



## **Educational Disparities Causal Map**

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Many Differences **One Destiny**

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# Educational Disparities Causal Map

## Introduction

Understanding educational disparities is inherently challenging. While individual components can be studied and understood, understanding educational disparities as a whole has proven much more challenging. These disparities accumulate over time, involve many interactions including circular causality and feedback mechanisms, and extend from early childhood and elementary education to college completion. Often, the connections between causes and effects are obscured.

However, there is reason to be optimistic. Unlike most disparities involving complex systems (e.g., environment and climate change, health care) that have physical momentum, educational disparities are much more likely to be socially constructed through patterns of human behavior, political institutions, and conceptual definitions of what constitutes education and what defines merit. In short, it is possible to imagine radical changes in educational systems *if the politics and people's mental models can be overcome*. Achieving this goal can be facilitated by tools that help people to visualize the elements and connections of this system and to identify the system's major feedback loops and potential intervention points.

Although the work presented here is a causal map and not a formal simulation model, the diagram was developed with the principles of system dynamics in mind and the potential for translating the diagram into an actual simulation model in future work.

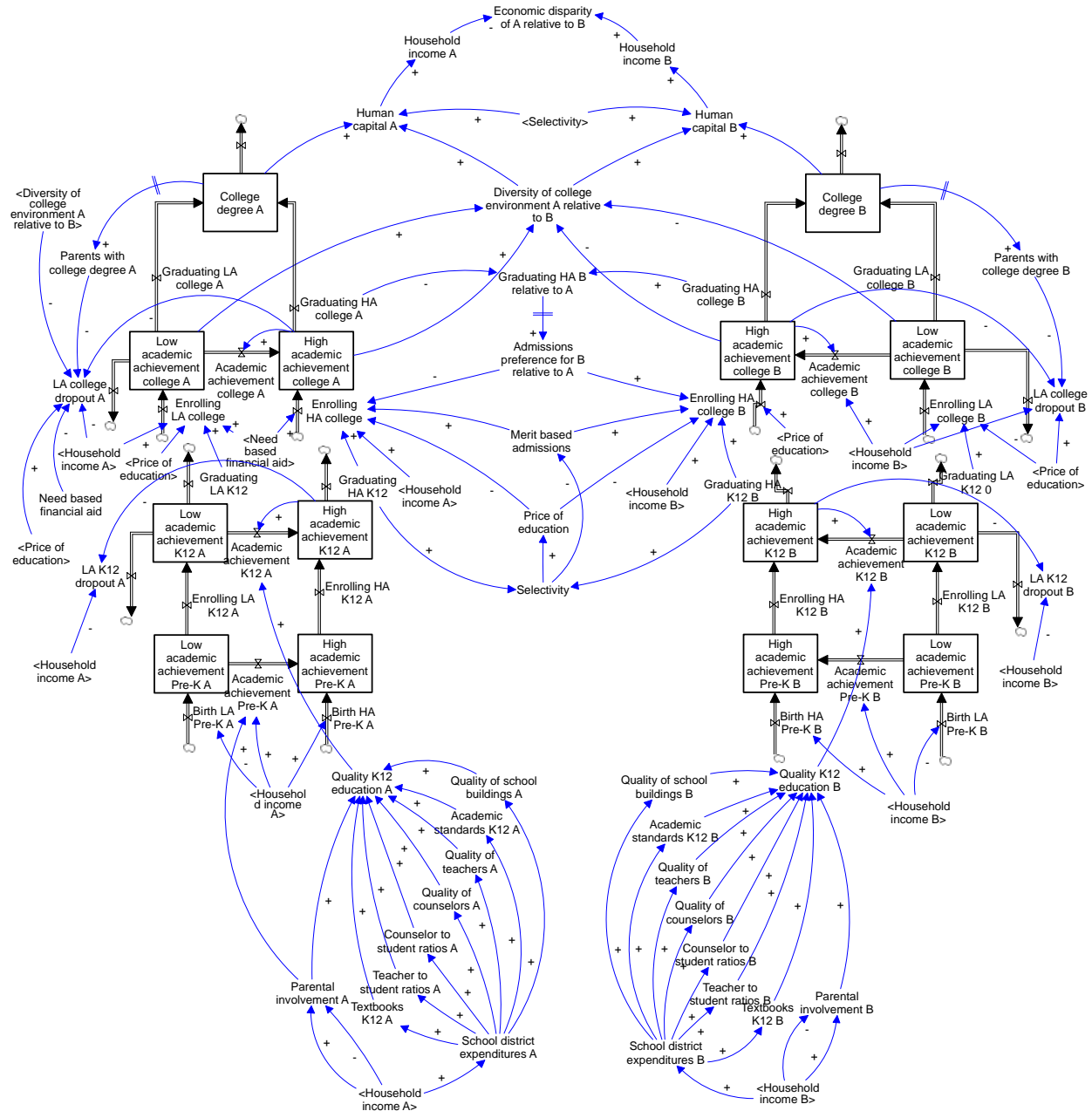
## Overview of Causal Map

The educational disparities causal map (overview shown in Figure 1) describes the complex system that constructs and sustains disparities between a disadvantaged group (A) and a privileged group (B). The diagram attempts to illustrate some of the major feedback mechanisms that reinforce and sustain educational disparities from preschool through the post-college experiences. The causal map consists of six major subsystems:

- educational experiences of group A
- educational experiences of group B
- economic disparities between group A and B
- diversity of the college environment
- admission preferences
- selectivity and price of college.

Each of these subsystems is described in more detail below.

**Figure 1: Overview of educational disparities causal map**



Central to this educational disparities map is the idea that as people move through educational systems from preschool through college, (1) educational achievement at any given level means transitioning from low achievement to high achievement, and (2) the educational achievement at one level carries over to the next level.

