Title

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Publication Date

2020

DOI

10.1177/2378023120927604

HHS Public Access
Author manuscript
Socius. Author manuscript; available in PMC 2021 January 05.

Published in final edited form as:
Socius. 2020 ; 6: . doi:10.1177/2378023120927604.

Tournament Mobility in Mathematics Course-Taking Pathways

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Abstract

This visualization represents the structure of mathematics course opportunities as seen in the progress through middle and high school for one cohort of students in Texas. Trajectories are consistent with a tournament mobility regime in which there are repeated opportunities to fall behind but almost none to catch up. Pathways are also characterized by staggered starts, with differences in when students begin the mathematics sequence that have consequences for ultimate attainment. The structure of mathematics opportunities provides many points where trajectories diverge, and these branching points disproportionately sort economically disadvantaged students into less advanced pathways.

Keywords

educational pathways; socioeconomic inequality; mathematics opportunities

Mathematics attainment in high school is related to many important later outcomes, but ultimate attainment results from a series of individual transitions throughout students' educational careers (McFarland 2006; Schiller and Hunt 2011). Figure 1 provides a parsimonious representation of mathematics progress for one cohort of students in public schools in Texas. The network of branching pathways traces how students are sorted from undifferentiated general mathematics instruction prior to 7th grade to many different destinations in 12th grade. In turn, these pathways reflect the ways that the organization of curricula—what and when opportunities are available as well as the rules for eligibility—structure school opportunities.

The most common mathematical careers, represented by three parallel diagonal lines, follow the traditional sequence of Algebra I, Geometry, Algebra II, Precalculus, and (if time allows) Calculus. But pathways diverge in two critical ways. First, typical progress is not certain. Students may repeat a level—represented by horizontal paths—or take a course that diverts from typical progress. For example, Mathematical Models and Application, a course

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Supplemental Material
Supplemental material for this article is available online.

reviewing algebra and geometry content, is a common alternative to Algebra II in 11th grade. Likewise, AP Statistics provides a less advanced alternative to Calculus. Notably, there are no countervailing accelerated pathways, meaning that students cannot move to a higher trajectory, nor can they catch up if they fall behind.[1] These dynamics are consistent with a tournament mobility regime (Rosenbaum 1976); students face a series of uncertain contests in which "winning" enables them to move forward to the next round but losing means falling behind irreparably.

The second distinguishing feature of mathematics pathways is that students begin the differentiated mathematics sequence at different times. Most students start Algebra I in ninth grade, many begin in eighth grade, and some begin in seventh grade. Given the mobility dynamics in high school, these starting points strongly shape how far students can go. For instance, the selective group of students in Algebra I are on the clearest path to advanced calculus. Conversely, there is not a pathway to calculus for students who begin Algebra I in high school. Thus, the structure of mathematics opportunities creates a tournament mobility regime with staggered starts; earlier entry allows the possibility—though not a guarantee—of further progress. It is notable that pathways are "messier" for the students who start differentiated coursework late; this reflects that late starters face the greatest risk for horizontal or downward movement by the end of their educational careers.

Students do not navigate this structure of opportunities equally, and each diverging path represents a categorical educational distinction that may reproduce social inequality (Domina, Penner, and Penner 2017). As shown by the color of each pathway in the figure, almost all diverging paths serve to heighten socioeconomic disparities by sorting more affluent students to a more advanced pathway. This is the case both for initial starting paths and those that divert progress later. Economically disadvantaged students are especially overrepresented in lower courses in later grades, where the risks of falling behind are highest. Students with fewer socioeconomic resources are more likely to be in these pathways because of differences in prior academic preparation, less information about courses and policies, and weaker connections to institutional resources (Lucas 1999). This visualization highlights that the socioeconomic gradient in ultimate attainment outcomes is created by the series of sequential categorical distinctions that schools make throughout students' educational careers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding

The author disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported by funding from the Texas OnCourse Research Network at the University

