

BASIC MATH STUDENT PROGRESS AND COURSE-TAKING PATTERNS

OFFICE OF PLANNING, RESEARCH AND INSTITUTIONAL EFFECTIVENESS

(AUGUST 2009)

BACKGROUND

Larger and larger numbers of students are entering colleges and universities underprepared for college-level coursework. Recent research has shown that as much as 58% of community college students enroll in a remedial course during their college careers (Attewell, Lavin, Domina & Levey, 2006). Much of the research on developmental education has revealed disappointing or inconclusive results of programs at community colleges nationally (Bailey, 2009; Merisotis & Phipps, 2000). With the increased demand for developmental courses and programs has come an increased focus on developmental education outcomes. San Joaquin Delta College is no exception to this trend.

When students first enroll at the College, they are required to complete assessments in reading, writing and mathematics to determine which courses would be most appropriate for their skill levels. Recent research conducted by the Office of Planning, Research and Institutional Effectiveness shows that up to 85% of students enrolled at the College need remediation in reading, writing, math or some combination of those three areas. Considering that so many students require remediation, it is essential to examine the long-term outcomes of the College's developmental education programs.

Students who assess at Level 1 in math (basic math) are placed in one of two courses: a three-unit Review of Arithmetic (Math 76) course or a series of four mini-courses on specific topics in the Applied Mathematics (Math 74) series. While the Math 76 course is a standard one-semester, lecture-format review course, the Math 74 series of courses is a fluid set of math courses combined with required math lab hours. The Math 74 series includes Math 74A (Whole Number Computational Skills), Math 74B (Word Problems), Math 74C (Fractions) and Math 74D (Decimals and Percentages), each of which is combined with Math 73 (Applied Mathematics Laboratory). These courses are designed to take most students about four semesters to complete, provided students enroll in each course sequentially for four semesters in a row. Completion of all four Math 74 courses is assumed to be comparable to completion of the Math 76 course.

In 2007-2008, the Math 74 courses had an annual enrollment of 2,615 students, and Math 76 had an annual enrollment of 1,405. In light of the large numbers of students who enroll in these comparable developmental courses, a study was undertaken to examine student course-taking patterns, progression in mathematics and costs of different math pathways. The goals of the study were to (1) identify the most common paths from the two basic math courses to Intermediate Algebra, (2) to determine if students who completed the Math 74 series of courses were more likely to complete Intermediate Algebra (Math 82) than Math 76 students, and (3) to determine the average cost per student for each Level 1 math pathway to Intermediate Algebra.

METHODOLOGY

Student course-taking and completion data were obtained from the College's System 2000 database for students who (a) enrolled in Math 74A or (b) enrolled in Math 76 between summer 2003 and spring 2008. Enrollment, FTES, instruction costs and faculty assignments were obtained from the College's faculty load reports for each summer, fall and spring term in the 2003-2004 through the 2007-2008 academic years. Budget data for instructional support were derived from the College's financial database system. Course repeat data were obtained for students in each group (Math 74 series and Math 76) to determine the average number of times required for a student to complete a given math course. To ensure proper comparison of the two pathways, only students who completed all four Math 74 series courses were compared to Math 76 completers. Three pathways to Intermediate Algebra were identified for students who completed basic math (Math 74 series or Math 76). Figures 1a and 1b illustrate the student pathways to Intermediate Algebra that were included in the study.

Figure 1a. Math 74 Pathways to Intermediate Algebra (Math 82)

