, “While some students are more likely to persist in tasks or exhibit self-discipline than others, all students are more likely to demonstrate perseverance if the school or classroom context helps them develop positive mindsets and effective learning strategies” (p.7).

The Guided Pathways model aims to clarify pathways to program completion, career advancement and further education for college students. Overall the guided pathways model is about efficiency and effectiveness. Guided Pathways provides students with a streamlined, higher education experience that supports them throughout their journey toward meeting their career goals and aspirations. Efficiency is
achieved through a systemic redesign of the student experience from student intake, structured program pathways, support structures and instruction to ensure student learning and progress on their pathway, and reduction in distractions or roadblocks. Effectiveness can be realized as more students complete college in a timely manner (Bailey, Jaggars, & Jenkins, 2015).

The Community College Research Center at Teachers College, Columbia University has closely studied the implementation of guided pathways by institutions from the American Association of Community Colleges’ (AACC) Pathways Project (Jenkins, Lahr, & Fink, 2017). In this report they summarize four main practice areas of the guided pathways model:

- Mapping pathways to student end goals
- Helping students choose and enter a program pathway.
- Keeping students on path.
- Ensuring that students are learning.

Institutions are taking a variety of approaches to addressing these practices as they implement the guided pathways. In terms of the practice of mapping the pathways to student end goals, some institutions are creating different pathways based on students’ “meta-majors” or programs of study. For example, some institutions like Lansing Community College have created three math pathways: quantitative reasoning, STEM (science, technology, engineering, and mathematics), and statistics. The foundational mathematics course of each pathway is designed so that the content aligns to a particular career or field. The courses are also designed to ensure a streamlined, efficient path for students. Some courses, like quantitative reasoning, have a “co-requisite” course to support students who may not be prepared for quantitative reasoning offering additional mathematics reinforcement so they can complete the course in one term (Jenkins, Lahr, & Fink, 2017). Ivy Tech Community College has created similar mathematics pathways and a co-requisite course for quantitative reasoning, with quantitative reasoning incorporating algebraic reasoning skills without a formal algebra structure. Quantitative reasoning combined with the co-requisite course serve as the foundational courses for non-STEM math pathways.

With respect to the practice of ensuring that students are learning, the guided pathway goal is for faculty to establish and assess whether groups of students are building the appropriate knowledge and skills as they advance along a pathway. Faculty are asked to create general program learning outcomes so students’ courses are not disconnected and knowledge and skills accumulate over time. At the time of the Community College Research Center’s report (2017) no institution was assessing the achievement of these learning outcomes at an individual level. To ensure learning within these pathways, instructors are focusing on collaborative and student-lead engagement or active learning in the student’s field of interest. As colleges attempt to create these general program level learning outcomes and create more student-lead learning experiences, courses are being customized and modified from the existing general education learning outcomes. With these changes, institutions will need to evaluate their assessment methods to monitor student learning and to measure student achievement of these learning outcomes (Jenkins, Lahr, & Fink, 2017).

Given the different approaches institutions are using to implement the guided pathways, there is a role Tutor.com tutors and the data produced from sessions can play. The core principles of learning that are executed in online tutoring sessions with Tutor.com tutors emphasize a student-directed approach to learning and meeting each individual student’s needs. To meet student unique academic needs, tutors take the time at the beginning of the session to understand the assignment, student’s prior knowledge, and other contextual information to best support the student. Throughout the session tutors set a roadmap to
celebrate quick wins which builds students confidence and is motivating for students. These principles support student learning at a personal level. These learning experiences as well as the data about students’ performance and student feedback on a tutoring session could assist institutions implementing guided pathways. The data could help assess if individual students are meeting learning goals and identify students who are at-risk of deviating from the pathway. On a more general level the session data could identify areas of greatest challenge for groups or cohorts of students in foundational courses of pathways providing institutions with course level information related to pre-requisite course or placement of students in courses. Using data to pinpoint challenges at the course level also provides critical feedback to institutions who want to ensure classroom instruction is effective and students are learning throughout their pathway of study. Boosting student confidence and building growth mindsets are also essential to keeping students on their pathway, another critical practice of Guided Pathways.

Overall, the data generated by online tutoring sessions that adhere to principles that are being embraced by institutions implementing the guided pathways appears to be a suitable place to explore these synergies and identify ways for continued collaboration between higher education institutions and Tutor.com.

**Methods**

The study was an exploratory, descriptive case study to determine how the data generated by tutoring sessions can support higher education institutions who are implementing the Guided Pathways model. We first identified seven community colleges that were a part of the Achieving the Dream network. From there we identified an institution with a high volume of session data that could be pared down to the individual course level.

This study focused on the topic and sub-topic data of each session to better understand students’ challenges in foundational mathematics courses as well as the point in time in which the students struggle most in these courses. We also wanted to better understand the non-cognitive aspects of success that impact student’s confidence that contribute to student achievement. To explore these non-cognitive aspects, we analyzed the students’ responses to standardized post-session surveys including comments from sessions where the student reported being more confident about the concept after a session.

Once we identified the key student challenges and their location in the foundational course and the non-cognitive factors that contribute to student’s feeling more confident or more willing to persist, we wanted to better understand how this data was useful to higher education institutions. We wanted to know how they would use this data to inform course design and/or instruction. How could it potentially inform course sequencing or additional student support. To gain the institution’s perspective we worked with the lead chair of the Mathematics Curriculum Committee for Ivy Tech so he could provide additional context that would inform its use for higher education institutions and answer our questions regarding the potential uses for these data to inform guided pathways.

**Guiding Questions**

The following questions guided the case study to explore and describe students’ academic and non-cognitive factors contributing to student achievement.

