Figure 4. The School Simulation Model
Appendix I: Model Equations and Table Functions

Average\_Student\_Academic\_Performance(t) = Average\_Student\_Academic\_Performance(t - dt) + (Rate\_of\_Increase\_in\_SAP) * \frac{dt}{dt}

INIT Average\_Student\_Academic\_Performance = .8

INFLOWS:
Rate\_of\_Increase\_in\_SAP = Quality\_&\_Intensity\_of\_Instruction*Student\_Effort\_in\_School

Community\_&\_Parent\_Interest\_in\_the\_School(t) = Community\_&\_Parent\_Interest\_in\_the\_School(t - dt) + (Rate\_of\_Change\_in\_LCLIS) * dt

INIT Community\_&\_Parent\_Interest\_in\_the\_School = 1

INFLOWS:
Rate\_of\_Change\_in\_LCLIS = Effect\_of\_QSL\_on\_LCLIS*Community\_&\_Parent\_Interest\_in\_the\_School

Quality\_of\_School\_Leadership(t) = Quality\_of\_School\_Leadership(t - dt) + (Rate\_of\_Change\_in\_the\_Quality\_of\_School\_Leadership) * dt

INIT Quality\_of\_School\_Leadership = 1

INFLOWS:
Rate\_of\_Change\_in\_the\_Quality\_of\_School\_Leadership = Effect\_of\_LCM\_Multiplier\_on\_the\_Rate\_of\_Leadership\_Change*Quality\_of\_School\_Leadership

Student\_True\_Grade\_Level(t) = Student\_True\_Grade\_Level(t - dt) + (Rate\_of\_Increase\_in\_Student\_s\_True\_Grade\_Level) * dt

INIT Student\_True\_Grade\_Level = 1

INFLOWS:
Rate\_of\_Increase\_in\_Student\_s\_True\_Grade\_Level = 1

Student\_Academic\_Motivation(t) = Student\_Academic\_Motivation(t - dt) + (Rate\_of\_Increase\_in\_SAM) * dt

INIT Student\_Academic\_Motivation = 1

INFLOWS:
Rate\_of\_Increase\_in\_SAM = Student\_Academic\_Motivation*Effect\_of\_Various\_Factors\_on\_Changes\_in\_Motivation

Teacher\_Quality(t) = Teacher\_Quality(t - dt) + (Rate\_of\_Change\_in\_Teacher\_Quality) * dt
INIT Teacher_Quality = 1

INFLOWS:

Rate_of_Change_in_Teacher_Quality = Effect_of_TQCM_on_RCTQ/DELAY(3,0)

Amount_and_Quality_of_Supervision_&_Prof_Development_Activities =
Effect_of_AQPDA_Multiplier

AQPDA_Multiplier =
Comparative_Level_of_Community_Resources_for_Schooling*Quality_of_School_Leadership

Average_Quality_of_Teacher_Recruitment_and_Selection =
Comparative_Level_of_Community_Resources_for_Schooling*Effect_of_School_Leadership_on_Teacher_Recruitment_and_Selection*Effect_of_SAP_on_Teacher_Recruitment

Change_in_SAM_Multiplier =
(Quality_&_Closeness_of_StudentTeacher_Relationship+Quality_&_Intensity_of_Instruction+1/Ratio_of_Out_of_School_Suspensions_to_Normal+Ratio_of_SAP_to_STGL)/4

Comparative_Level_of_Community_Resources_for_Schooling =
Effect_of_LCLIS_on_Community_Resources_for_Schooling

cost_rigor =
Effect_of_School_Leadership_on_Content_Rigor*Effect_of_Teacher_Quality_on_Content_Rigor

Effect_of_Performance_Ratio_on_Parent_Pressure =
IF(Ratio_of_SAP_to_STGL<1)THEN(1/Ratio_of_SAP_to_STGL)ELSE(1)

Expected_ASAP =
Average_Student_Academic_Performance*Effect_of_QSL_on_RCEAASAP

Extra_Help_for_Underachieving_Students =
Interest_of_School_Ldship_in_Underachieving_Student_Help*Teacher_Effort_to_Help_Underachieving_Students*Parental_Pressure_from_Student_Underachievement