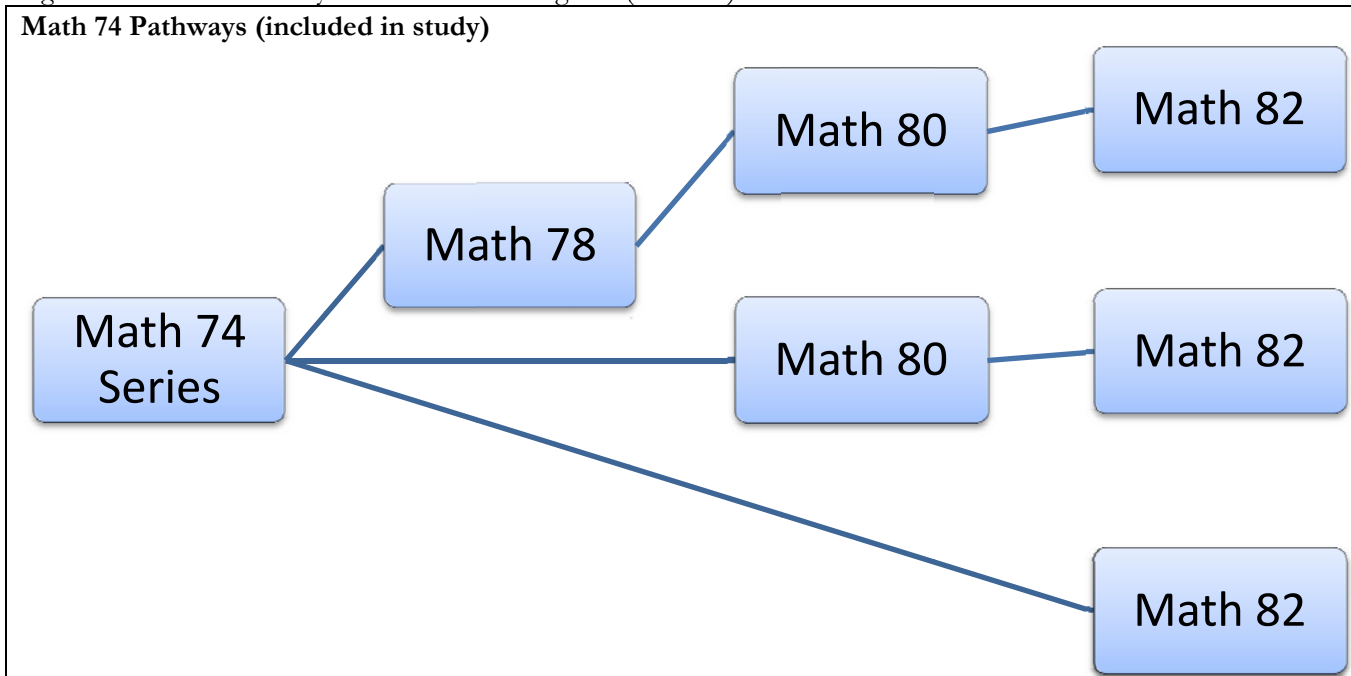
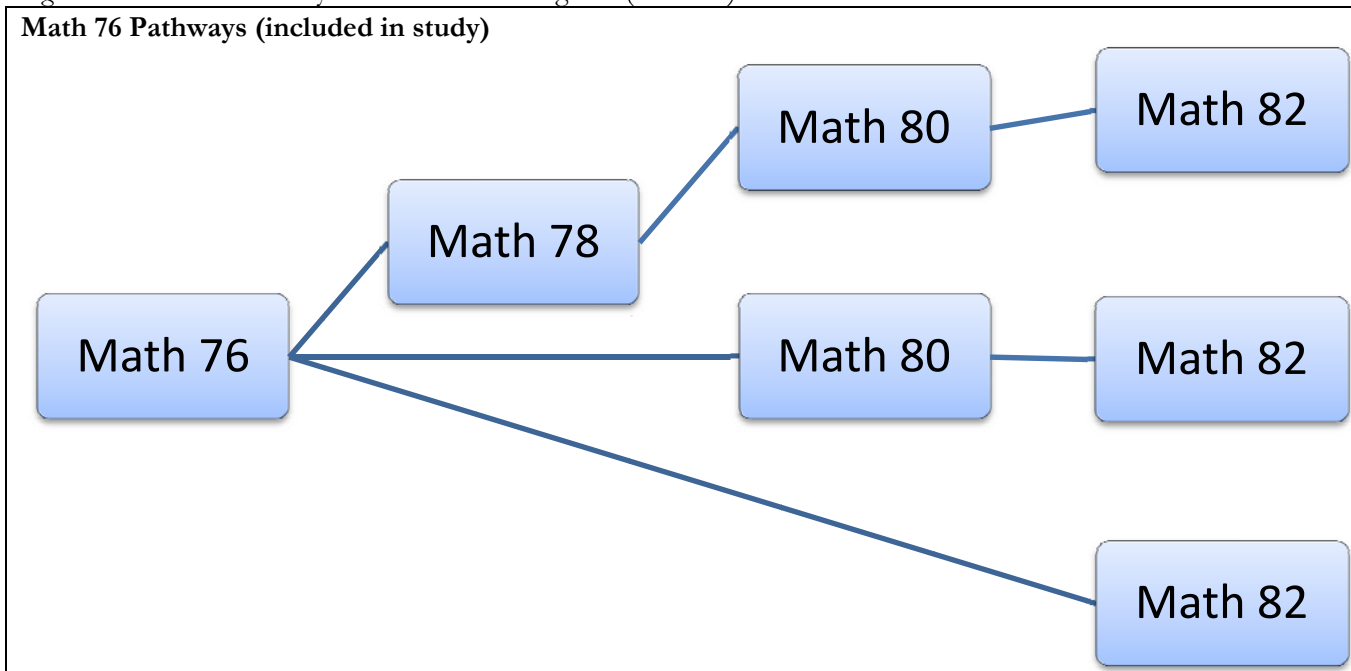


Figure 1b. Math 76 Pathways to Intermediate Algebra (Math 82)



Student enrollment, course attempts and success data were obtained for students in each pathway, and costs were calculated for each course along the pathway to Math 82. Student outcomes for each pathway were then compared to determine which pathways had the highest completion rates for Math 82. In addition, costs for each pathway were compared to determine which pathways were more cost-effective for students to take en route to Math 82. Cost figures are provided for each pathway a “Model Student” and an “Average Student.” A description of cost calculations is provided below.

Cost Calculation: Model Student

The “Model Student” figures provide costs per course for each pathway assuming each student passes the course on his or her first attempt. Cost per enrollment figures were calculated by summing the costs of faculty, staff and tutoring for the Math 74 series or Math 76 course, the tutoring and instructional costs for Math 78 and the instructional costs for Math 80 and Math 82. Shared costs were divided between courses according to proportional FTES in 2007-2008. Cost per enrollment was calculated by dividing annual costs by total annual (duplicated) enrollment for each course in 2007-2008 (the most recent year for which data was examined). Cost per FTES figures were calculated by summing the annual costs of each course and dividing it by the annual FTES total for each course.

Cost Calculation: Average Student

The “Average Student” calculation is similar to the “Model Student” calculation but also factors in the number of attempts required for an average student to pass a course. The same calculation employed for the Model Student cost estimates was used for the Average Student cost estimates, but average attempts required to succeed in each course was added as a multiplier for each course’s cost per enrollment and cost per FTES figures.

RESULTS

The results of the analysis are provided on the following pages in the form of student progression/flow charts for each major pathway and sub-pathway to Intermediate Algebra. Figure 2a illustrates completion rates and average number of repeats for Math 74 series students. Figures 2b through 2d illustrate the three different Math 74 pathways and Figures 3a through 3c illustrate the same pathways for Math 76 students. Notes are provided below charts where appropriate, and a summary of costs is provided below each basic math pathway.

Math 74 Pathways to Intermediate Algebra

Only about one in six students (17%) who started in Math 74A (Whole Number Computational Skills) completed the entire Math 74 series. Students who completed fewer than four of the Math 74 courses were not included in the analysis because completion of the entire Math 74 series is assumed to be the equivalent to the completion of the Math 76 course. The average Math 74 series completer took slightly more than four (4.33) attempts to complete the four courses, for an average of just over one attempt per Math 74 course. On average, students took nearly three terms to complete the four Math 74 courses, suggesting some overlap of Math 74 course enrollment. Among the 417 students who completed the series, just over one in six stopped out and did not complete a higher level math course at Delta College.