1. What are students’ greatest areas of struggle in a foundational mathematics course?
2. When do those areas of struggle occur within a course?
3. Does online tutoring have an impact on students’ non-cognitive skills (confidence, persistence, and growth mindset)?
Case Population
The original seven Achieving the Dream institutions included College of Ouachitas, Montgomery County Community College, Central Alabama Community College, Rose State College, Ivy Tech Community College, National Park College, Guilford Tech Community College. Students from all of these institutions had a total of 79,148 sessions from 2015 – 2017. The case population included sessions from Ivy Tech Community College, a state-wide system of community colleges in the state of Indiana, with 45 sites, centers, and campuses and serves over 160,000 students each year. Eighteen percent of this student population is fully online while 26% are taking at least one online course. Seventy-one percent of the population consists of full-time students, while 29% are part-time students. The part-time student population has a retention rate of 40% and the full-time population has a retention rate of 49%. From 2015 through 2017 students from Ivy Tech had a total of 64,083 sessions across all of the subjects.

Data Sources
The data included in this study were generated by surveys both tutors and students complete at the end of each session. In the tutor’s post-session survey, the tutor evaluates the core concepts that were discussed and the student was engaged in learning during the session. There are many concepts that may be touched upon, but in the end the tutor evaluates the focus of the session to identify the main topic and the appropriate sub-topic for the session. The tutor also assesses student’s achievement of understanding and prior knowledge of the core concept as well. For the purposes of this study, the topic and sub-topic of the session were used.

The student survey includes several questions that provide feedback to the tutor as well as gauge the student’s perception of the benefits of the session by asking about whether the session helped students complete the assignment, improve grades, and improve confidence. The student also has a comment field where the student can choose to comment on the tutoring experience.

Analysis
The sets of data were intended to describe student challenges in mathematics courses. The first two authors of this paper do not have experience teaching these courses and neither has a mathematics instruction background. These findings were initially presented with an objective eye. After conducting the analysis, the authors met with the lead mathematics chair at Ivy Tech to discuss the findings so he could provide additional context to some of the course findings.

Topic Drill Down
To better understand student challenges, we started by analyzing all of the sessions across the seven community colleges to identify the domain (math, English, science, etc.) that presented the greatest challenge for students. Identification of student challenge was simply the domain/subject/course that included the highest session count representing students seeking tutoring support over the 2015 – 2017 time period. Once we identified the domain, we identified the specific subject (Algebra, Calculus, etc.) that presented students with the greatest challenges. Next, we identified the institution with the highest number of sessions within that subject and looked at courses that mapped to that subject. We then focused on the

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1 Tutor.com categorizes their subjects broadly to serve multiple markets, both K-12 and Higher Education. The tutors in a subject such as Algebra II have passed an exam that covers the full spectrum of topics included in Algebra II. At the time of implementation with a higher education institution, we map that specific institution’s courses to the appropriate subject(s) based on the topics included in the course. For example, a College Algebra course would best map to Algebra II while a Developmental Math course would best map to Algebra.
tutor post-session survey data where the tutor identifies the topic and sub-topic of the session. From these data we identified the top three topics and the relevant sub-topics for which students requested the most tutoring support and the timing by the week of when students sought support for that course. We looked at that course in the fall and spring semesters.

Qualitative Analysis of Student Comments
Using students’ responses on the post-session survey, we first identified students that indicated the session improved their confidence across all institutions, from Ivy Tech, and then within one of Ivy Tech’s foundational mathematics courses, MATH136. To explore factors that may impact student’s self-reported increase in confidence following a session, we then focused our analysis on the 793 comments left by students from MATH136 that reported the tutoring session improved their confidence. We conducted our initial open coding by reviewing a large sampling of the student comments. We validated and adjusted our coding categories that emerged from the data against the framework presented by Farrington et al. (2012) to provide a research-based and common language to discuss non-cognitive skills, such as motivation, persistence, confidence, and mind-set. We then completed a second coding of the comments using the adjusted, validated categories.

Findings
Topic Drill Downs
The data set includes all sessions from seven community colleges where a tutor completed the post-session survey and included a topic and sub-topic of the session (n=45,276 sessions) from 2015 - 2017. Of those sessions 42.8% (n=19,384) were in math subjects. Algebra II accounted for 37% (n=7,180) of the math sessions. This is a subject commonly routed to some developmental math courses as well as College Algebra courses based on the institution. These courses are a part of the foundational math pathway of many students on a mathematics pathways and/or program or career pathway. We focused on the math courses to learn more about the challenges students have in these courses which may help community college instruction for remediation and academic support for students.

The following topic drill down for Algebra II sessions (n=7,180) in Table 1 are from sessions where a topic and sub-topic were selected in the tutor post-session survey that occurred in 2015 through 2017 across all seven community colleges. Based on this data, a key concept for which students are reaching out for support is Linear Functions, 28.4% (n= 2,042) of all of sessions. Quadratic functions was 15.8% (n=1,135) of the Algebra II sessions and Exponential and Logarithmic Functions accounted for 14.1% (n=1,014) of the sessions. We focused the analysis on linear functions and exponential and logarithmic functions which typically are taught at different points of a semester.

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2 The linear function data includes both topics of Linear Function and Linear Functions, Equations, and Inequalities. In July 2017 Tutor.com changed the name of the topics to provide more information to the tutors. Tutors were not consistently clear on where to locate linear equations and inequalities, so it was included in the topic name. All sub-topics for the topics remained the same except for an additional Other sub-topic. The name of Quadratic Functions was also changed. For the remainder of this paper the combined totals for both topics will be referred to as Linear Functions and Quadratic Functions respectively.
It is clear that Linear Functions is a challenging concept across many institutions. There are eight possible sub-topics for Linear Functions (Table 2), if “Other” is included. The sub-topics below identify the specific pain points for many students in a College Algebra course with the linear functions concept. When we looked at the Sub-Topic Drill Down of Linear Functions (n= 2,042 sessions), Solving Linear Equations (n=689 sessions), the mechanism of finding a solution, is the challenge in 33.7% of these sessions.