[1]There are apparent accelerated pathways from Algebra I to Algebra II (from 8th and 9th grades), but these reflect schools that switch Geometry and Algebra II in the sequence of courses. The one notable accelerated pathway is from Precalculus in 11th grade to the Calculus BC in 12th grade.

of Texas at Austin. The data used in this study come from the Texas Education Research Center. The conclusions of this research do not necessarily reflect the opinion or official position of Texas OnCourse, the University of Texas at Austin, the Texas Education Research Center, the Texas Education Agency, the Texas Higher Education Coordinating Board, the Texas Workforce Commission, or the State of Texas.

Biography

Paul Hanselman is an assistant professor of sociology at the University of California, Irvine. His research focuses on how schools influence social inequalities and the impacts of school-based educational interventions on these processes.

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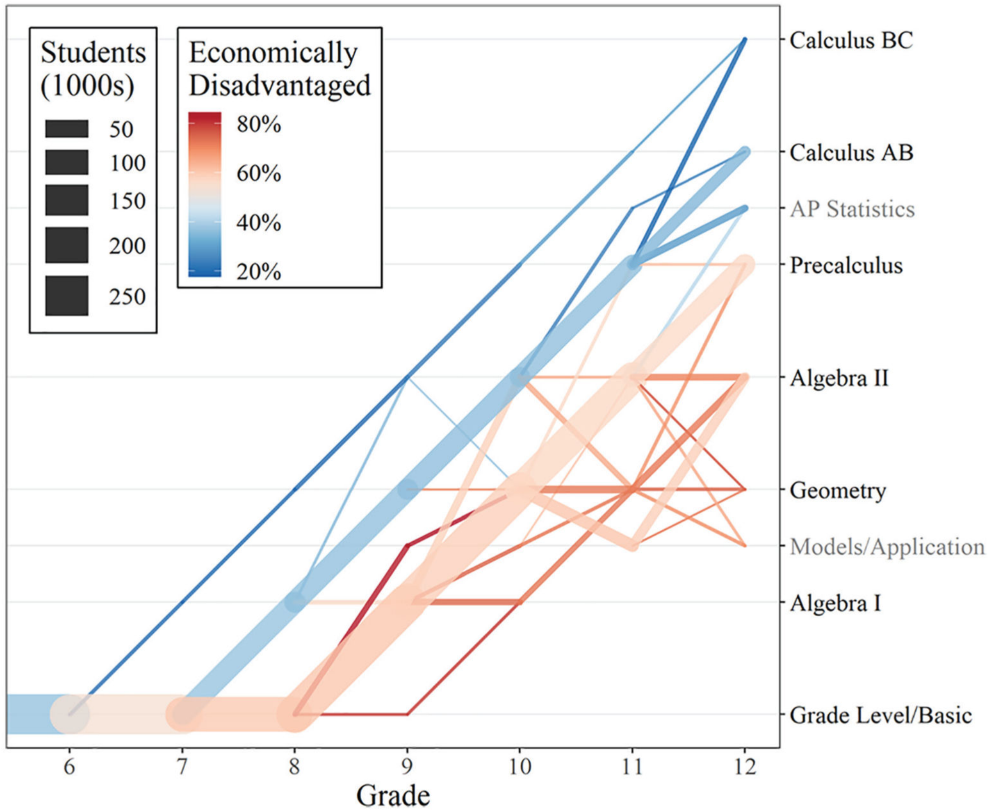

Figure 1.

Mathematics trajectories of one cohort of students in Texas (n > 300,000). The width of each line segment represents the number of students making this transition (e.g., Algebra I in grade 8 to Geometry in grade 9), and the color represents the mean economic disadvantage of these students. Mathematics courses listed with black text represent the typical sequence. Those listed in gray represent alternatives that often divert from typical progress. Paths for infrequent courses (Independent Study and Other Mathematics courses) are omitted for legibility. For a version that includes exits from mathematics coursework, see supplementary materials.