Figure 2 shows the basic movement of people in group A. The boxes represent the population of people at each stage of educational experiences, from pre-kindergarten through college. These boxes are called stocks or levels. For example, “low academic achievement K12 A” represents the

population of people in group A who are in primary and secondary schools with low academic achievement. The double lines with “bow-ties” represent transitions from one stage to another stage, and the variables designate how fast people transition into or out of a given stage. For example, “Enrolling HA K12 A” represents how fast people are enrolling in the K-12 high academic achievement stock. These transitions are often called rates or flows.<sup>1</sup> For example, “Graduating HA college A” represents the transition of college students from group A with high academic achievement graduating and entering the demographic group of adults with college degrees (“College degree A”). The cloud symbols represent transitions into and out of the system. For example, in Figure 2, “LA K12 dropout A” represents low achieving students from the privileged group who dropout before high school graduation and leave the system.

In addition to the stocks and flows shown in Figure 2, there are variables with single lines and arrowheads that represent causal links. For example, “Parents with a college degree” influences the rate that low achieving students drop out of college. This is shown as a single line with an arrowhead from “Parents with college degree A” pointing to “LA college dropout A”.

The minus sign means more parents with college degrees in group A will lead to *less* dropout in group A if everything else is equal. Similarly, the plus sign between “Graduating LAK12” and “Enrolling LA college” means that the more students graduating will lead to an *increase* in the number of students enrolling in college if everything else is equal.

The causal direction of stocks and flows (the boxes and pipes in Figure 2) depends on whether the flow is moving into or out of the stock. A flow pointing into a stock *adds* to the stock at the end of the flow, and *subtracts from* the stock at the beginning of the flow. For example, in students transitioning from “Low academic achievement college A” to “High academic achievement college A”, the rate “Academic achievement collage A” *subtracts from* “Low academic achievement college A” and *adds to* “High academic achievement college A”. So the more “Academic achievement college A” there is, the *less* “Low academic achievement college A” there will be, implying a minus sign. And, the *more* “High academic achievement college A” there will be, implying a plus sign.