Table 2. Sub-Topic Drill Down of Linear Functions

<table>
<thead>
<tr>
<th>Sub-Topics</th>
<th>Session Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Functions</td>
<td>1713</td>
</tr>
<tr>
<td>Slope, Intercepts, Points on a Line</td>
<td>260</td>
</tr>
<tr>
<td>Solving Linear Equations</td>
<td>591</td>
</tr>
<tr>
<td>Solving Linear Inequalities</td>
<td>114</td>
</tr>
<tr>
<td>Solving Problems with Equations and Inequalities</td>
<td>221</td>
</tr>
<tr>
<td>Systems of Equations and Inequalities</td>
<td>273</td>
</tr>
<tr>
<td>Writing and Graphing Linear Equations</td>
<td>204</td>
</tr>
<tr>
<td>Writing and Graphing Linear Inequalities</td>
<td>50</td>
</tr>
<tr>
<td>Linear Functions, Equations, and Inequalities</td>
<td>329</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
</tr>
<tr>
<td>Slope, Intercepts, Points on a Line</td>
<td>57</td>
</tr>
<tr>
<td>Solving Linear Equations</td>
<td>98</td>
</tr>
<tr>
<td>Solving Linear Inequalities</td>
<td>28</td>
</tr>
<tr>
<td>Solving Problems with Equations and Inequalities</td>
<td>56</td>
</tr>
<tr>
<td>Systems of Equations and Inequalities</td>
<td>34</td>
</tr>
<tr>
<td>Writing and Graphing Linear Equations</td>
<td>27</td>
</tr>
<tr>
<td>Writing and Graphing Linear Inequalities</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>2042</td>
</tr>
</tbody>
</table>
The next most common topic for which students sought support was quadratic functions. Similar to linear functions, this topic includes data after the topics were renamed in July 2017. Across the two topics there are six possible sub-topics for Quadratic Functions. The sub-topics below identify the specific pain points for many students in developmental or college algebra courses with the quadratic functions concept. When we looked at the Sub-Topic Drill Down of Quadratic Functions (n=1,135 sessions), Solving Quadratic Equations (n=530) and Factoring Quadratic Equations (n=393) are the source of challenges in 81.3% of these sessions.

Table 3. Sub-Topic Drill Down of Quadratic Functions

<table>
<thead>
<tr>
<th>Sub-Topics</th>
<th>Session Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratic Equations, Inequalities, and Functions</td>
<td>207</td>
</tr>
<tr>
<td>Complex Solutions to Quadratic Equations</td>
<td>3</td>
</tr>
<tr>
<td>Factoring Quadratic Equations</td>
<td>61</td>
</tr>
<tr>
<td>Graphing and Properties of Quadratic Equations</td>
<td>34</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
</tr>
<tr>
<td>Solving Quadratic Equations and Inequalities</td>
<td>100</td>
</tr>
<tr>
<td><strong>Quadratic Functions</strong></td>
<td><strong>928</strong></td>
</tr>
<tr>
<td>Complex Solutions to Quadratic Equations</td>
<td>26</td>
</tr>
<tr>
<td>Factoring Quadratic Equations</td>
<td>332</td>
</tr>
<tr>
<td>Graphing and Properties of Quadratic Equations</td>
<td>126</td>
</tr>
<tr>
<td>Solving Quadratic Equations and Inequalities</td>
<td>430</td>
</tr>
<tr>
<td>Systems of Nonlinear Equations and Inequalities</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1135</strong></td>
</tr>
</tbody>
</table>

Based on the cross-institutional data it is also clear that exponential and logarithmic functions is another challenging concept for students. A little over fourteen percent (14.1%) of all of the Algebra II sessions were students seeking help with this topic. When we look at the sub-topic break down of Exponential and Logarithmic Functions (n=1,050), Radical Expressions, Equations, and Rational Exponents is of slightly greater challenge than the other sub-topics.

Table 4. Sub-Topic Drill Down for Exponential and Logarithmic Functions

<table>
<thead>
<tr>
<th>Sub-Topics</th>
<th>Session Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exponential and Logarithmic Functions</td>
<td>1014</td>
</tr>
<tr>
<td>Graphing Exponential and Logarithmic Functions</td>
<td>44</td>
</tr>
<tr>
<td>Properties of Exponents and Logarithms</td>
<td>305</td>
</tr>
<tr>
<td>Radical Expressions, Equations and Rational Exponents</td>
<td>333</td>
</tr>
<tr>
<td>Solving Exponential and Logarithmic Equations and inequalities</td>
<td>233</td>
</tr>
<tr>
<td>Solving Problems with Exponential and Logarithmic Functions</td>
<td>99</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1014</strong></td>
</tr>
</tbody>
</table>

Ivy Tech Data

We intended to make this data useful to institutions trying to keep students on their pathway and to ensure learning. We looked at Ivy Tech’s math courses mapped to Tutor.com Algebra II subjects, which means these students requested help with one of the following courses, and they were routed to our Algebra II tutors.

Table 5 is the distribution of sessions across four different developmental math and college algebra courses offered by Ivy Tech. In the spring of 2014 Ivy Tech shifted to mathematics pathways, so the data included in this case study, starting in spring 2015 reflects tutoring sessions a full year after the implementation of mathematics pathways. MATH 080 is a co-requisite course with a Quantitative Reasoning course which together are considered the initial course in most degree programs’ pathways. For students placing into the
lowest course of a STEM type pathway, student would take MATH023 followed by MATH100 and then MATH136, which is a gateway College Algebra course for STEM related degree programs, where the pathway leads to Calculus. MATH 100 is an intermediate algebra course. Students in the MATH 136 College Algebra course account for 60.4% of the sessions across all four courses. In MATH 136 19.7% of the sessions were on the topic of Linear Functions; 18.8% were Exponential and Logarithmic Functions; and 17.9% of the sessions were on the topic of Quadratic Functions.