Forty percent of Math 74 series completers took a pre-algebra course after the Math 74 courses. Of those, over 81% completed the pre-algebra course, and the vast majority of those went on to enroll in Elementary Algebra (Math 80). Nearly three in four (73%) of those students passed Elementary Algebra, and most went on to enroll in Intermediate Algebra (Math 82). Of those, 77% eventually passed the degree-applicable course in an average of 1.40 attempts. Of the 162 Math 74 completers who started on this pathway, about one in four (24%) successfully completed Intermediate Algebra.

The largest proportion of Math 74 series completers (45%) enrolled in Elementary Algebra after completing Math 74. Among these students, nearly three in four (74%) passed Elementary Algebra, and the vast majority of those enrolled in Intermediate Algebra. Of those who enrolled in Intermediate Algebra, 85% eventually passed, equaling 50% of all the students who started on this pathway.

Very few students—only nine—enrolled in just Intermediate Algebra after completing the Math 74 series. Of these students, seven (78%) passed Intermediate Algebra, and all seven students passed in their first attempt.

Math 76 Pathways to Intermediate Algebra

The majority of students that enrolled in Math 76 completed the course, but among those who completed the course, the majority (59%) stopped out and did not take a higher-level math course. Just 10% of all Math 76 completers enrolled in Pre-Algebra after Math 76. Of those who enrolled in Pre-Algebra, just over three in four (76%) eventually passed the course, and of those about 88% enrolled in Elementary Algebra. Of those who enrolled in Elementary Algebra, just over two in three (69%) passed, and, of those, 60% enrolled in the next course,

Intermediate Algebra. Among those who enrolled in Math 82, 71% eventually passed. Similar to the results for Math 74 students, around one in four (27%) Math 76 completers in this pathway successfully completed Intermediate Algebra.

Over one in four Math 76 completers enrolled in Elementary Algebra after Math 76. Nearly three in four (74%) eventually passed Elementary Algebra, and about two in three of those students enrolled in Intermediate Algebra. Of those who enrolled in Intermediate Algebra, over three in four (78%) eventually passed, equaling just under half (48%) of all Math 76 students in this pathway.

Just 5% of Math 76 completers enrolled directly in Intermediate Algebra. Of these, nearly three in four (73%) eventually passed Intermediate Algebra in an average of 1.54 attempts. These results reveal very similar outcomes for students in Math 74 and Math 76 with similar course-taking patterns. It should be noted that a large number of students stop out at the basic math level regardless of whether they started off in Math 74A or Math 76.

Cost Comparisons

Costs of starting in Math 74 were compared to those of starting in Math 76 for students taking the same subsequent math courses. Because the Math 74 series consists of four courses, the costs for Math 74A, Math 74B, Math 74C and Math 74D were aggregated for the 2007-2008 academic year and divided by the annual FTES and enrollment for all four courses combined. In addition, to determine the cost of students completing the Math 74 series, both the course cost per FTES and cost per enrollment were multiplied by four (representing the completion of all four series courses). Costs for Math 78, Math 80 and Math 82 were calculated and were included as standard costs in both the Math 74 and Math 76 pathways.

✓Model Student

For the “Model Student,” the cost of taking the four Math 74 courses, Math 78, Math 80 and Math 82 was over \$18,000 per FTES and about \$1,350 per enrollment. For a comparable student in Math 76, the cost per FTES was just over \$5,000, and the cost per enrollment was about \$620.

For Math 74 students who went directly into Math 80, the total cost per FTES for the Math 74 courses, Math 80 and Math 82 was over \$16,700 per FTES and just under \$1,200 per enrollment. For Math 76 students on the same pathway, the cost per FTES was \$3,743, and the cost per enrollment was around \$460.

For the few students who enrolled directly in Math 82 after Math 74, the total cost per FTES for that pathway was about \$15,600, and the cost per enrollment was just over \$1,000. For Math 76 students who enroll directly in Math 82, the cost per FTES was about \$2,580, and the cost per enrollment was just over \$300.

✓Average Student

The “Average Student” cost calculations factor in the average number of attempts required for students to complete a given course. These figures were multiplied by the cost per FTES and cost per enrollment for each course and were included in the total cost for each pathway.

For Math 74 series completers who enrolled in Math 78, Math 80 and Math 82, the total cost per FTES was over \$20,000, and the total cost per enrollment was just under \$1,600. For Math 76 completers on the same pathway, the total cost per FTES was \$6,157, and the total cost per enrollment was \$764. The total cost for Math 74 completers who enrolled in Math 80 and Math 82 was \$18,716 per FTES and \$1,373 per enrollment. The total cost for Math 76 completers on the same pathway was about \$4,680 per FTES and \$580 per enrollment.

For Math 74 completers who enrolled in just Math 82, the total cost per FTES was \$16,789, and the total cost per enrollment was \$1,115. The total cost per FTES for Math 76 completers who enrolled in just Math 82 was \$3,360, and the total cost per enrollment was just over \$400.

CONCLUSIONS AND RECOMMENDATIONS

The present study investigated the course-taking patterns, costs and math progression of students placing in Level 1 math courses. Successful completion of intermediate algebra served as the criteria for success, and students who completed the four-course Math 74 series were compared to students who completed the single Math 76 course. The data for this study reveal that the Math 74 sequence helps some low level students succeed in subsequent math courses, but it comes at a high cost. Only 17% of the students who initially enroll in Math 74 complete the series of four courses, and of that group, only 40% complete Math 82, the degree-applicable math class. This means that only 7% of the initial cohort of Math 74 students complete the associate degree-required math course.