Interest_of_School_Ldship_in_Underachieving_Student_Help =
IF(Quality_of_School_Leadership)>1.15THEN(1/Ratio_of_ASAP_to_Expected_ASAP)ELSE(1)

Leadership_Change_Multiplier =
Community_&_Parent'Interest_in_the_School*(1/Ratio_of_ASAP_to_Expected_ASAP)

Parental_Pressure_from_Student_Underachievement =
IF(Community_&_Parent'Interest_in_the_School>1.5)THEN(Effect_of_Performance_Ratio_on_Parent_Pressure)ELSE(1)
Quality & Closeness of Student-Teacher Relationship = 
Student Personal Intelligence * Teacher Perception of Student Ability & Motivation

Quality & Intensity of Instruction = 
Effect of TQ on Q&II * Teacher Perception of Student Ability & Motivation * Effect of Pers Intell on the Quality & Intensity of Instruction * Effect of Content Rigor on QII

Ratio of ASAP to Expected ASAP = 
Average Student Academic Performance / Expected ASAP

Ratio of Out of School Suspensions to Normal = 
(1 / Student Academic Motivation) * 1 / Ratio of SAP to STGL

Ratio of SAP to STGL = 
Average Student Academic Performance / Student's True Grade Level

Student Effort in School = 
IF(Student Academic Motivation = 1 OR (Student Academic Motivation > 1)) THEN (Student Academic Motivation * Effect of Extra Help on Student Effort) ELSE (Student Academic Motivation * Effect of Extra Help on Student Effort * Effect of Student Resilience on Student Effort in School)

Student Personal Intelligence = 1

Student Resilience = 1.2

Teacher Effort to Help Underachieving Students = 
IF(Teacher Quality > 1.5) THEN (1 / Ratio of ASAP to Expected ASAP) ELSE (1)

Teacher Perception of Student Ability & Motivation = 
Effect of SAP to STGL Ratio on TPSA&M * Effect of QSL on TPSA&M

Teacher Quality Change Multiplier = 
Effect of AQTR&S on the Teacher Quality Change Multiplier * Effect of PD on Teacher Quality Change

Effect of AQPDA Multiplier = GRAPH(AQPDA Multiplier) 
(0.5, 0.85), (0.6, 0.88), (0.7, 0.9), (0.8, 0.95), (0.9, 0.98), (1, 1.00), (1.10, 1.00), (1.20, 1.05), (1.30, 1.10), (1.40, 1.15), (1.50, 1.20)

Effect of AQTR&S on the Teacher Quality Change Multiplier = 
GRAPH(Average Quality of Teacher Recruitment and Selection) 
(0.5, 0.875), (0.6, 0.9), (0.7, 0.925), (0.8, 0.95), (0.9, 0.975), (1, 1.00), (1.10, 1.00), (1.20, 1.01), (1.30, 1.01), (1.40, 1.02), (1.50, 1.02)
Effect_of_Content_Rigor_on_QII = GRAPH(content_rigor)
(0.5, 0.755), (0.6, 0.85), (0.7, 0.855), (0.8, 0.95), (0.9, 0.955), (1, 1.00), (1.10, 1.01), (1.20, 1.01), (1.30, 1.02), (1.40, 1.02), (1.50, 1.03)

Effect_of_Extra_Help_on_Student_Effort =
GRAPH(Extra_Help_for_Underachieving_Students)
(0.5, 1.00), (0.6, 1.00), (0.7, 1.00), (0.8, 1.00), (0.9, 1.00), (1, 1.00), (1.10, 1.03), (1.20, 1.06), (1.30, 1.09), (1.40, 1.12), (1.50, 1.15)

Effect_of_LCLIS_on_Community_Resources_for_Schooling =
GRAPH(Community_&_Parent'_Interest_in_the_School)
(0.5, 1.00), (0.6, 1.00), (0.7, 1.00), (0.8, 1.00), (0.9, 1.00), (1, 1.00), (1.10, 1.03), (1.20, 1.06), (1.30, 1.09), (1.40, 1.12), (1.50, 1.15)

Effect_of_LCM_Multiplier_on_the_Rate_of_Leadership_Change =
GRAPH(Leadership_Change_Multiplier)
(0.00, -0.08), (0.167, -0.07), (0.333, -0.06), (0.5, -0.0575), (0.667, -0.055), (0.833, -0.05), (1, 0.00), (1.17, 0.05), (1.33, 0.075), (1.50, 0.1)