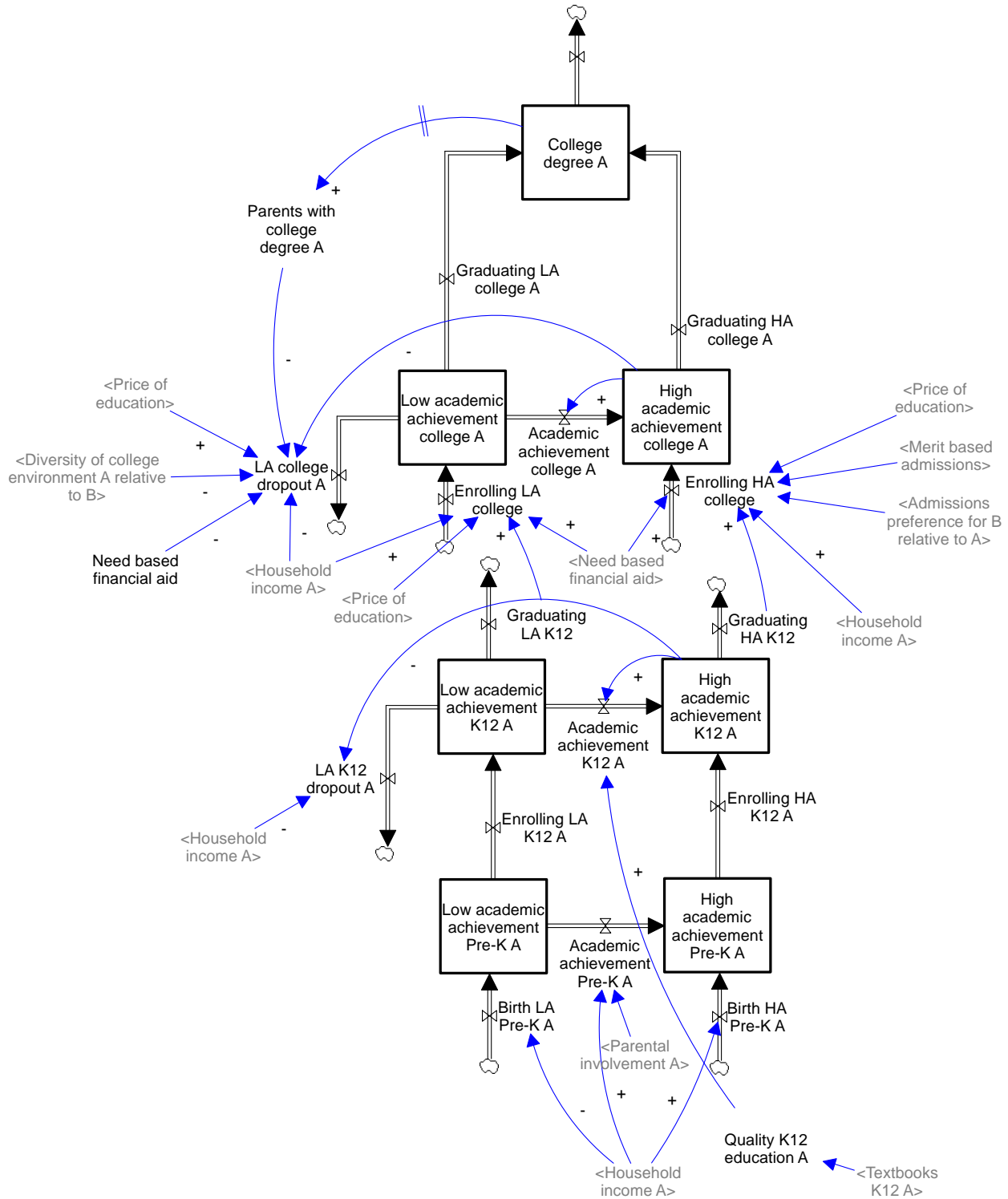
It is important to note that the plus and minus signs do not mean “better” or “worse”, and only reflect the type of relationship between the two variables connected by the casual arrow. To read through a causal chain then, one begins with an initial increase and then works through the causal chain. For example, an *increase* in “College degree A” leads to an *increase* in “Parents with college degree A” (because there is a plus sign between the two variables), which then leads to a *decrease* in “LA college dropout A” (because there is a minus sign).