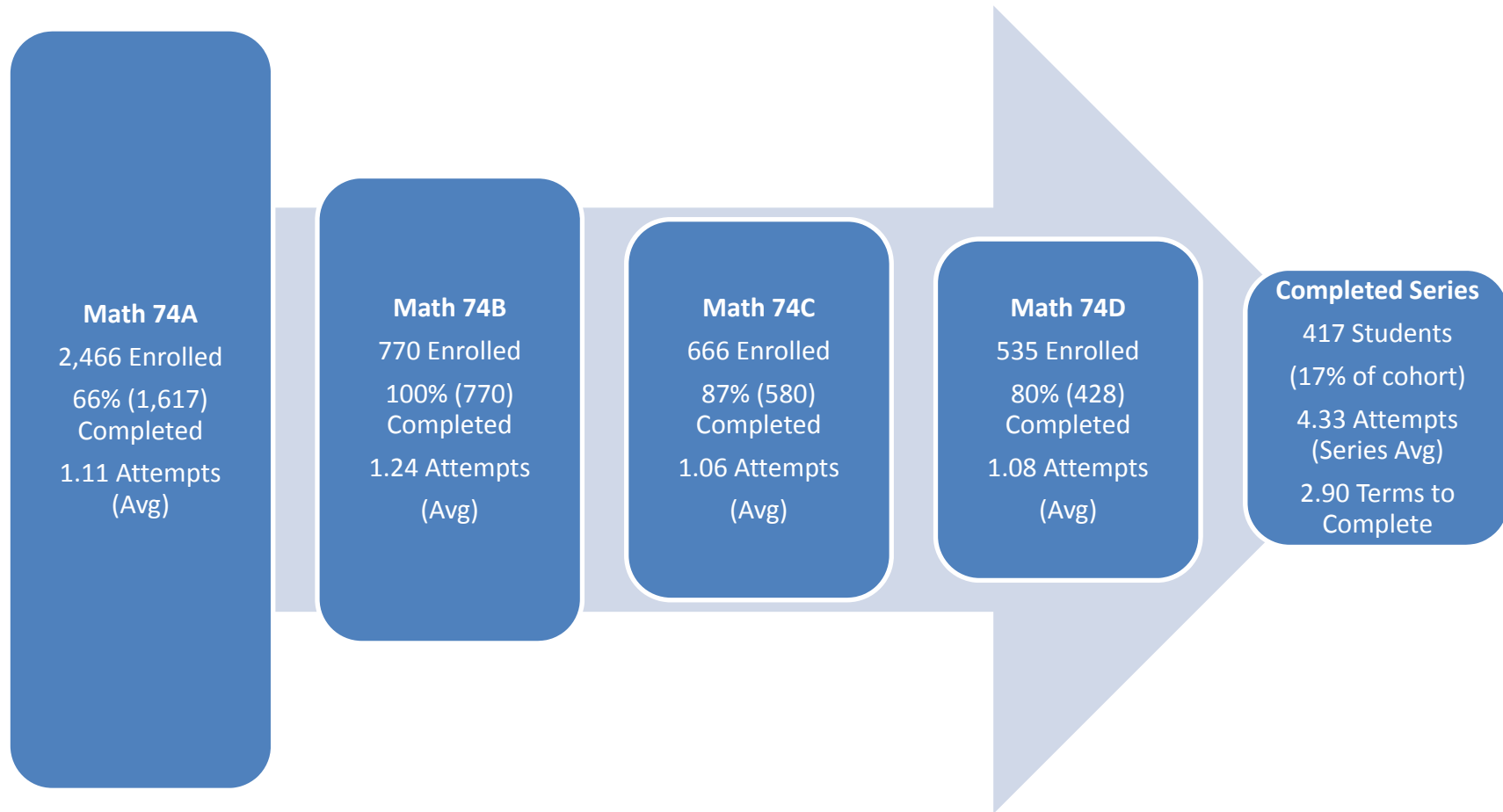
When Math 74 students are compared to Math 76 students, it appears that both groups of students are about equally likely to complete Math 82 if they take the same pathway to get to that course (e.g., Pre-Algebra to Elementary Algebra to Intermediate Algebra; Elementary Algebra to Intermediate Algebra; or straight to Intermediate Algebra). However, the cost of providing instruction to Math 74 students is far higher than if they were to initially enroll in Math 76, Review of Arithmetic. The cost of the average student progressing through the recommended sequence of courses from Math 74 to Math 82 is \$14,321 more expensive than a student progressing from Math 76 to Math 82. This is a cost that is three times more expensive than the one-semester approach.

Since the four-course sequence is designed to achieve the same end as the one-semester course (Math 76), the College could generate some cost savings by phasing out the four-semester option of basic skills math instruction. Such a recommendation may present a “sink or swim” approach to low-performing math students. However, in tight budgetary times, the College cannot afford to devote excessive resources to any program. The completion rates of students in the Math 76 course indicate that many of the students who enroll in Math 74 are equally likely to do well in Math 76. In the end, there appear to be some significant cost savings that can be achieved by shifting away from the four-semester basic skills math sequence.