Effect_of_PD_on_Teacher_Quality_Change =
GRAPH(Amount_and_Quality_of_Supervision_&_Prof_Development_Activities)
(0.5, 0.875), (0.6, 0.9), (0.7, 0.925), (0.8, 0.95), (0.9, 0.975), (1, 1.00), (1.10, 1.01), (1.20, 1.01), (1.30, 1.01), (1.40, 1.02), (1.50, 1.02)

Effect_of_Pers_Intell_on_the_Quality_&_Intensity_of_Instruction =
GRAPH(Student_Personal_Intelligence)
(0.5, 0.75), (0.6, 0.8), (0.7, 0.85), (0.8, 0.9), (0.9, 0.95), (1, 1.00), (1.10, 1.05), (1.20, 1.10), (1.30, 1.15), (1.40, 1.20), (1.50, 1.25)

Effect_of_QSL_on_LCLIS = GRAPH(Quality_of_School_Leadership)
(0.00, 0.1), (0.167, 0.075), (0.333, 0.05), (0.5, -0.01), (0.667, -0.02), (0.833, -0.01), (1, 0.00), (1.17, 0.02), (1.33, 0.025), (1.50, 0.03)

Effect_of_QSL_on_RCEAASAP = GRAPH(Quality_of_School_Leadership)
(0.00, 1.00), (0.167, 1.00), (0.333, 1.00), (0.5, 1.00), (0.667, 1.00), (0.833, 1.00), (1, 1.00), (1.17, 1.01), (1.33, 1.01), (1.50, 1.02)

Effect_of_QSL_on_TPSA&M = GRAPH(Quality_of_School_Leadership)
(0.5, 1.00), (0.6, 1.00), (0.7, 1.00), (0.8, 1.00), (0.9, 1.00), (1, 1.00), (1.10, 1.01), (1.20, 1.03), (1.30, 1.04), (1.40, 1.06), (1.50, 1.07)

Effect_of_SAP_on_Teacher_Recruitment = GRAPH(Ratio_of_SAP_to_STGL)
(0.5, 0.9), (0.6, 0.92), (0.7, 0.94), (0.8, 0.96), (0.9, 0.98), (1, 1.00), (1.10, 1.02), (1.20, 1.04), (1.30, 1.06), (1.40, 1.08), (1.50, 1.10)
Effect of SAP_to_STGL_Ratio_on_TPSA&M = GRAPH(Ratio_of_SAP_to_STGL)
(0.5, 0.5), (0.6, 0.6), (0.7, 0.7), (0.8, 0.8), (0.9, 0.9), (1, 1.00), (1.10, 1.10), (1.20, 1.20), (1.30, 1.30), (1.40, 1.40), (1.50, 1.50)

Effect of School_Leadership_on_Teacher_Recruitment_and_Selection =
GRAPH(Quality_of_School_Leadership)
(0.5, 0.85), (0.6, 0.88), (0.7, 0.91), (0.8, 0.94), (0.9, 0.97), (1, 1.00), (1.10, 1.03), (1.20, 1.06), (1.30, 1.09), (1.40, 1.12), (1.50, 1.15)

Effect of School_Leadership_on_Content_Rigor =
GRAPH(Quality_of_School_Leadership)
(0.5, 0.875), (0.6, 0.9), (0.7, 0.925), (0.8, 0.95), (0.9, 0.975), (1, 1.00), (1.10, 1.02), (1.20, 1.05), (1.30, 1.07), (1.40, 1.10), (1.50, 1.12)

Effect of Student_Resilience_on_Student_Effort_in_School =
GRAPH(Student_Resilience)
(0.5, 0.75), (0.6, 0.8), (0.7, 0.85), (0.8, 0.9), (0.9, 0.95), (1, 1.00), (1.10, 1.10), (1.20, 1.20), (1.30, 1.30), (1.40, 1.40), (1.50, 1.50)

Effect of Teacher_Quality_on_Content_Rigor = GRAPH(Teacher_Quality)
(0.5, 0.875), (0.6, 0.9), (0.7, 0.925), (0.8, 0.95), (0.9, 0.975), (1, 1.00), (1.10, 1.02), (1.20, 1.05), (1.30, 1.07), (1.40, 1.10), (1.50, 1.12)