Some variables in the diagram influence a number of other variables. To make the diagram more readable, these variables are often shown in several places enclosed in brackets, for example, “<Price of education>”. The use of brackets simply means that the variable has been defined in another part of the model.

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<sup>1</sup>The term ‘rate’ in this context refers to how fast something happens in terms of units of people/time. This is fundamentally different from the proportion of people who might experience some event (e.g., graduation rate), which is a proportion and dimensionless.

Figure 2: Educational experiences of group A



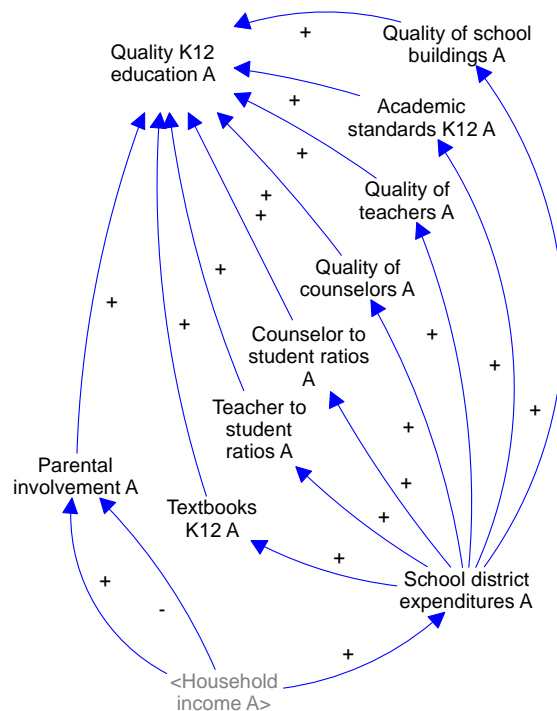
In the educational disparities causal map, people enter the system at birth into either a low or high academic achievement stock. The main determinant of which stock children enter is household income. In pre-kindergarten, early childhood education can help children move from low to high academic achievement through programs designed to improve learning. Effective programs move

children from the low to high academic achievement stock, while ineffective programs either do not facilitate this growth or may actually move children “backwards” from the high to the low academic achievement stock. The main assumption in this diagram is that the primary determinants of early childhood education are household income and parental involvement.

Children enroll in the primary and secondary education system by transitioning from pre-kindergarten and enrolling in kindergarten. Similar to the pre-kindergarten subsystem, the primary and secondary education system moves children from the low to the high achieving stocks if it is effective; an ineffective system either does not move or moves children backwards. The primary determinant of academic achievement in K-12 is the quality of education, shown in Figure 3. It is important to note that a failing educational system can *still* graduate some high achieving students, but it will do so essentially because of the individual attributes of the students and their support system and not because the educational system is effective. While students in both the low and high academic achievement stocks can graduate, the assumption in the diagram (Figure 2) is that only children in the low academic achievement group are at risk of dropping out, and this is influenced by household income.