Table 5. Topics by Course at Ivy Tech Mapped to Algebra II (2015-2017)

<table>
<thead>
<tr>
<th>Topics</th>
<th>MATH023</th>
<th>MATH080</th>
<th>MATH100</th>
<th>MATH136</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Value Equations and Inequalities</td>
<td>3</td>
<td>45</td>
<td>73</td>
<td>121</td>
<td></td>
</tr>
<tr>
<td>Conic Sections</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Exponential and Logarithmic Functions</td>
<td>41</td>
<td>16</td>
<td>197</td>
<td>681</td>
<td>952</td>
</tr>
<tr>
<td>Functions</td>
<td>6</td>
<td>7</td>
<td>34</td>
<td>392</td>
<td>443</td>
</tr>
<tr>
<td>Linear Functions</td>
<td>299</td>
<td>60</td>
<td>405</td>
<td>623</td>
<td>1482</td>
</tr>
<tr>
<td>Linear Functions, Equations, and Inequalities</td>
<td>54</td>
<td>9</td>
<td>65</td>
<td>90</td>
<td>227</td>
</tr>
<tr>
<td>Matrices</td>
<td>2</td>
<td>2</td>
<td>20</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Numbers</td>
<td>17</td>
<td>36</td>
<td>13</td>
<td>32</td>
<td>101</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>28</td>
<td>23</td>
<td>84</td>
<td>159</td>
</tr>
<tr>
<td>Patterns and Functions</td>
<td>5</td>
<td>5</td>
<td>12</td>
<td>135</td>
<td>158</td>
</tr>
<tr>
<td>Polynomial, Rational Expressions, Equations and Functions</td>
<td>5</td>
<td>2</td>
<td>44</td>
<td>99</td>
<td>150</td>
</tr>
<tr>
<td>Polynomials</td>
<td>39</td>
<td>4</td>
<td>146</td>
<td>385</td>
<td>578</td>
</tr>
<tr>
<td>Probability</td>
<td>5</td>
<td>12</td>
<td>2</td>
<td>17</td>
<td>66</td>
</tr>
<tr>
<td>Quadratic Equations, Inequalities, and Functions</td>
<td>12</td>
<td>2</td>
<td>46</td>
<td>110</td>
<td>171</td>
</tr>
<tr>
<td>Quadratic Functions</td>
<td>102</td>
<td>6</td>
<td>206</td>
<td>538</td>
<td>860</td>
</tr>
<tr>
<td>Radical, Exponential and Logarithmic Equations and Functions</td>
<td>4</td>
<td>4</td>
<td>25</td>
<td>141</td>
<td>177</td>
</tr>
<tr>
<td>Real Numbers</td>
<td>119</td>
<td>62</td>
<td>60</td>
<td>97</td>
<td>363</td>
</tr>
<tr>
<td>Sequences and Series</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Statistics</td>
<td>7</td>
<td>37</td>
<td>5</td>
<td>12</td>
<td>86</td>
</tr>
<tr>
<td>Total</td>
<td>737</td>
<td>291</td>
<td>1387</td>
<td>3612</td>
<td>5977</td>
</tr>
</tbody>
</table>

Linear Functions
To begin our analysis of the timing of these topics and sub-topics within a course semester, we analyzed when students sought tutoring support by the week. To provide guide posts for analyzing the weekly data, Week 1 is January 1⁴ and Weeks 23 and 35 are the beginning of June and September respectively. Ivy Tech’s summer term often starts during the first week of June (week 23). Fall semester starts the third week in August (week 34) and spring semester fluctuates starting between the second and third weeks of January (weeks 3 and 4). For Linear Functions, we looked at the timing of when students requested help with this topic across a semester’s time. The data show number of sessions for each week of instruction. The data covers spring 2015 through fall 2017, which includes different instructors for the same course. In Figure 1 below the orange topic represents the shift in topic name which occurred in July 2017.
We chose to dive a little deeper into the initial peak of usage at the beginning of the semester in weeks 37 – 41 in the fall semester and weeks 5-10 in the spring semester. Since the summer semester is typically taught on an expedited schedule, those weeks have been left out of this analysis. We analyzed the data for all sub-topics under both Linear Functions and Linear Functions, Equations and Inequalities. In Figure 2 below, the sub-topics from both topics are included except the undefined “Other” sub-topic.

For weeks 37 through 41 in the fall semester, there were a total of 233 sessions. Solving Linear Equations (n=75) was the main sub-topic students struggled with in the concept of Linear Functions. Solving linear equations involves working through the mechanics of the equation to solve for the variable, while solving problems is more of an application of linear equations to solve real-world or word problems. When we looked at the specific questions students are asking in both sub-topics, a majority of the sessions were about setting up and solving word problems or applied problems. Another interesting pattern is the slight increase in sessions focused on slope, intercepts, and points on a line starting at week 39 into weeks 40 and 41 (n=13). Weeks 40 and 41 appear to be more dispersed across the sub-topics, this could be an area of transition from one topic into another topic for students.

Figure 2. Sub-Topic Drill Down into Weeks 37 - 41
When we looked at weeks 5 through 10 of the spring semester, the total session volume is lower (n= 70) compared to the fall semester. For math at Ivy Tech, students are often encouraged to take their math courses as early as possible, which could be a cause for the differences in session volume. We saw the prominent sub-topics involved in students’ sessions were again Solving Linear Equations (n=35) and Solving Problems with Equations and Inequalities (n=21). There also seem to be consistent issues as seen in the fall semester with solving problems with equations and inequalities, which would be word problems, and working with systems of equations and inequalities. We looked closer at the types of questions students are asking in these sessions, and a majority of the questions involved setting up equations from word problems. Many students did not know where to begin. As a little anecdote, one proud student started the session saying, “I did it, let me show you:)

Figure 3. Sub-Topic Drill Down Weeks 5-10

The challenges described in both the fall and spring semesters tend to follow the table of contents for the first five chapters of a standard commercial textbook. At the time of this study instructors at Ivy Tech used commercial textbooks to instruct the class.