REFERENCES

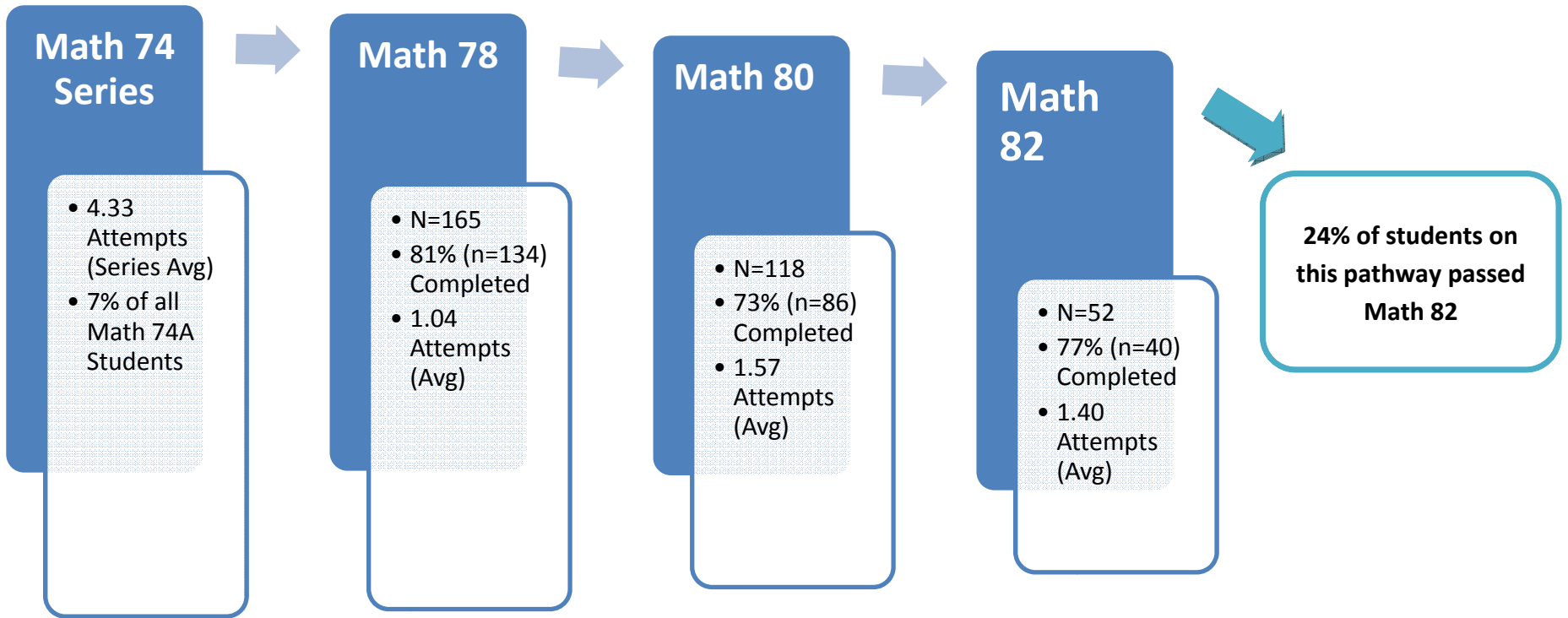
- Attewell, P., Lavin, D., Domina, T. & Levey, T. (2006). New evidence on college remediation. *The Journal of Higher Education*, 77(5), 886-923.
- Bailey, T. (2009). Challenge and opportunity: Rethinking the role and function of developmental education in community college. *New Directions for Community Colleges*, 145, 11-30.
- Merisotis, J. & Phipps, R. (2000). Remedial education in colleges and universities: What’s really going on? *The Review of Higher Education*, 24, 67-85.

Figure 2a. Math 74 Series Completion Rates, Cohort N=2,466



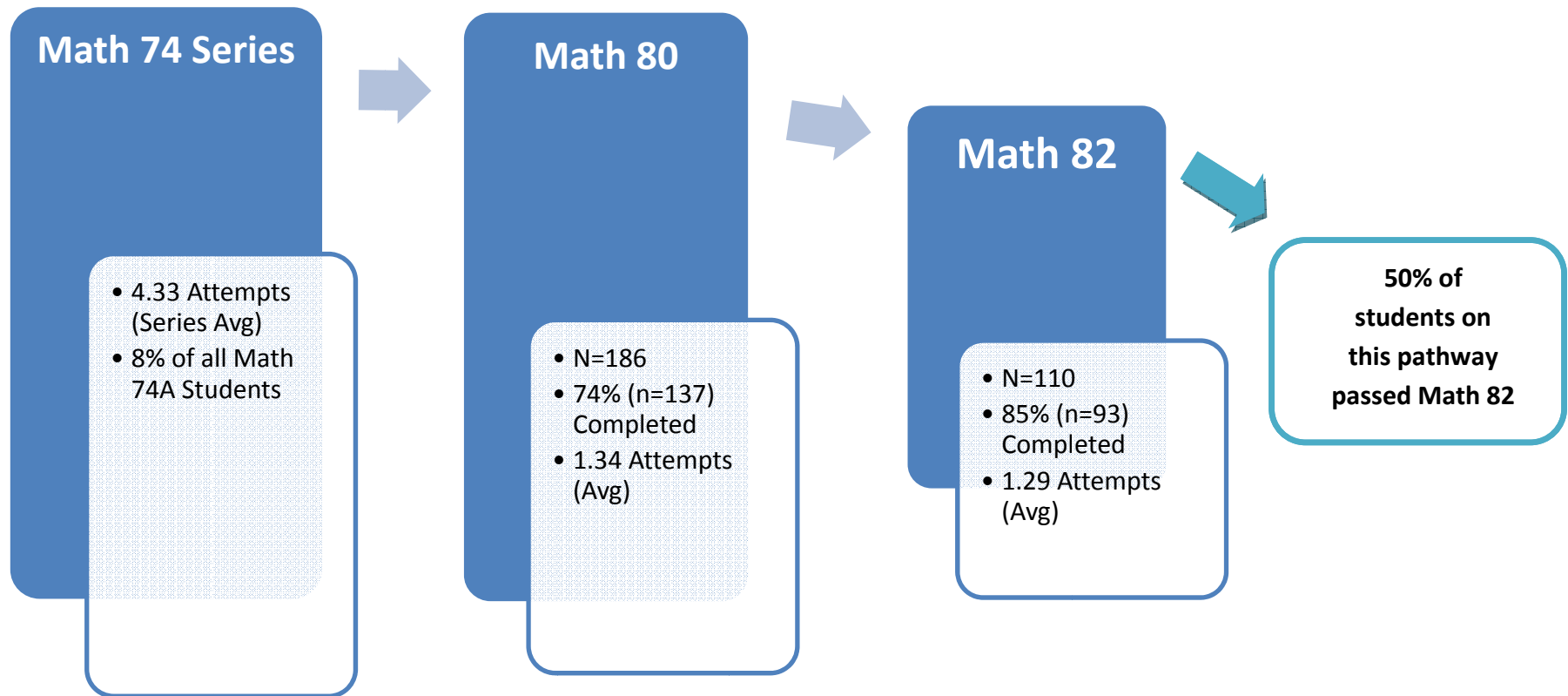
Note: Overall, 417 (16.9%) of the 2,466 students who start in Math 74A complete all four Math 74 courses. And 57 of the 417 students (13.7%) who complete the Math 74 series “stop out” and take no higher-level math courses.