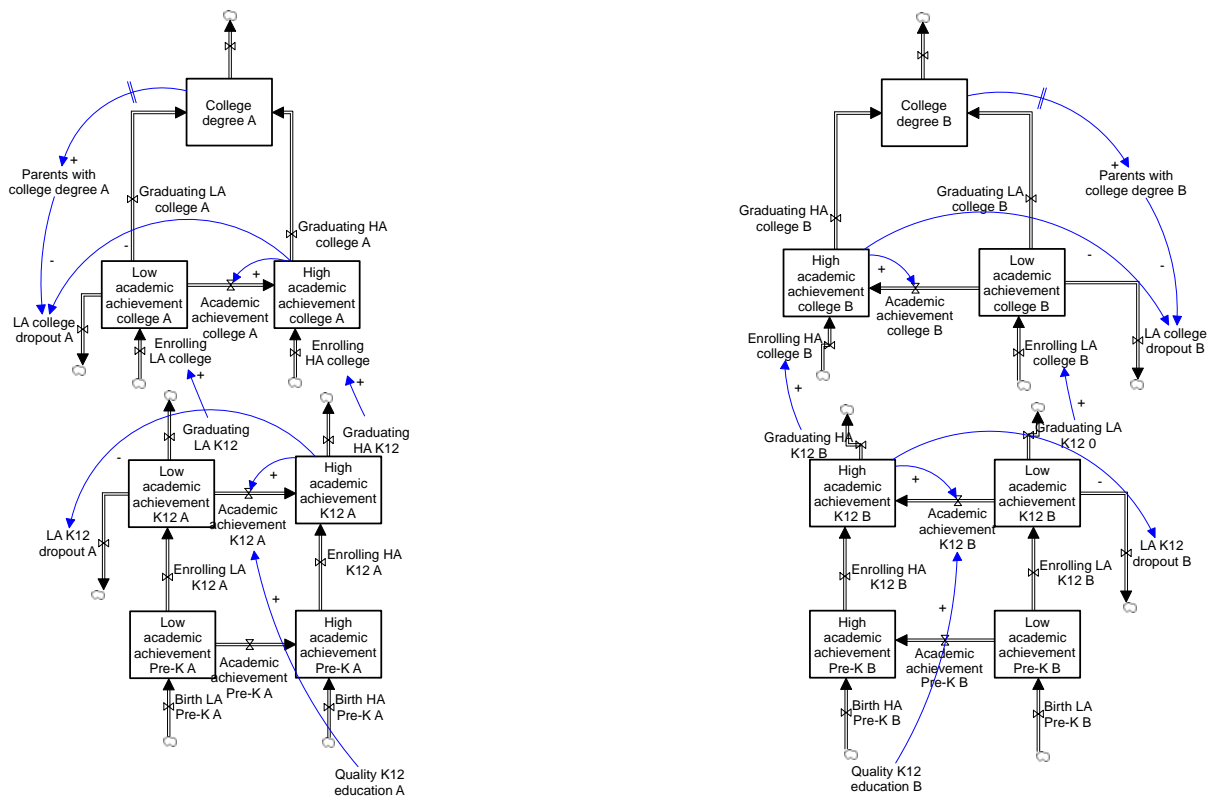
Figure 3 shows the complex set of factors influencing the quality of K-12 education including the quality of school buildings, academic standards, quality of teachers, quality of counselors, counselor to student ratios, teacher to student ratios, textbooks, and parental involvement. These in turn are influenced by household income and school district expenditures.

**Figure 3: Factors influencing the quality of education**



When students graduate from 12<sup>th</sup> grade, some go on to college. The fact that not all students go on to college and that students might not enter college immediately after high school graduation is reflected as a causal link (as opposed to a flow). Students entering college are assumed to enter with their level of academic achievement from 12<sup>th</sup> grade. Enrolling in college is influenced by the price of a college education, household income, and need based financial aid.

**Figure 4: Educational experiences for group A (left) and group B (right)**



Similar to the K-12 structures in Figure 2, academic achievement represents a transition from low to high academic achievement; both low and high achievement college students can graduate, but low academic achievement students are at greater risk of dropping out. Dropout at the college level is influenced by the price of education, diversity of the college environment, household income, having parents with a college degree, and financial aid.