Exponential and Logarithmic Functions
As a part of our deep dive into the topics and sub-topics of the MATH 136 course, we also looked closely at the topic of Exponential and Logarithmic Functions, which was 18.8% of the sessions for this course. Looking at the timing of student support in this topic for this course (Figure 9), there are clear peaks at week 49 for the fall semester and week 18 for the spring semester, all of these weeks appear to be toward the end of the semester. Instead of analyzing at the same weeks as Linear Functions, we decided to dive into these peaks to identify sub-topics that might be most challenging for students.
For the topic of Exponential and Logarithmic Functions there are 5 possible sub-topics (Figure 5). For weeks 47 through 51 there were 234 sessions related to this topic. The peak sub-topics were both Properties of Exponential and Logarithms (n=73) and Solving Exponential and Logarithmic Equations and Inequalities (n=98).

To get a better sense of the peak at week 18 in the spring semester, we looked at the weeks leading up to the 18th and into the 19th week to get a better sense of the student areas of challenge (Figure 11). During weeks 15 through 19 there were a total of 142 sessions in this topic. The trend in this time-period appears to be students’ challenge with Properties of Exponents and Logarithms (n=45) and Solving Exponential and Logarithmic Equations and Inequalities (n=46). This trend appears to be similar to the fall peak trend. Despite having different instructors within the courses and a syllabus that does not dictate instruction at a weekly level, perhaps there are nonetheless consistencies in the approach to teaching College Algebra at Ivy Tech. Starting at week 16 there is an upward trend of student challenges with Solving Problems with Exponential and Logarithmic Functions.
After diving into these individual topics and sub-topics at a weekly level, we took a step back and looked at MATH 136 as a forest instead of the individual trees. Looking at Linear Functions, Quadratic Equations, and Exponential and Logarithmic Functions across the three semesters. There is consistency in the patterns for each topic in each semester. These patterns provide some insight into the consistency of instruction in these courses, which tend to use commercial textbooks.

Figure 7. Session Count for Linear Functions, Quadratic Functions, and Exponential and Logarithmic Functions

We have just touched upon analysis that can be completed by looking at topics and sub-topics that challenge students across a semester for Ivy Tech’s MATH 136 course. These descriptions beg explanations which can only be presented by the instructors and faculty of this course at Ivy Tech. They can provide the many contextual factors that should be considered such as individual student placement into mathematics courses, performance in pre-requisite courses, complexity of the problems presented to students, and additional detail about the topic. For example, our data show students struggling with linear functions throughout the semester. Only instructors can provide the additional detail that further describes the depths of students’
challenges, did they struggle with linear functions or functions in general across the course. Mathematics is a domain where the topics build on one another. An interesting trend in both the fall and spring semesters is a small volume of students challenged by Radical Expressions, Equations, and Rational Exponents. This is a topic typically covered in MATH 100 so it would be considered a pre-requisite topic. However, the methods of solution typically presented involve “transforming” them into either linear or quadratic equations for solution, so student may be struggling with this transformation. A deeper dive into these sessions may present instructors with specific areas where students are struggling with the pre-requisite knowledge and/or the process of transforming toward the solution. Instructors could provide this additional detail to help further explain the depth of students’ struggles and the appropriate remediation or pre-teaching for these topics.

The partnership between the tutoring service and the institutions’ instructors was an essential step in this analysis ensuring the data was interpreted consistently and appropriately within the context of the course or series of courses. Through this level of collaboration, we improved the level of description possible so it can have the greatest impact on institutions that desire to better understand student learning along guided pathways, courses sequences within a pathway, and student entry points into pathways.

**Student Post-Session Survey Findings**

As mentioned above, students have the option to complete a post-session survey that asks them to rate their experience with their tutor. All questions on the survey are optional. Students tell us:

- If they would recommend the service to a friend
- If they are glad their institution offers the service
- If the service is helping them to:
  - Complete their assignments
  - Improve their grades
  - Feel more confident about their school work

Students also are provided with a free text field to share any feedback they wish. For this study we focused on responses that would provide an insight into the non-cognitive attributes that students demonstrated in these sessions and/or have been fostered within the sessions. We evaluated:

1. Tutor Ratings on a scale of 1 to 5 with 5 being excellent.
2. Responses regarding whether the student would recommend the service to a friend.
3. Student responses regarding feelings of confidence about their school work, belief that they are improving in completing their assignments and improving their grades.
4. Student responses and comments regarding appreciation that the service is made available to them.
Table 6. Post-Session Survey Student Responses

<table>
<thead>
<tr>
<th>Survey Responses</th>
<th>All Colleges</th>
<th>Ivy Tech</th>
<th>MATH 136</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Response to Confidence</td>
<td>30.06</td>
<td>29.96</td>
<td>34.51</td>
</tr>
<tr>
<td>% Improved Confidence</td>
<td>96.64</td>
<td>96.6</td>
<td>97.98</td>
</tr>
<tr>
<td>Tutor Average Rating (1-5)</td>
<td>4.586</td>
<td>4.599</td>
<td>4.61</td>
</tr>
<tr>
<td>Recommend Rate</td>
<td>96.98</td>
<td>97.09</td>
<td>98.28</td>
</tr>
<tr>
<td>Help with completion of assignment</td>
<td>95.67</td>
<td>96.01</td>
<td>97.53</td>
</tr>
<tr>
<td>Help improve grades</td>
<td>95.81</td>
<td>95.92</td>
<td>97.74</td>
</tr>
<tr>
<td>Glad service is offered</td>
<td>98.69</td>
<td>98.7</td>
<td>99.27</td>
</tr>
<tr>
<td>Total Sessions</td>
<td>84,738</td>
<td>65,224</td>
<td>5,604</td>
</tr>
<tr>
<td>Survey Response Rate</td>
<td>30.06</td>
<td>29.96</td>
<td>34.51</td>
</tr>
<tr>
<td>Comments Provided</td>
<td>11,024</td>
<td>8,812</td>
<td>793</td>
</tr>
</tbody>
</table>

Confidence Ratings and Comments
We analyzed student responses to these questions and reviewed and categorized their comments in an attempt to understand non-cognitive aspects of the experience of receiving help with their MATH 136 assignments.

The percentage of students who responded to the “Is the service helping you feel more confident?” question increased slightly for MATH 136 students versus the overall data set and data for Ivy Tech Community Colleges. For all 3 groups, over 96% of students completing the survey indicated that they felt more confident about their school work at the end of the session and that rate rose to 97.98% for MATH 136 students.