Figure 2b. Math 74 Series to Math 78 (Pre-algebra), N=165 (40% of Math 74 Series Completers)



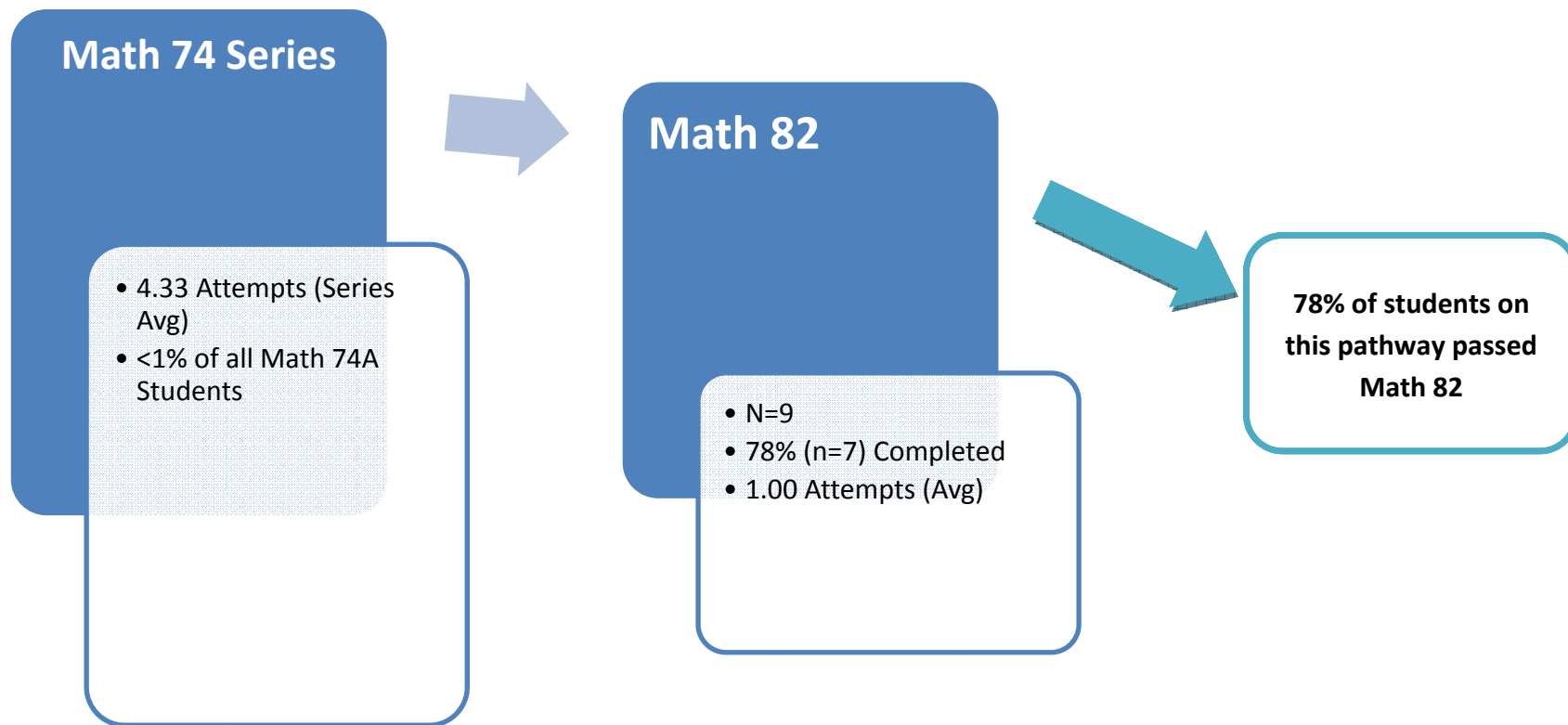
Course	Math 74 Series	Math 78	Math 80	Math 82	Total Pathway Cost
Model Student (Assumes student passes on his/her first attempt)					
Cost per FTES	\$14,316.62	\$1,300.69	\$1,158.46	\$1,291.44	\$18,067.22
Cost per Enrollment	\$870.72	\$158.72	\$154.83	\$172.61	\$1,356.87
Average Student (Costs multiplied by average attempts required to pass course)					
Cost per FTES	\$15,497.75	\$1,352.72	\$1,818.78	\$1,808.02	\$20,477.27
Cost per Enrollment	\$942.55	\$165.07	\$243.09	\$241.65	\$1,592.35

Figure 2c. Math 74 Series Direct to Math 80 (Elementary Algebra), N=186 (45% of Math 74 Series Completers)