Effect of TQCM_on_RCTQ = GRAPH(Teacher_Quality_Change Multiplier)
(0.5, -0.3), (0.6, -0.15), (0.7, -0.1), (0.8, -0.06), (0.9, -0.03), (1, 0.00), (1.10, 1.00), (1.20, 1.00), (1.30, 1.01), (1.40, 1.01), (1.50, 1.01)

Effect of TQ_on_Q&II = GRAPH(Teacher_Quality)
(0.5, 0.955), (0.6, 0.96), (0.7, 0.965), (0.8, 0.97), (0.9, 0.975), (1, 1.00), (1.10, 1.05), (1.20, 1.10), (1.30, 1.15), (1.40, 1.20), (1.50, 1.25)

Effect of Various_Factors_on_Changes_in_Motivation =
GRAPH(Change_in_SAM_Multiplier)
(0.00, -0.025), (0.167, -0.025), (0.333, -0.02), (0.5, -0.02), (0.667, -0.015), (0.833, -0.01), (1, 0.00), (1.17, 0.01), (1.33, 0.02), (1.50, 0.03)
Appendix II: Factors Affecting Differential Student Achievement

• Family wealth
• Family education
• Family nutrition
• Family health care
• Pre-natal nutrition
• Pre-natal health care
• Pre-natal maternal trauma
• Early childhood nutrition
• Early childhood health care
• Parenting practice
APPENDIX III: Categorized Achievement Gap Bibliography

Black-White Achievement Gap


Brain Plasticity


Class Size Effects on Achievement


Community and Neighborhood Effects on Achievement


Culture and Reform


Early Childhood Education Effects on Achievement


Family and Parenting


**Importance of Closing the Achievement Gap**


http://www.google.com/#hl=en&q=Policies+to+Foster+Human+Capital&aq=f&oq=&aqi=g1&fp=Qmi82At0098


International Achievement Gap


IQ, Heritability, Neuroscience and Mutability


Law, Litigation, and Achievement


**Leadership**


Smock, Jessica (May 2009). No Child Left Behind’s School Choice Provisions: Are Students Receiving Meaningful Options? Unpublished class paper (SED AP 702), Boston University School of Education.

**Opportunity and Achievement**


Peer Groups, Interactions and Achievement


**Poverty and Achievement**


**Problem Analysis and Systems Thinking**


Childress, Stacey, and Marietta, Geoff (June 12, 2008). A Problem-Solving Approach to Designing and Implementing a Strategy to Improve Performance. Public Education Leadership Project at Harvard University. [DO NOT QUOTE]


Psychology of Effort and Achievement


Racial Identity, Oppositional Culture, and Achievement


Relationships and Achievement


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Allen, Dave L. (2004). An Examination of the Relationship Between Teachers’ Perceptions of their School’s Ability to Foster a Culture of Resilience and Student Outcomes on the Ohio Sixth Grade Reading Proficiency Test. The University of Cincinnati unpublished doctoral dissertation.


Nears, Kennard () The Achievement Gap: Effects of a Resilience-Based After School Program on Indicators of Academic Achievement.


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School Organization and Achievement

Bourque, Mary M. (December 2005). The K-8 Grade Span and the Middle School Model. Term paper, Boston University School of Education, SED AP 701.

Segregation and Achievement


Self-Efficacy, Self-Concept, Self-Esteem and Achievement


Broege, Nora, et al. (n.d.) Performing Well, But Feeling Bad: The Classroom Experiences of Adolescents


Social Capital and Achievement


Standards and Testing

Darling-Hammond, Linda (2003). Standards and Assessments: Where We Are and What We Need. *Teachers College Record,*

**State Policy Effects on Achievement**


**Statistics on the Achievement Gap**


University of Chicago News Office (April 28, 2005). Economics research shows black-white achievement gap has stopped narrowing. http://www-news.uchicago.edu/releases/05/050428.neal.shtml

**Teacher and Principal Quality**


Clotfelter, Charles, et al. (March, 2007). *High-Poverty Schools and the Distribution of Teachers and Principals*  