Tutor Ratings and Recommend Rate
On the assumption that student ratings and comments about their tutors provide insight into whether the student felt a personal/supportive connection with their tutors, which can result in reduced anxiety toward the assignment or subject and affect student confidence and persistence, we analyzed student ratings of their tutors.

Across all subjects and the seven colleges included in the data set, the average tutor rating was 4.58 out of 5. For MATH 136, the average rating rose to 4.61 indicating a high level of satisfaction with the interaction the student experienced with the tutor.

Also, assuming that students would not recommend a service that they did not find helpful, we looked at the recommend rate responses. The recommend rates for all schools, Ivy Tech and MATH 136 range from 96.98% to 97.09% to 98.28%.
Help with Completion of Assignments:
Students who indicate a desire to complete assignments are indicating motivation to succeed as well as conscientiousness and some degree of self-efficacy, qualities which are essential to helping them achieve academic success. Assignment completion is also an indicator of a willingness to practice and grapple with the material both of which are also key factors in achieving deeper learning. Over 97% of the MATH 136 students who completed the survey indicated that they felt that on-demand tutoring was helping them to complete their assignments.

Help improving grades
Although this data is subjective and students are unsure of final grades as they seek help during the course, we considered the responses to the question on whether the service was helping students to improve their grades as an indication of their desire to improve grades, perception of progress toward achieving their goal as well as a potential indication of improved confidence as they seek to improve their grades. 97.74% of the MATH 136 students responding stated that they felt that receiving help with their assignments was affecting their grades positively.

Appreciation that the service is offered
99% of the students who experienced an increase in confidence responded to the question, “Are you glad your institution offers the service?” in the affirmative. We interpret this affirmative response to be an indication that the student values the availability as well as the helpfulness of the service which is discussed further below. The simple fact of knowing that academic assistance is readily accessible seems to reduce student anxiety and consequently foster a more confident attitude toward their ability to succeed.

Student Comments Findings
There was a slight increase in the percentage of comments left for MATH 136 students as compared to all students in the data set and to Ivy Tech students. We analyzed and categorized student comments to gain an understanding of the non-cognitive attributes which students demonstrated in their use of the service or were fostered within the tutoring sessions.

Successful learning, in fact, success in general, requires a combination of academic (cognitive) and social cognition or (non-cognitive) factors. This aligns with the review conducted by Farrington, et al. (2012),

“Recent research on non-cognitive factors has not only suggested their importance for student academic performance but has also been used to argue that social investments in the development of these non-cognitive factors would yield high payoffs in improved educational outcomes as well as reduced racial/ethnic and gender disparities in school performance and educational attainment.” (p.7).

We reviewed student survey responses and post session comments to identify non-cognitive factors which students brought to the tutoring environment as well as behaviors fostered or reinforced by the tutoring experience. Based on these data we aimed to determine how the service was or was not addressing not just academics but also the non-cognitive needs of students which support or hamper their academic achievement. These data were also evaluated as to whether they provided insights that would be helpful to institutions working with these students.

The non-cognitive factors we considered to be most appropriate to this data set included: help-seeking, perceived value, confidence, growth mindset and persistence. The following categories emerged from the
data and the category titles are our adaptation and interpretation of the framework presented by Farrington et al. (2012). Note that all student comments are unedited.

Help-Seeking
Students who seek academic help demonstrate not only a motivation to learn but also some level of confidence that they have the capacity to master the material. If a student has no belief in his or her ability to achieve understanding either individually or through help, he will not seek to achieve it. All of the students who sought help through the service demonstrated this desire to seek help as they voluntarily initiated contact with an online tutor.

Factors that Support Help-Seeking
Help-seeking is a behavior that can be fostered and students also left comments indicating conditions which either encouraged or enabled them to take this help-seeking step including:

- **Availability of help.** Students indicated that they were accessing help because it was made available to them and they also frequently requested that the help be continued.

  I think this is an awesome idea, really helps! 4/25/15 12:12 AM

  I am so glad that this service is available. It is very helpful. I just wish I actually utilized it in the past! THANK YOU IVYTECH for giving us this option! 9/22/15 6:27 PM

  THANK YOU SO MUCH FOR THIS SERVICE. PLEASE CONTINUE IT FOR US! 5/1/15 1:35 PM

  I am thrilled this service is available! 9/12/15 5:13 PM

  EXCELLENT SERVICE. PLEASE KEEP IT FOR US, WE NNED IT VERY MUCH!!! 4/13/15 9:26 PM

- **Ease of access.** Students mentioned ease of access, namely that the service is available online and that the user interface is simple as a factor that nurtured their willingness to use the service.

  She was awesome! I love that I can ask questions as we solve and the program is really easy to use. 2/5/16 11:54 AM

  The tutor was awesome I am so happy that ivytech offers this service its really helping me a lot i think i am going to pass my math class just because of this service. the best thing is that it is very convenient 4/23/15 8:05 PM

- **Timeliness of access.** Another factor mentioned as supporting the use of help-seeking is the fact that the help is available 24/7, when the student has time to access help and when the student needs help.

  i was really lost with my math and being a stay at home mom i work really late at night on my hw so this 24hr service is perfect for me 9/1/15 10:32 PM

  it helps when everything else is closed, im not just sitting here crying bc i cant figure it out. i have real help now at the time i need it most 9/1/15 11:37 PM

  Love this service! So helpful and always available! 10/26/16 3:36 PM

  24 hour student support is excellent, especially for late night studiers such as myself. 4/29/16 10:06 PM
• **Supportive, non-judgmental assistance.** Students mention that they appreciate being able to receive help in an environment where they feel supported and where they feel that the individual providing the help is willing to meet the student wherever she or he is academically.