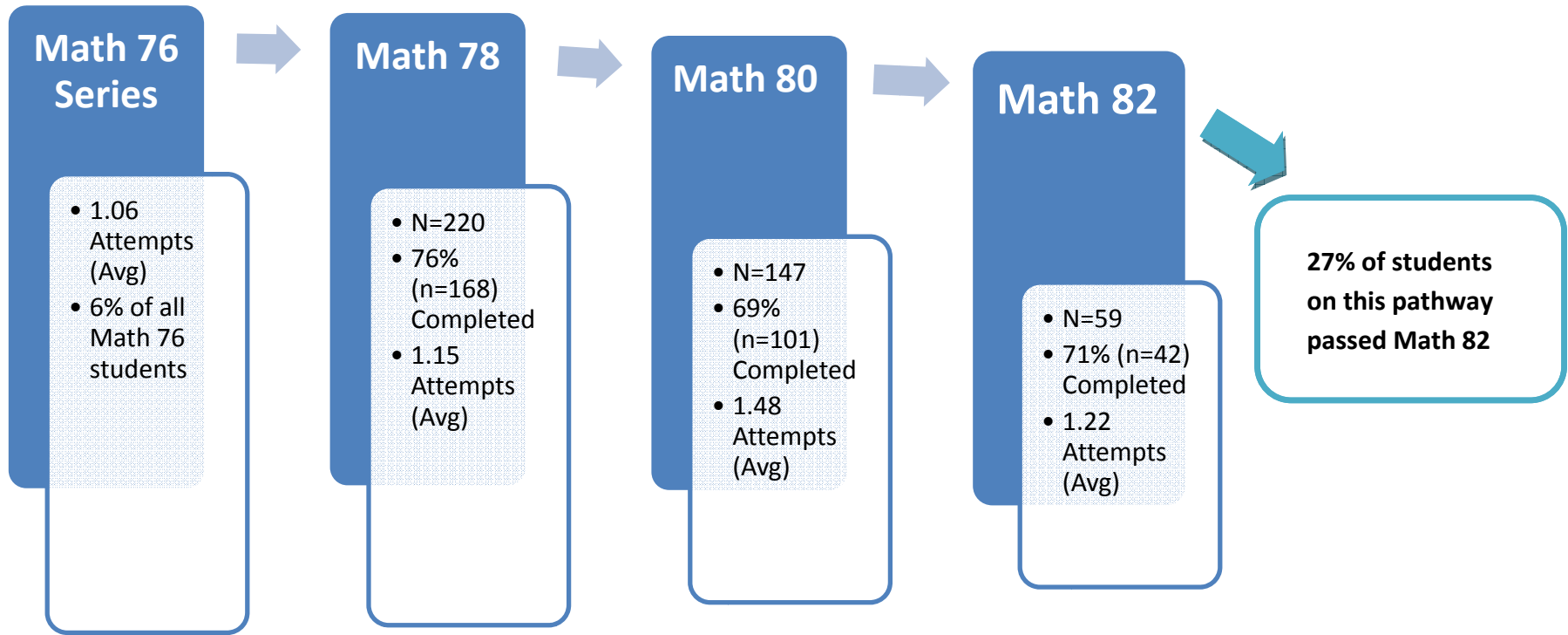
Course	Math 74 Series	Math 80	Math 82	Total Pathway Cost
Model Student (Assumes student passes on his/her first attempt)				
Cost per FTES	\$14,316.62	\$1,158.46	\$1,291.44	\$16,766.53
Cost per Enrollment	\$870.72	\$154.83	\$172.61	\$1,198.16
Average Student (Costs multiplied by average attempts required to pass course)				
Cost per FTES	\$15,497.75	\$1,552.33	\$1,665.96	\$18,716.04
Cost per Enrollment	\$942.55	\$207.48	\$222.66	\$1,372.69

Figure 2d. Math 74 Series Direct to Math 82 (Intermediate Algebra), N=9 (2% of Math 74 Series Completers)



Course	Math 74 Series	Math 82	Total Pathway Cost
Model Student (Assumes student passes on his/her first attempt)			
Cost per FTES	\$14,316.62	\$1,291.44	\$15,608.07
Cost per Enrollment	\$870.72	\$172.61	\$1,043.32
Average Student (Costs multiplied by average attempts required to pass course)			
Cost per FTES	\$15,497.75	\$1,291.44	\$16,789.19
Cost per Enrollment	\$942.55	\$172.61	\$1,115.16

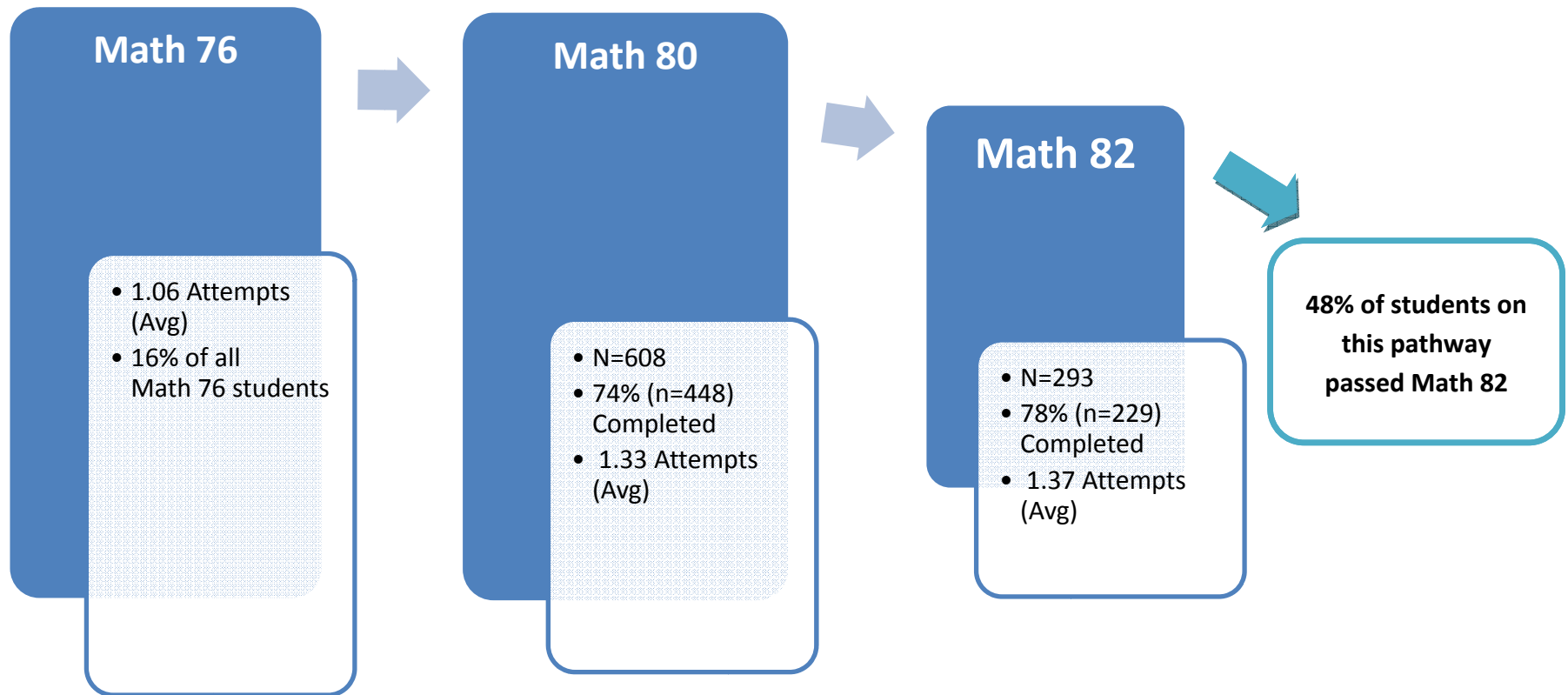
Figure 3a. Math 76 Direct to Math 78 (Pre-Algebra), N=220 (10% of Math 76 Completers)



Note: Of the 3,752 students who enrolled in Math 76, 2,172 (58%) eventually passed the course. Over half (59%) of those stopped out after Math 76.