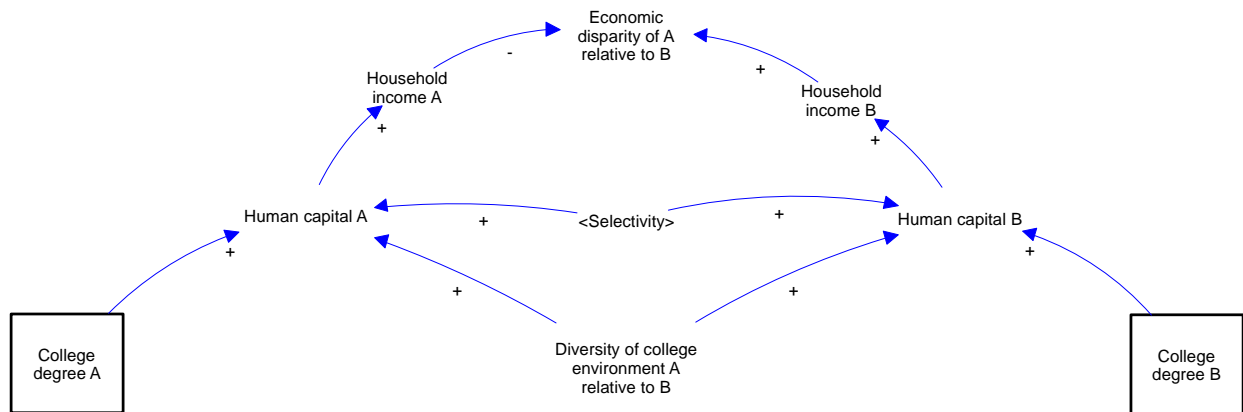
When students graduate, they enter the stock of adults with college degrees. This creates a reinforcing feedback mechanism where more “Parents with college degrees” leads to fewer dropouts, which in turn leads to even more students graduating.

This educational disparities model assumes that the basic feedback structure of educational experiences is the same (see Figure 4) for both groups. That is, both groups would, under the same conditions, have similar patterns of educational experiences. The important point here is that differences between groups are not due to individual characteristics, but the accumulated advantages and disadvantages that emerge and are sustained by the system of feedback loops.

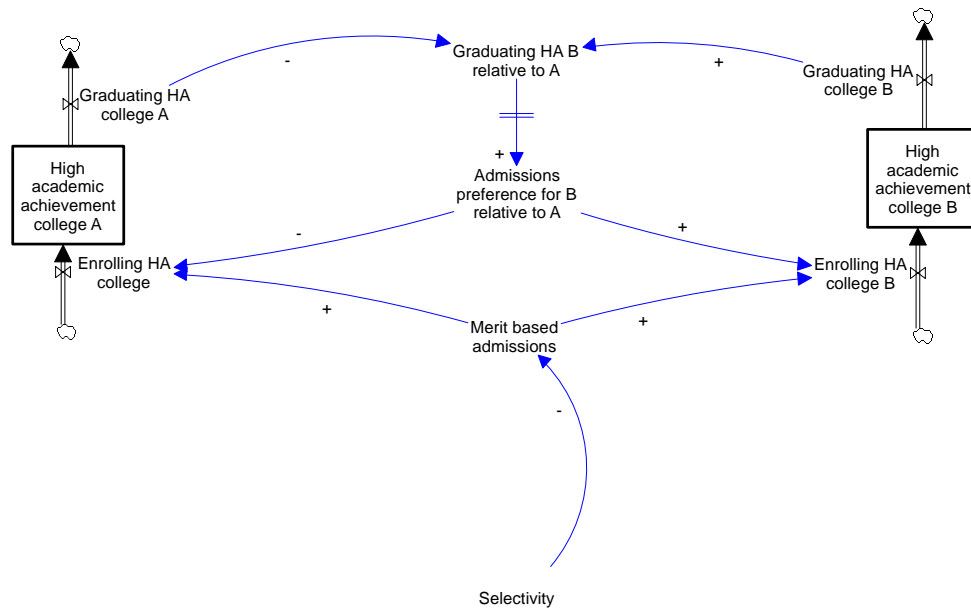


Figure 5 shows the structure of economic disparities. Economic disparities are represented as the income of households in group A relative to group B, which is essentially a ratio of the average household income for group A to group B. Household income is seen as a function of human capital that is increased by having a college degree, the selectivity of colleges, and the diversity of the college environment.