William H. extremely patient and went at pace for me to understand. not once did I feel inferior. not sure 15hrs per semester is enough time for people like me. =) 6/8/16 8:32 PM

always nice and do not make you feel dumb!! thanks for helping us 9/11/16 5:43 PM

The person who helped me was very supportive. I appreciate that. 9/4/16 3:46 PM

• **Knowledgeable assistance.** Students made it clear that they appreciated help that was provided by a knowledgeable source and that is an important factor for them in help-seeking.

Sanatan K was so friendly and extremely knowledgeable, i would definitely use this service again. 2/17/17 3:50 PM

quick and smart!! 10/13/17 10:28 PM

• **Efficient help.** Students are pressed for time and value a tutoring experience that is efficient.

Excellent tutor. I appreciate the time taken with me to help me to better understand how to do this type of problem. Very efficient with our time!!! 1/23/16 3:43 PM

Value of Academic Support
The responses to the “Are you glad the institution is offering this service?” question, the “Would you recommend this service to a friend?” as well as many student comments expressing thanks to the institution and the tutor are indications that the students value the fact that the assistance is available as well as the quality of the assistance provided. Valuing help is an indication that a student has a growth mindset and is willing to see academic success as a goal that is achievable. Some students mentioned that they wished they had accessed help sooner in the semester.

Wish I had used this earlier! Ahhh! 12/2/15 7:48 PM

I can't thank you enough for this service! 9/12/15 8:25 PM

Thank you for this incredible help. Keep it up please. 9/29/15 8:25 PM

I wish I had known about this at the beginning of the semester. This service would have helped me get better grades on my e1ams. Great service!! 4/26/15 12:30 PM

This was my first time using the online tutor and I think that it is absolutely AMAZING! I was stuck on a math problem for an hour and decided what the heck I will give it a try and the tutor made me do the work but helped me through to understand! I will definitely be telling my friends about this feature! 1/21/17 10:42 AM

Confidence/Mindset
Confidence impacts the degree by which students persist and a student’s willingness to take on a task (Bandura, 1986). As mentioned above, one can assume that students seeking help possess some level, however small, of confidence that by seeking help, they are willing to take on the task of finding a tutor to
achieve their goal of succeeding in the course. Many students experienced an increase in their level of confidence through the use of tutoring help as demonstrated by the fact that 97.98% of students who responded to the question “Is the service helping you feel more confident?” responded in the affirmative. This increase in confidence is underlined by student comments such as:

The tutor was awesome. confident and reassuring. for someone like me that lacks confidence, that means a lot! 6/8/16 12:26 PM

Nikhat A is an Excellent tutor. Really takes the time to explain the problem to me!! Makes me feel at ease with Algebra. I am studying for my final and this gives me more confidence. Thank you Nikhat!! 5/4/16 8:47 PM

My tutor was excellent in helping me achieve what I was doubting myself in. 1/28/16 8:10 PM

Thank you so much. I was so frustrated but am not anymore. I understand how to approach my problems and get correct answers. 1/29/17 2:45 AM

Many factors could support/foster/nurture/be involved in this increase in confidence. Among those mentioned by students are:

- **Achieved understanding in the session** which encourages them to view “effort” positively in the sense that they further develop the sense that if they put forth effort they can succeed.

  Fantastic tutor. I left with my head high, the answer correct, and more knowledgeable in the subject. 8/30/16 12:33 PM

  I love this little tool on blackboard it helps me out so much when I am stuck on a problem in math or have a question about any other subject! The tutors don’t give you the answer but they walk you through it and help you understand it! 4/5/17 9:04 AM

  I just used this for the first time and I am amazed. I might actually be able to pull off passing my class by help of this! 9/28/15 7:42 PM

  Mohit was a very good teacher. I did not understand much for this homework but by the time I was done, I understood it well! 2/15/16 10:48 PM

  My tutor was great, really help me to not only finish my homework but also to understand the material. 10/15/15 11:54 PM

- **Were able to receive confirmation or affirmation of their understanding** of a topic; these students demonstrate a belief in their ability to understand the material but want some reassurance that they are on the right track.

  I loved how instead of solving for me and me watching I worked through the problem 9/9/15 3:43 PM

  “I’m glad the tutors don’t just give the answer. Prompting the students with questions to motivate them to do the proper steps is awesome! 4/30/16 12:02 AM

  i like that she asked me to work through it on the screen to show her where I went wrong! That REALLY helped. 6/14/17 1:59 PM

- **Experienced a sense of support or acceptance** from the tutor thus providing a safe environment to express frustration, confusion, lack of understanding; a safe place to try out ideas and approaches
and also a reinforcement or an encouragement to believe that the student is capable of succeeding in the course.

I was struggling with a problem in my Math136 class where we were completing the square. I was struggling to understand the method being used and where they were coming up with the numbers being used and my tutor was very patient and explained the method to me very clearly twice until I understood completely. She included valuable equations as well to help me understand. 9/22/15 4:41 PM

So helpful, I wasn’t afraid to say that I really didn’t understand something. 2/2/17 1:20 PM

He was very friendly and easy to work with. He didn’t make me feel stuck, I appreciate him. 2/22/17 10:47 AM

After struggling with this problem for hours and being near tears, this tutor was able to make everything so clear and he gave me the confidence I needed to take my test tomorrow! 9/21/17 9:01 PM

PERFECT Tutor. Could not ask for anything better! 10/17/15 7:45 AM

- Experienced praise  In discussing the various sources of growth mindsets, Carol Dweck states that “seemingly subtle aspects of praise can have dramatic effects on students’ mindsets and resilience.” (as quoted in Bill and Melinda Gates Foundation, 2014, p. 9). Not all praise is created equal, however. Praise that motivates a student’s self-efficacy and motivation to persist is directed toward recognizing effort on task rather than more generally directed praise.