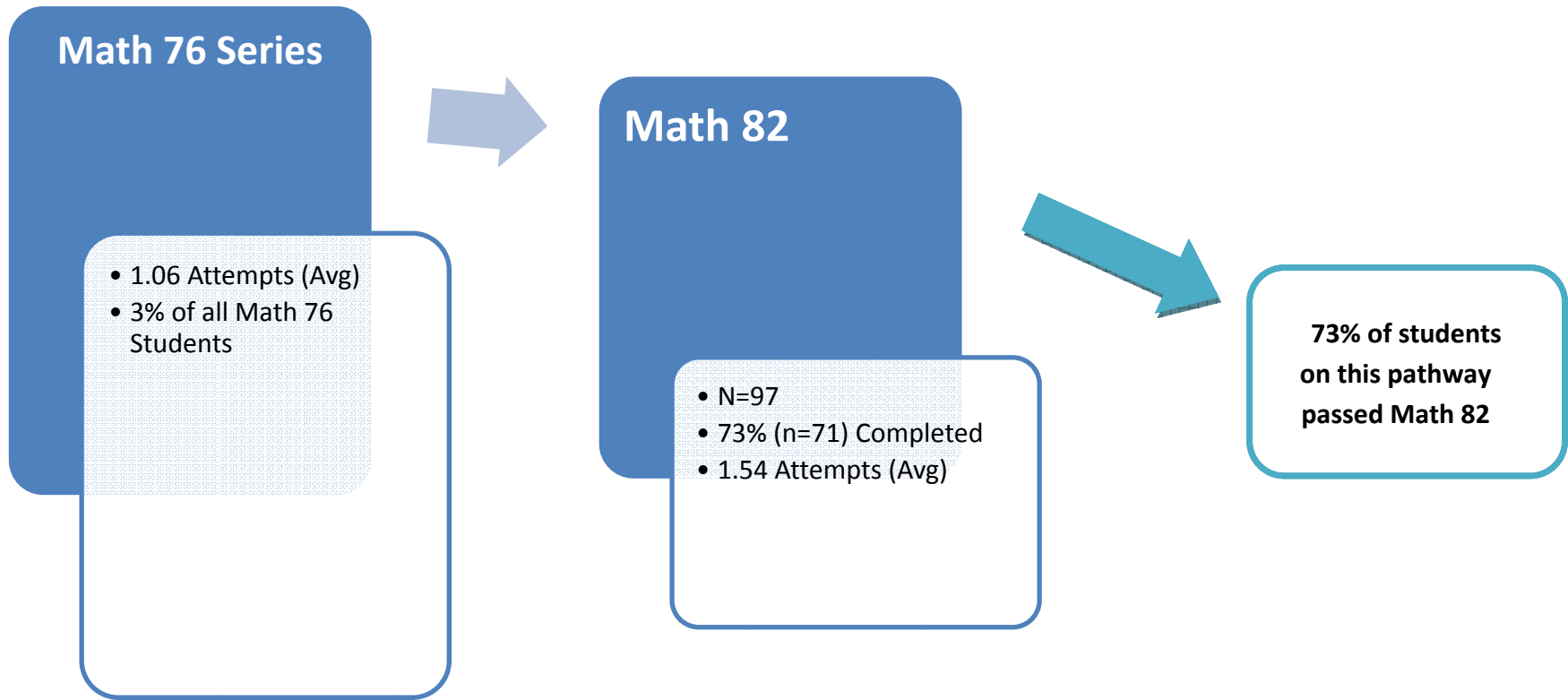
Course	Math 76	Math 78	Math 80	Math 82	Total Pathway Cost
Model Student (Assumes student passes on his/her first attempt)					
Cost per FTES	\$1,293.26	\$1,300.69	\$1,158.46	\$1,291.44	\$5,043.85
Cost per Enrollment	\$133.36	\$158.72	\$154.83	\$172.61	\$619.51
Average Student (Costs multiplied by average attempts required to pass course)					
Cost per FTES	\$1,370.85	\$1,495.80	\$1,714.52	\$1,575.56	\$6,156.73
Cost per Enrollment	\$141.36	\$182.52	\$229.15	\$210.58	\$763.62

Figure 3b. Math 76 Direct to Math 80 (Elementary Algebra), N=608 (28% of Math 76 Completers)



Course	Math 76	Math 80	Math 82	Total Pathway Cost
Model Student (Assumes student passes on his/her first attempt)				
Cost per FTES	\$1,293.26	\$1,158.46	\$1,291.44	\$3,743.16
Cost per Enrollment	\$133.36	\$154.83	\$172.61	\$460.80
Average Student (Costs multiplied by average attempts required to pass course)				
Cost per FTES	\$1,370.85	\$1,540.75	\$1,769.28	\$4,680.88
Cost per Enrollment	\$141.36	\$205.93	\$236.47	\$583.76

Figure 3c. Math 76 Direct to Math 82 (Intermediate Algebra), N=97 (5% of Math 76 Completers)



	Math 76	Math 82	Total Pathway Cost
Model Student (Assumes student passes on his/her first attempt)			
Cost per FTES	\$1,293.26	\$1,291.44	\$2,584.70
Cost per Enrollment	\$133.36	\$172.61	\$305.96
Average Student (Costs multiplied by average attempts required to pass course)			
Cost per FTES	\$1,370.85	\$1,988.82	\$3,359.68
Cost per Enrollment	\$141.36	\$265.81	\$407.17