**Figure 5: Economic disparities**



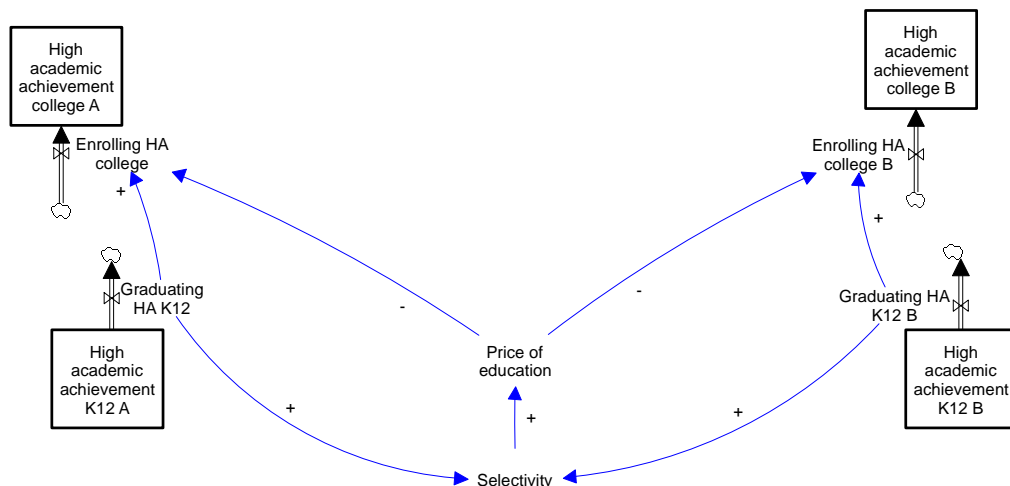
**Figure 6: Admission preferences**



This educational disparities causal map assumes that colleges develop admissions criteria aimed at reproducing the distribution of high academic achieving students (Figure 6). For example, if 80% of the high academic achieving students come from the privileged group B and 20% from the disadvantaged group A, then the admission criteria will reflect an attempt to recruit and admit students with the same characteristics and hence socially reproduce this distribution over time. This

can be mitigated with more creative admission policies that take into account other student attributes and incorporate more objective selection criteria. However, increased selectivity, particularly at elite colleges, reduces the pressure to implement more objective admissions policies.