I felt very positive after finishing my problems. the positive comments make me feel like i can come back anytime with any problem i have. 10/7/15 12:32 PM

Love this tutor! Always leave feeling positive from this program 8/30/16 12:43 PM

Love my tutor! Always leave feeling accomplished! 9/1/16 12:33 PM

My tutor was very helpful and encouraging. Go Mathew! 12/8/15 1:36 PM

My tutor was nice and helpful. She gave me so many compliments which made me more comfortable to talk to her and it made me more confident and not second guess myself! 10/24/16 7:04 PM

Persistence

Improved confidence and the experience of successfully understanding a topic encourage students to persist in striving to learn and continuing to seek help when needed. Persistence is an indication that a student believes that with effort, s/he is capable of succeeding. It is evidence of and fosters an ongoing growth mindset. This is a difficult factor to quantify from the post-session survey data, but student comments indicate a commitment to persist with their goal of doing well in the course.

Excellent tutor!!! I appreciate the way Taylor explained to me the way to find a variable in a formula. This really gave me confidence that I can possibly figure out others like these in the future. 1/24/16 3:56 PM

Andrew was extremely helpful and I will be back on this site again! 6/18/15 9:51 AM
Really made me get involved in order to solve the problem which really helps me understand what is going on. I plan to use this great feature that Ivy Tech offers! 6/15/15 8:12 AM

I'm glad the tutors don't just give the answer. Prompting the students with questions to motivate them to do the proper steps is awesome! 4/30/16 12:02 AM

Discussion

The findings from this case study and the data generated through Tutor.com tutoring sessions can contribute to higher education institutions’ implementation of Guided Pathways. As institutions build program maps, data on students struggles across courses and within courses could be beneficial to map sequences and identifying points of entry into programs. Institutions use different placement tools to assess students’ knowledge and skills upon entering a program, placing them into specific courses. Once placed into a program pathway, students in a course such as college algebra may come into that course from different pre-requisite courses. For example, the pathway to MATH 136 that was described earlier which includes MATH023, MATH100, and then MATH 136. It would be interesting to look at the percentage of students placed into each of those courses and then their struggles and performance in MATH 136. Data from this case study could be drilled down even further into individual sections and combined with institutional student data on previous course performance and placement tool performance. This additional research into student placement and the tools of placement as well as entry into pathways may help determine if students from different entry points or placement tools struggle in these courses.

In terms of informing instruction and course design, the drill down analysis resulted in descriptions of student’s struggles that for the most part align to standard commercial textbooks. The results were almost predictable, essentially validating the sequence followed by most instructors. Further analysis would provide additional depth of students’ challenges, by examining the exact questions and problems students are bringing to tutors. But what if those problems don’t come from commercial textbooks? As more institutions move toward open educational resources (OER), instructors have more flexibility and ownership of the course. For example, inverse functions can be incorporated into linear or quadratic functions but should be included before exponential and logarithmic functions. Sequences followed by instructors could vary based on instructor experience, resulting in more variation among the courses. Similar case studies could be very beneficial to institutions and instructors as they vary the course design to be more adaptive with the course sequence and want to learn more about students’ learning challenges with OER content.

Academic success requires attention to the whole student, not just their content and skills learning outcomes. The case study revealed some factors that contribute to students exhibiting a willingness to seek help as long as that help meets certain criteria, feeling more confident and being willing to persist in striving to meet the demands of their coursework. These factors are not surprising in terms of what is accepted by most of the education community about learning and student success. These findings can reinforce for institutions creating general program learning outcomes and designing courses and instruction for guided pathways to include within learning outcomes these non-cognitive skills such as persistence, confidence, and growth mindset. Some of these can be incorporated into sound instruction and pedagogy and support services. There may be individual instructors who need additional support and professional development to implement these key aspects to learning within their courses. Institutions can incorporate this additional support into their implementation plan.

A key part of implementing Guided Pathways is monitoring student progress and ensuring students remain on their program map. Profiles of students who are successfully using this service could be created with
Tutor.com’s demographic data combined with institutional data. Not all students seek the help of a tutor with Tutor.com. Some students are more comfortable asking questions in class, while others may seek a safe, anonymous environment to work with a tutor. Instructors and counselors could use this data to target groups of students who have successfully and frequently used online tutoring support and encourage other students with similar profiles to take advantage of the service. Online students versus classroom students may be more comfortable accessing online tutors. Identifying these student groups and developing messaging that would encourage them to seek the help provided by an online tutor or other institutional support systems could be valuable to ensuring students remain on the program map.

Finally, the most critical use of this data is to collaborate with institutions to help them make evidence-based decisions on program map design, instruction and course design, and selecting student support services through efficacy research. The data presented in this case study captures the factors of student success and struggles in tutoring sessions, but more rigorous studies could be conducted to connect student challenges and confidence to other performance indicators. Tutor.com’s online tutoring service would be an important component of student support and progress monitoring. It serves as an early warning system to identify students at risk and implement timeline interventions to help students course correct. Participation in tutoring that meets student help-seeking requirements, increases student confidence, and encourages persistence in overcoming challenges in certain course topics which in turn could impact student performance in future courses, course completion, pathway completion, and graduation. These types of studies are critical to developing and evaluating effectiveness of a guided pathway system. Tutor.com encourages and willingly participates in these studies with its clients.

**Conclusion**

Many factors contribute to student success or lack thereof within the college setting, particularly for students learning at a distance. The most significant factor is each student’s ability to master the academic content, which requires that institutions understand and address each student’s academic as well as socio-cultural development. This case study provides insight for all institutions but particularly for those implementing the practice areas of Guided Pathways. The foundational or gateway courses in mathematics are an important part of all students’ pathways. Identifying not only the areas of greatest challenge for students but also when these challenges occur within a course sequence, helps students get off to a good start in the first semester and year of their pathway. Additional collaboration with institutions could result in better understanding of student performance in courses based on entry point and placement tools. Boosting student confidence, persistence, and building growth mindsets are essential to keeping students on their pathway, another critical practice of Guided Pathways. These non-cognitive skills can be incorporated into student learning outcomes and become a core part of instruction as well as the design of student support services. Using data to pinpoint challenges at the course level also provides critical feedback to institutions that want to ensure classroom instruction is effective for each student and students are learning throughout their pathway of study. We look forward to continued collaboration with Ivy Tech to develop additional studies that can inform the Guided Pathways and Achieving the Dream communities.
References


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