**Figure 7: Price of education**



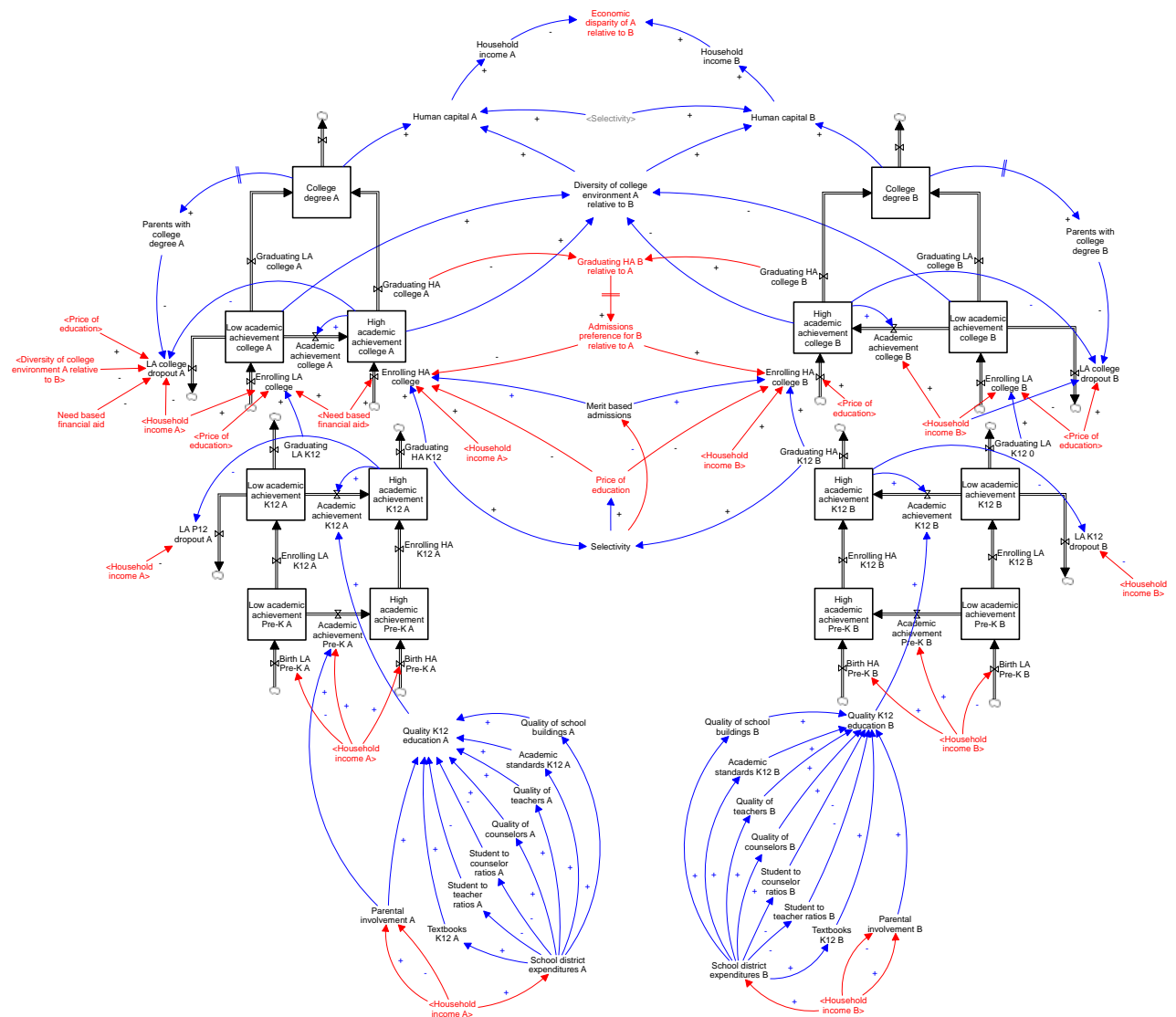
The selectivity of colleges is taken to be directly influenced by how many high academic achieving students are graduating from high school. That is, the more high academic achieving students graduate from high school from both groups, the more selective a college admissions process can be. This in turn directly influences the price of education that the college can demand as shown in Figure 7.

The causal map highlights a number of feedback mechanisms that can either mitigate or exacerbate educational disparities. One of the immediately apparent implications from the diagram (Figure 1) is that it may be quite possible to increase college enrollment and even college graduation rates without reducing educational disparities, thereby potentially exacerbating educational disparities as a larger pool of high school graduates enables colleges to be more selective and increase the price of education.

**Eliminating Educational Disparities**

What would happen if we eliminated these disparities? Figure 8 shows (in red) the structures that would weaken and eventually disappear if educational disparities were eliminated. For example, the price of education would no longer be a factor in low academic achieving college students dropping out, nor would the diversity of college enrollment or the availability of financial aid.

**Figure 8: Overview of system if disparities were eliminated with structures shown in red lose their influence**



## Conclusion

The current map represents an overview of education from birth through early childhood, primary and secondary education, college, and into adulthood for two different groups: a disadvantaged group and a privileged group. It presents a dynamic hypothesis about the underlying causal structure that continues to sustain educational disparities, and raises questions about how and where one can intervene to mitigate and ultimately eliminate those disparities. The causal map is generic in the sense that it can be applied to a wide variety of comparisons between different groups at different levels of aggregation from a single school district to state level to national level.

The causal map has been developed with the principles of system dynamics in mind so that it is possible to translate the qualitative causal map into formal simulation models. The main data sources needed for such an effort are enrollment data and trends for early education, primary and secondary education, and college education in addition to basic demographic information and trends for the same geographic area. Future work could focus on building a preliminary simulation model to explore how the system structures interact and help illustrate some basic principles of systems. Workshops could be developed based on such models to help communities, policy makers, politicians, and government staff better understand where the leverage points might be, as well as some of the inherent trade-offs between different types of interventions. And, more sophisticated versions of such models could be developed to support the design and evaluation of specific interventions.





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